Introduction

Contrary to Francis Bacon, the history of technological change is the history of humanity wrought.¹ There is perhaps nothing that has altered our species more. A glance at any era in history reveals this to us. In pre-history, during the last great glacial period, as humanity faced extinction in Europe, the invention of the needle, and subsequently fitted-clothes, kept the species warm enough to survive roughly thirty thousand years of inconceivable hardship.² The Middle-Ages, a period traditionally thought of as dark and infertile, saw the invention of the mechanical clock, without which the factory system of time-orientated labour, such as the one that emerged from the industrial revolution, is unimaginable.³ In recent centuries technological change has altered almost anything we care to think about.

However, aside from being, by any definition, important, technological change is also wonderfully elusive, both as a concept and a real process. To be sure, we can mark a lot of it, as I have just done above, but what about the underlying causes of it; how knowable are they? To what extent can we really grasp the contours of technological change as a reality, and thus represent it theoretically in a coherent way?

The ancient phrase “necessity is the mother of invention” would lead us to believe that it is rather knowable indeed. The narrative of humanity inventing in response to dire need, such as in the needle example mentioned above, is a strong one. Francis Bacon framed invention as

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¹ The original assertion is that the ‘history of arts [mechanics]’ is the ‘history of Nature altered or wrought.’ Francis Bacon (1605), *The Advancement of Learning*, Book II, Section II.5, [http://www.gutenberg.org/dirs/etext04/adlr10h.htm](http://www.gutenberg.org/dirs/etext04/adlr10h.htm), last accessed 22:44 21/08/2012
precisely this: man’s greatest weapon in his on-going struggle with nature.\footnote{William Leiss (1972), \textit{The Domination of Nature}, New York: G. Braziller, p. 47} It is also a recognisably biblical motif: our exit from the Garden of Eden suddenly putting us at the mercy of a new and unfriendly environment, with only the sweat of our faces and the sharpness of our wits keeping starvation at bay.

Yet even under the most superficial of examinations, this narrative breaks down. Northern Europe had always been cold and dark, and hence water and sun clocks impractical. Why was it not until the thirteenth century AD that the escapement mechanism, the basis of the first truly mechanical clocks, was finally developed?\footnote{Kenneth F. Welch (1972), \textit{The History of Clocks and Watches}, New York: Drake, pp. 28-43} It is suspected that the inventor was a monk.\footnote{David S. Landes (1983), \textit{Revolution in Time: Clocks and the Making of the Modern World}, Cambridge, MA: Harvard University Press, p. 61} Did he perhaps feel pressed by the religious necessity of attending early morning Matins at just the right time? Hence, can we say that there was insufficient necessity before then? If so, how much necessity is sufficient?

Moreover, what about the innumerable accidental inventions without which the modern world would be much the poorer? For instance, Bakelite (plastic), stainless steel and the X-ray all came from scientific and technological experimentation not at all directed towards discovering these things. Other technologies, such as the laser, the transistor, and, most famously of all, the World Wide Web, found a range of applications to dwarf anything its inventors could have imagined. Precisely what necessity could therefore be said to have driven their creation? The original phonograph, which evolved into the record player and spawned an industry of recorded music, was originally invented by Edison as a means of recording the last words of the dying.\footnote{Ruth Schwartz Cowan (1997), \textit{A Social History of American Technology}, New York: Oxford University Press, p. 124} The latter is a worthy task, but not
one practiced with great frequency. On the other hand, it is hard to imagine life without recorded music. Hence, might we say instead that invention is in fact the mother of necessity? Or, for the famously shrewd Edison, can we simply say that the prospect of money motivated his inventiveness?

If so, what about all those things that have never been invented? Why, in spite of all the financial rewards that would come the way of an inventor, has there never been a cheap, straightforward family aircraft? How is it that the causal factors that led to the aeroplane and motor-car did not also take effect in this case? Are there physical barriers to certain inventions or are we simply awaiting a flash of inspiration?

And what about lesser kinds of technological change, such as the improvement of existing technologies; is necessity at the heart of these also? Take, for instance, the development of rubber inflatable tires for bicycles. These gave the machines greater speed and made them more comfortable to use, but would they have ever occurred to John Dunlop if not for the earlier efforts of Charles Goodyear in developing vulcanised rubber (entirely by accident)? If not, and it is difficult to imagine that they would, how much of invention and innovation generally is dependent on the existence of earlier, facilitative inventions?

Finally, we are not even sure why some societies are inventive and others not. Europe in the Middle-Ages produced a substantial number of technological improvements: in agriculture, transport, energy and mechanics. At the same time, the Islamic world, despite being richer and better educated, produced comparatively little and the previously fruitful Chinese were reaching the end of their long period of creativity. Overall then, if our understanding of the process is deficient, and thus our

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9 Lynn White, Jr. (1940), ‘Technology and Invention in the Middle Ages’ in Speculum, Vol. 15, pp. 141-159
10 Joel Mokyr (1990), The Lever of Riches, Oxford: Oxford University Press, p. 44
representations of it likely very flawed, how much confidence can we have in policies that depend on technological change proceeding rapidly in a very specific direction?

This thesis is about technological optimism in the economics of climate change. It is a critique of an understanding of technological change. This critique takes the form of a Foucauldian genealogy; it performs a critical history of economic growth theory, the source of the conceptualisation of technological change that powers the Intergovernmental Panel on Climate Change (IPCC)’s mitigation projections. Its aim is to rob them of the scientific allure that underpins their credibility. This is the specific purpose of a genealogy, and hence why it is employed here. Foucault attacks the notion that disciplines like economics are simply rationalised; that they produce technical solutions through narrow, scientific methodologies. Rather, he argues that the knowledge they produce is determined by very specific rationalities. These rationalities are products of the histories of the disciplines; they form and gain power over time as a result of chance and very particular circumstances. Foucault shows us that there is no necessary reason at all for them to be as they are, aside from their historical trajectory. They form unified wholes not from adherence to specific methodologies, but because of particular conditions that made them into coherent systems of thought. In revealing these histories, therefore, we can undermine the truth claims that the rationalities produce and empower. We can show how these truths are produced rather than discovered.

Hence, this thesis aims to make two major contributions. Firstly, it aims to show how particular conditions led economics to believe it can predict the future of technological change. In particular, it will substantiate the claim that the notion that technological change might be constant and predictable arose, in essence, to justify Adam Smith’s distaste for government intervention. Secondly, and in the process, it will reveal that the
understanding of technological change utilised in climate change mitigation models is dependent upon a metaphysical essence, an essence originating in the fusion performed by Adam Smith of Stoic natural law and a Baconian enthusiasm for technology. The resultant projections, therefore, are not the reliable output of scientific investigation, but rather the product of a very specific rationality, a rationality that I will call negative progress. Finally, as a result of the effectiveness of this critique of the technological optimism in climate change economics — the single greatest defence offered by proponents of the existing unsustainable mode of economic organisation — space will be opened up for alternative approaches to the problem of climate change, approaches that reject the appeal of the ‘growth paradigm.’ Imagining what these might be, however, is not a task of this thesis.

The thesis thus asks the following core research question: what history made possible the technological optimism of climate change economics? In other words, what are the origins of the rationality of negative progress that produces this technologically optimistic knowledge? The technological optimism I examine in chapter one is simply the belief that technology can prevent environmental degradation from derailing economic progress. In chapter two I refine this definition and take technological optimism to mean an unsustainable faith in the ability of technological change to marry economic growth with a level of ecological stability sufficient for human well-being.

In chapter one I do two major things. Firstly, I analyse the existing critiques of technological optimism in response to environmental degradation. I argue that technological optimism is a logical product of the concept of sustainable development, a framework for policy that seeks to marry ecological sustainability with economic growth. I then show how these existing critiques are insufficient because they are unable to address the power of ingenuity. In other words, these critiques cannot prevent the
future from being harnessed to defeat problems identified in the present. Until we can undermine the conceptualisation of technological change that allows this to be, it will never be possible to convincingly argue for an alternative mode of economic organisation. Secondly, I show how technological optimism is thus a crucial buttress for the continued existence of narratives of progress and thereby set up the methodological problem to be addressed in chapter three: whether we should examine each particular instance of technological optimism as a single case resulting from an ideology of scientific-technical progress, as per Habermas, or whether we should treat each as a unique problem, and thus chart the history that made it possible, as per Foucault.

Before this though, in chapter two, I examine in detail the various models of climate change mitigation upon which the mainstream approach to sustainable development is based. I focus the examination upon the work of the IPCC, because this is much less likely to be tempered by political opportunism. That is, while the approaches of the EU and USA are premised on much the same modelling, they are not developed with anywhere near the same rigour, and can also be plausibly critiqued as soft targets, wherein the technological optimism is a product of no more than a cynical abdication of responsibility. Showing that the IPCC’s work also resounds with technological optimism allows us to reasonably claim that a much more fundamental cause is in effect: it shows that invention – which, it is universally agreed, cannot be modelled – actually plays a vital role in the projections of the future provided by the models. These are futures where growth and climate change mitigation below the goal of two degrees centigrade are commensurable. It also finds a strange tension within the modelling literature, where the projections are simultaneously proclaimed with great confidence and offered with great caution. It is claimed in the literature I examine that the unpredictability of invention motivates the
latter. However, this caution is superseded by the confidence placed by the discipline in past technological change as a guide to the future. I conclude that these findings must provide the focus for the subsequent critique.

However, before I proceed with any deeper examination, I note the substantial methodological problem one faces when trying to examine narratives of progress. Indeed, there are a number of potential approaches, two of which I examine comparatively in chapter three. The first is the work of Jurgen Habermas, which has already highlighted the existence of a dominating ideology of technological progress, one that makes into technical problems, resolvable by the tools of a technologically enthusiastic rationality, everything that might hinder its continuation. The strength and relevance of this approach means that it cannot be ignored as a potential methodology. However, I find that it is inadequate for the task of undermining technological optimism within economics because, in sacrificing the more ephemeral parts of his Frankfurt School legacy, Habermas also abandons his means of critiquing scientised disciplines like economics and, particularly, conceptions of technological change within them. Instead I argue that a Foucauldian genealogy is more suited to the task, since it is designed explicitly to provide a means with which to critique powerful knowledges around and upon which the institutions and policies of the present are structured. Foucault’s approach involves showing how what is taken to be scientific truth could in fact have been otherwise. As opposed to Habermas, then, Foucault argues against the notion of a single, universal reason-gone-bad, saying instead that within each system of thought lies a particular rationality, with its own structure to be parsed and history to be examined. What are taken to be truths within the human sciences, things supposedly discovered by scientific means are, for Foucault, instead the products of a messy history; a very particular
construction where potential alternatives are suppressed, rather than a process of progressive discovery.

This first half of the thesis leads directly into the genealogy that makes up the bulk of it. In chapter four, then, I locate in the work of Adam Smith the arrival into economics of a conception of technological change. The particular form it takes is shown to be the product of Smith’s faith in a future of harmonious progress (based on his Stoic pantheistic ontology) as long as man is left to his own devices. Moreover, in order to produce this harmonious advancement – what I call, borrowing a little from Isaiah Berlin, negative progress – and to cement his claims that it can function as an alternative to the progress by reason and plan (positive progress), which dominated the continental Enlightenment, Smith creates in his economics a static, timeless representation of change. His is the first work of economics that is able to predict the future because he constructs economic time as a series of identical cycles, where the process remains identical in each one. This allows the future to be represented as nothing more than a quantitative increase on the past, rather than a fundamentally altered state. In order for this notion to be stable, technological change must function like every other objectification: its past, present and future process must be entirely knowable, with its operations in each cycle identical. We thus see that Smith’s vision of economic man, his homo œconomicus, is not merely a perfectly rational actor, but also a creature that possesses a perfectly harmonious and knowable ingenuity. It is this structuring that allows the discipline to progress in the way that it does: with technological change neutered as a source of disharmony, a model based on an infinite progression of identical cycles is allowed to triumph. The disharmonious tendencies of technological change are ignored in the process, mainly because, in the clash between Ricardo and Malthus that we examine in chapter four, Ricardo is the victor. Ricardo is not interested in the empirical
reality of economic life, as Malthus is, but rather develops the abstract aspects of Smith’s creation. He pushes to the outside all of the more sociological elements, most importantly technological change, under the assumption that Smith accounted for them adequately. Ricardo’s work marks the beginning of what is referred to now as exogenous technological change, where the process is not discussed within economic models but rather is simply assumed to work in the way imagined by Smith, and desired by the discipline. Moreover Ricardo is really the creator of the method of economics. He takes Smith’s confidence in an automatic progress and renders it in the form of an axiomatic model, where all the simplified objects act in a perfectly harmonious and progressive way. It is to this Ricardian approach that economics has looked ever since, maintaining the static progress of Smith, all underpinned by the assumption that technological change acts only harmoniously and predictably.

In the final three chapters, I trace these foundations up to the present day of climate modelling, noting how very little change takes place until the time of Keynes. At this point, as a result of the tremendous disruption caused by the great depression, negative progress is partially abandoned, and government intervention made “scientifically” plausible. However, this is largely discarded in subsequent years, and thus Robert Solow is able to create a model of progress that in broad terms is identical to that of Smith and the classics. It is the now mathematically represented objectification of technological change in this model that ultimately forms one of the two major approaches to climate change mitigation modelling. The other, which arises in reaction to Solow’s work, is the endogenous approach of Romer. Though he recognises, finally, the conflict between technology and the perfect market, Romer still maintains the vision of harmonious progress Smith created, with one important caveat: government intervention is required to, and capable of, providing additional incentives
if *homo economicus* is to act in accordance with the fullness of her powers. This modelling structure thus allows for long-term growth models to be used in climate change mitigation wherein incentives can simply be created by the government, with ingenuity expected to respond in a perfectly predictable way. However, the ability of economists to produce this kind of knowledge, and affect how governments and people act as a result, does not come from their discovery of a scientific means of doing so. Rather, it is based on the core of the rationality that Smith created within the discipline: a progress wherein time operates in continuous, infinite and identical cycles and thus one in which technological change operates at all times in the same way. It is this that permits the confidence we discover in chapter two, a confidence in the predictability of human ingenuity, even while the heart of this, invention, is recognised as being inherently unpredictable. In fact, we see that the discipline, rather than giving us a truth, is providing no more than a knowledge produced by a very particular history, one which, given its dubiously metaphysical origins in Stoic pantheism, can hardly be said to form a sound basis for climate change policy. Thus the technological solution, which permits both growth and climate change mitigation to be reconciled, is shown to be tremendously fragile and risky. I conclude that, if society is serious about preventing the worst effects of climate change, a *political* solution must be reached.
Chapter One

Technological Change and Progress in the Sustainable Development Literature

This thesis focuses only upon the technological optimism of climate change economics. However, this case can also be read as representative of a broader conviction, where technology is viewed as the answer to the ecological problems of progress. The aim of this chapter is twofold. First of all, it shows that technological change is, in the last analysis, the centre-piece of the mainstream approach to environmental degradation and crucial to the continuation of any narrative of progress. This sets up the methodological discussion of chapter three. Second of all, it shows, through an analysis of existing critiques, the originality and superiority of the Foucauldian critique that forms the bulk of this thesis.

Hence, in this chapter, I examine other instances of technological optimism in response to environmental degradation. I note that these could be attributed to an ideology of progress and describe how they are critiqued in the sustainability literature. I begin with perhaps the primary framework within which ecological problems are addressed: sustainable development. I show how it must always, in the end, come down to a judgement of the capabilities of technology. However, I also show that the basis for this judgement is not always the same and examine the three most significant forms it regularly takes, noting specific challenges that have been made to each and their policy implications. We will see that technological optimism is a major point of clash between what are generally seen as the “mainstream” and “radical” approaches to environmental degradation. However, the varying forms that this optimism takes invites us to ask whether each is caused by a greater, overarching belief in progress, or
whether they should be viewed as separate instances with their own individual dynamics.

Indeed, as we will see in chapter three, Habermas argues that a governing ideology of technical-scientific progress leads society to treat all major problems as technical problems requiring technical solutions. At first glance, this seems a plausible theoretical framework to employ for a critique of technological optimism. As Nisbet tells us, progress is the idea that history has been the story of human advancement and that this advancement will continue into the future.\(^\text{11}\) At present, the material well-being of humanity is the primary criterion deployed to measure progress. It is a desire to maintain this that motivates weak sustainability, the mainstream approach to environmental problems, to seek technological solutions (the main weapons in its armoury) to environmental problems. These problems, the most significant of which is climate change, invite us to ask whether the progress of the past has mortgaged that of the future and thus cast doubt on the viability of continued economic growth. However, if adequate technological solutions to these problems can be found, a belief in progress can once more be asserted with confidence. Thus we have technological optimists: those who see human ingenuity as able to meet the demands that progress places upon it. It is therefore easy to imagine a Habermasian critique being employed to explain technological optimism. If we could show the existence of an overarching ideology of scientific-technical progress, technologically optimistic solutions to the problems facing progress might be straightforwardly explained and critiqued. Though, in the next chapter, I demonstrate this not to be the case, technological optimism certainly plays a major role in the sustainable development literature more generally. This is the framework within which

environmental policy discussions almost invariably take place, as I will now illustrate.

The concept of sustainable development has not been with us for very long. It is generally held to have emerged out of the environmental radicalism of the early 1970s when what is now commonly referred to as neo-Malthusianism\(^ {12} \) – in essence, the belief that the earth’s resources are scarce enough to warrant immediate action to preserve them, such as limits on population – had its high tide; most notably with the Club of Rome report *Limits to Growth*. This report projected three possible futures based on variables such as population growth, industrialisation and resource depletion.\(^ {13} \) It concluded that in two of these scenarios the world faced collapse by the mid twenty-first century, while the third saw a more or less stable continuation. Perhaps unsurprisingly, these predictions came under immediate and sustained criticism from some of the world’s most highly regarded economists, who derided its methodology and use of statistics.\(^ {14} \)

However, arguments similar to the Club of Rome’s were made throughout the 1970s and were taken seriously enough by the political establishment to provoke an international response; most notably in the form of the UN’s *Bruntland Report* of 1987.\(^ {15} \) This was the first mainstream effort to use the term ‘sustainable development,’ defining it as development that “meets the needs of the present without compromising the ability of future

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\(^ {13} \) Donella H. Meadows, Dennis L. Meadows, Jorgen Randers and William W. Behrens (1972), *The Limits to Growth*, New York: Universe Books


generations to meet theirs." This definition was vague enough to satisfy the less radical stakeholders, but few others.

The Rio de Janeiro Earth Summit, which took place five years later, marked the high point of this new approach in terms of media attention and optimism. Thereafter the unavoidable question of priority began to separate the more economically-minded adherents from those who placed greater emphasis on the ecological side, with the latter effectively becoming the radical alternative to (and critique of) the former.

At this point the problem of sustainability was already very much within the sphere of economics. This was always likely to occur; firstly because Limits to Growth was itself an economic tract, and secondly because economics, at its heart, is an analysis of scarcity. It is concerned with the most efficient means by which to divide up scarce resources. Moreover, the basis of this early environmental concern was the depletion of resources; in other words, a condition of scarcity. This condition called for decisions about present and future consumption and how best to manage the relationship between the two, as the definition of sustainable development quoted above shows plainly. Some of this framing, as Tijmes and Luijf argue, can be seen as the product, rather than the cause, of the subsuming of ecological concerns into an economic rubric. For our purposes, however, it is enough to note that mainstream economics, informed by the sciences, now provides the framework through which environmental issues are conceived in official policy work.

As will be shown in chapter four, ideas about technological change have played a central, perhaps even dominant, role in modern visions of

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16 Ibid., p. 196
17 Ibid.
18 Ibid.
economic progress. Thinkers such as Bacon, Hume, Smith, Benjamin Franklin, Marx, and many others, gave it considerable emphasis. Bacon, for instance, saw human ingenuity as man’s greatest attribute and conceived of progress as the ever greater domination of nature by humanity through technology. For Smith, as we shall also see in chapter four, technological change is at the core of the progress with which he was predominantly concerned: human enrichment. For Marx, technologically-sophisticated modes of production are the greatest of capitalism’s contributions to his teleological vision of history as the progress of human well-being and freedom. In his utopian end, it would be a new, and non-capitalist, technology that would ultimately liberate man from the need to labour slavishly for his livelihood. Under capitalism, however, technology performs the opposite role, either alienating men from their labour or pauperising them by rendering this labour redundant. As we shall see in chapter seven, Marx began a long, alternative tradition to that of mainstream economics, one where technology takes on a sinister character.

For the discipline as a whole, however, even in most of the heterodox schools, technological change is regarded as the single greatest motor of human progress. It is theorised, more or less inarguably, as the key to economic growth; something which correlates very strongly, albeit far from perfectly, with increases in general material well-being. As Mokyr argues, ‘the criterion (for progress) economists would like to use is the capacity of the productive sector to satisfy human needs relative to resources. Technological progress, in that sense, is worthy of its name. It has led to something that we may call an “achievement,” namely the liberation of a substantial portion of humanity from the shackles of subsistence living.’

Accompanying this achievement, as we now know, has been more or less increasing degradation of the environment. This degradation has been at the heart of many challenges to the dominant mode of economic organisation. This is true whether the harms are small, like the deaths of wildlife caused by the use of certain pesticides, or large, like climate change which, it is often argued, renders this mode of economic organisation untenable. With this challenge to economic organisation comes, necessarily, a challenge to the vision of progress that underpins it.

There are a number of ways, however, that this vision can adapt to these challenges and preserve itself. For instance, banning DDT hardly constituted the enactment of a new vision of progress, nor indeed, did removing the lead from petrol. In fact, this latter example marks the key to the adaption of the mainstream vision of progress to environmental challenges: technological change. As we have seen above, the discipline of economics has always been technologically optimistic. However, in response to climate change, the role of technology in preserving progress has increased, as human ingenuity is called upon to reconcile this most serious form of environmental degradation, which has been caused by actions that fall under an economic conception of progress, with the continuation of this vision in its current form. Of course, other changes, such as the more efficient organisation of workplaces, must also play a role, but as we can see from the IPCC reports discussed in chapter two, technology is expected to bear the bulk of the load. The heart of the approach is, as Arvesen et al put it, ‘the notion that energy efficiency and “clean” energy technologies can deliver amounts of climate change mitigation sufficient to deem fundamental changes in social and economic

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structures to be unnecessary.\textsuperscript{23} In other words, technology is the key to sustainable development.

Economics, however, is far from the only framework available for analysing the environment-growth dynamic. To get a feel for the lay of the land insofar as sustainable development is concerned, it is useful to follow Daly and divide it into ‘weak’ and ‘strong’ sustainability.\textsuperscript{24} These two categories shade into each other at a point, but perhaps a meaningful distinction can be drawn that allows us to understand the fundament of the clash in question, and thus the purpose of the two categories as explanatory devices. On the one hand are those who see economic growth, the development side, as primary, with environmental degradation as one threat to its progression. Naturally there is an inclining scale of seriousness, with some seeing it as a tremendous threat, and others a minimal one, for reasons that we shall get to. On the other are those who see environmental degradation as the principal concern, with economic growth conditional upon its stabilisation to a certain level of solidity. Theoretically, within this latter group the perceived seriousness of this degradation should range also. However, encompassing both sides, and their internal ranges, we have in effect a wider spectrum of views on sustainability, the fundamental bifurcation resting on the question: ‘should growth be curtailed?’ At one end of the spectrum are those who consider environmental damage to pose a problem of limited importance, and at the other, those who insist that the environment is facing catastrophe, to the extent that all concerns with economic development must be jettisoned. Often present at these extremes are philosophical viewpoints that respectively place on the environment no moral worth independent of human need, or rights at least the equal of


those enjoyed by humanity. The importance of the concept of technological progress to all of these positions is clear.

A strong belief in humanity’s capacity to overcome environmental problems through the use of technology – in particular, to overcome anticipated problems through the utilisation in the future of technologies that are not yet available in the required form (if at all) – naturally conditions the extent to which one views environmental degradation as a problem. The dividing line on this spectrum separates two groups on either side immediate to it that, to basically the same extent, value economic growth and consider environmental degradation a major concern. The basis for the division therefore really rests on two things: firstly the extent of the independent moral worth one confers upon “nature,” and secondly, the degree to which one believes that humanity has the technological prowess to mitigate environmental damage. These two factors are naturally interdependent. For instance, one might place a very high degree of independent moral worth on the environment but also have a great faith in human ingenuity, allowing one to reconcile oneself to a weak sustainability policy preference. Alternatively, one might have a very minor regard for the value of the environment independent of human welfare, but feel existing or future technologies to be wholly inadequate to the task of matching even this limited valuation. In practice, though, the ethical dimension plays a far less significant role in dividing opinion than the technological, firstly because both sides, for the most part, place roughly equal levels of independent moral worth on the environment – not many of the influential discussions are based on non-anthropocentric ethics – but more importantly because, as noted, technology always has the conceptual potential to render one’s concerns, no matter how great, functionally

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irrelevant. Policy divisions, therefore, predominantly rest on different degrees of faith in human ingenuity. If, given an appraisal of our powers to militate against them, one still believes that the harms to humanity that will come from environmental degradation outweigh the benefits of continuing growth, then one falls into the strong sustainability camp. If, on the other hand, one thinks that our best efforts are just sufficient to make growth the more utile option, then one becomes a proponent of weak sustainability. Some, such as Barnett,²⁶ attempt to abdicate the ethical question by arguing, with dubious veracity, that the welfare of humans and the environment are so entirely wrapped up in each other as to make the anthropocentric–biocentric divide effectively irrelevant. This is a hard opinion to credit, but even assuming it has validity, it serves simply to make the technological question the governing one alone. In effect, it annuls the moral choice between humanity and “nature.”

In the final analysis, therefore, we can see that ethical considerations, perception of the seriousness of the environmental threat and all other issues that might enter into sustainability discussions, are dependent on one’s estimation of the powers of human ingenuity. It is even logically possible to view the scale of environmental degradation as enormous, while placing upon the environment more moral worth than that placed on humanity, and still have sufficient faith in human ingenuity to be relatively relaxed about the current mode of economic organisation.

In practice, of course, the most environmentally conscious tend to be dismissive of the powers of ingenuity, while those most interested in economic growth view it as almost omnipotent. However, this phenomenon rests on psychological biases or political interests; there is no logical reason why it must be the case. In any case, the theoretical possibilities of human ingenuity being endless, every other concern can

logically be rendered dependent upon it. This is what has occurred with regard to sustainable development and its ethical elements; with the result that the latter have been made effectively redundant.

Technological optimism on the weak sustainability side does not take a single form though. Instead it takes, broadly speaking, three forms. The first is a very general belief in the capacity of technology, one not necessarily connected with detailed examinations of technological capacity or formal theories of technological change, but still easily discernible. One might almost go as far as to describe this form as supported by a fallacy, namely that because both growth and sustainability are necessary, they are therefore also compatible, with technological change acting as the bridge. It certainly appears operative in what is often referred to as ‘ecological modernisation,’ now considered the dominant approach to environmental problems in the Western world.27 Hajer describes this as ‘a strategy of political accommodation (with) the radical environmentalist critique of the 1970s,’ one in which the ecological crisis, far from being ‘a threat to the system, now becomes a vehicle for its very innovation.’28 Barry notes this as well, citing a representative speech by John Prescott from his days as deputy Prime Minister: “(treating) the environment with respect will not impede economic progress, it will help identify areas of inefficiency and waste and so unleash whole new forces of innovation.”29 EU policy-papers make similar claims: ‘(the) overall aim is therefore clear: to exploit the potential of environmental technologies for meeting the environmental challenges faced by mankind while contributing to competitiveness and

27 Barry, Op. Cit., p. 446
growth.\textsuperscript{30} In neither of these two cases is there sufficient argumentative support for such grandiloquent claims, rather they are fairly adjudged political hyperbole made utterable by a vague, perhaps societal technological optimism. However, these effectively asserted expressions of technological optimism do not exhaust the meaning of ecological modernisation; rather they are of interest to us because of what they represent: as Hajer put it, this aspect of ecological modernisation ‘suggests that there is a techno-institutional fix for present problems…based on the fundamental belief in progress.’\textsuperscript{31} There is considerable spending and effort behind these policies and, from conversations with policy-makers in Europe, much genuine belief.\textsuperscript{32}

As an aside, it is easy to fall into the notion that ecological modernisation is different from sustainable development, rather than a sub-field of it. For instance, Barry argues this implicitly when noting that ecological modernisation’s ‘reliance on a set of technological fixes to solve what are widely seen as political problems is often perceived as a key weakness, and one of its principal limitations when compared to its sister discourse of sustainable development, which has explicit political bargains about limits and global justice built in, even in its relatively conservative versions.’\textsuperscript{33} It is of course true that under sustainable development broader issues have always been brought into the discussion; however, as the Bruntland Report makes clear, the heart of the matter is still technological change: “(the) concept of sustainable development does imply limits - not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the

\textsuperscript{31} Ibid., pp. 32-3
\textsuperscript{32} Interview with Commission of the European Communities Official One, Brussels, 08/05/2012; interview with Commission of the European Communities Official Two, Brussels, 08/05/2012
\textsuperscript{33} Barry, \textit{Op. Cit.}, p. 452
biosphere to absorb the effects of human activities. But technology and social organization can be both managed and improved to make way for a new era of economic growth. In reality, ecological modernisation is nothing more than the logical end-point of the sustainable development dynamic discussed above.

In any case, the more faith-based technological optimism discussed above shades neatly into the second form I mentioned. This is the technological optimism that is underpinned by engineering knowledge. The reason why I described it as shading into faith-based technological optimism is because this engineering type is usually premised on the existence, or development of, promising technologies, albeit not in such a way as to provide it with rigorous justification. Moreover, engineering knowledge is temporally limited: it cannot logically make predictions beyond the potential of existing technologies and even then only to a degree. Hence, when the limits of plausible certainty are passed, when engineering knowledge is used to support, say, fifty-year predictions, or the likelihood of invention, it becomes almost indistinguishable from the vague, unempirical technological optimism described above. And indeed, this limit is often passed: in the course of my research, an EU Commission policy-maker working in the area of environmental technology told me that he did not believe invention to be a significant barrier to mitigating climate change. This was despite an admission that at its most fundamental level invention is entirely unpredictable. When I asked him where this confidence came from, his reply was really based on his subjective experience of working amongst engineers: ‘maybe because I have worked too much in Germany, but there are lots of inventors and then also you get lots of people who have some kind of very innovative ideas. I think for them what is more important is to have a stimulating framework to really get it done, and

34 In Tijmes, Op. Cit., p. 332
that’s where the problem is.’ Moreover, some recent critical analyses of previous “Technology Foresight” studies tell us that we can extend this judgement to the potential of existing technologies.

Technology Foresight studies have been described rather grandly as involving ‘systematic analysis and discussion about possible technology futures’ but are essentially a guide to the most significant technologies in particular fields based on expert engineering opinion of their likely potential. The weight of these on policy should not be downplayed; at several points in the EU’s Environmental Technology Action Plan (ETAP) and Strategic Energy Technology-plan (SET-plan) they are cited as major drivers of European technology planning. However, an analysis carried out by the World Bank, which looked at past Foresight Studies, their accuracy and the likely reasons behind their findings, quite thoroughly pulls apart their pretences. It noted, firstly, ‘the technological optimism of the 1970s about nuclear energy... (wherein the) IIASA and OECD projected a median share of nuclear energy in 2010 of 40% and 25% respectively (it is in fact less than 6%)’ a result still ‘far lower than the US studies.’ When it attempts to correlate its findings with world events it reaches the important conclusion that ‘forecasts are indicative of the global outlook that prevails when they are elaborated.’ For example: ‘(the) first striking feature is that the 1970s technological optimism about our ability to switch away from fossil fuel (fossil fuels were projected to have only a 50-70% share in total

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39 Ibid., p. 2
primary energy at $t+30$) decreased significantly in the 1990s (a share of 75-90%), likely influenced by the long period of relatively low oil prices after 1985. As for the last decade, the report considers the influence of the Kyoto Protocol to be instrumental in sparking an upsurge in the predicted share of global energy to be claimed by renewables. However, it points out firstly that ‘technical inertia cannot explain why the projected prospects for shifting away from fossil energies have been so stable since the early 1980s. Historically, the promises of generous technical change on the supply side were not fulfilled in the case of the nuclear energy, nor in the case of new and renewable energies and secondly that ‘(this) pessimism cannot obviously be extrapolated for the future but the above analysis is a reminder of the false impression of the ease of substituting for fossil fuels, an impression that emerges in long-run energy forecasting.

Another report notes the poor methodology the studies employ, with much greater emphasis being placed on the prediction for the technology than its current state, the latter often meriting ‘one sentence only.’ Finally, it is the ‘positive environmental effects of future technology developments that are described, while negative environmental impacts and risks seldom are represented. Important uncertainties are also often absent in the descriptions.

In addition to these critiques of engineers’ predictive powers, a few studies have analysed renewable technologies as they exist today and argued that the confidence of those working on them is misplaced. The aim of these

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40 “t+30”, i.e., the year 2000
41 Hourcade and Nadaud, Op. Cit., p. 21
42 Ibid., p. 21
43 Ibid.
44 Ibid.
46 Ibid.
studies is the same as that of this thesis: to repoliticise climate change policies and environmental policy more generally. Michael Heusemann, a marine biotechnologist with a strong research background in climate change technologies, has authored a number of critiques of this type. However, whilst some of his criticisms are reasonable and convincing, others are not particularly compelling, and a few are downright ludicrous. Of the former, he makes a strong case for the danger posed by renewables to eco-diversity, particularly solar panels as they stood in 2003. His criticisms of hydroelectric power are less convincing, since they revolve around sediment build-up without any explanation of why this cannot simply be removed.

His response to the possibility of new technologies is almost risible, however. He points out, in some detail, that ‘it is impossible from a thermodynamic point of view to design industrial technologies that have no negative environmental impacts.’ This argument implies that we should reject as sustainable any technologies that harm the environment. Had this been married to a non-anthropocentric ethic, perhaps an argument could be made. But in the absence of this, it seems a ludicrous condition to put on technological change. For any mode of existence that humanity might choose would necessitate some environmental damage. Moreover, the argument also implicitly rests on a strict conceptual opposition between human and “nature” that no longer seems tenable. In the end though, as noted, his aim is to show that it is chimerical to presume an easy merging

48 Heusemann (2003), Op. Cit., p. 27
49 Heusemann (2003), Op. Cit., p. 28 (my italics)
of ecological and economic imperatives. As he puts it, ‘technological optimism in eco-efficiency is in fact used to inhibit the much needed public discourse about the underlying causes of unsustainability.’\textsuperscript{51} Indeed, it can hardly be disputed that this is the role technology has been cast to play in weak sustainability. In effect, the promise of technological change, which is limited only by the laws of physics, seems to direct policy-makers to a place where hard political choices about economic organisation are avoidable. As Krier puts it, ‘(the) disservice of technological optimism is its implicit, unexamined claim that engineering can rise above politics.’\textsuperscript{52}

This effect is most significant in the last of the three forms that weak sustainability takes: the form that is underpinned by economic modelling. This is because, along with short-term modelling, economics also supplies long-term analysis, which is naturally less certain but more significant, because it colours our perception of a much longer timeframe. Indeed, economics is normally deployed in the pursuit of long-term forecasts of technological change. This is most likely due to the fact that it is the only means of doing so that can claim to be “scientific.” As we shall see in the next chapter, it is particularly influential in climate change mitigation models and thus of the most concern to this thesis.

Interestingly, the treatment of technological change that underpins these models comes, as we shall also see, from the more popular growth models that have dominated the discipline of economics since the late 1950s. As Barry argues, for those wishing to see the world move to a “green” kind of political economy, critiquing ‘conventional, neo-classical economic growth as the main economic policy objective of any state or society is a \textit{sine qua non}.’\textsuperscript{53} However, though a considerable amount of critical work has been done on the question of growth in general, there has been strangely little

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\textsuperscript{51} Heusemann (2003), Op. Cit., p. 31  
\textsuperscript{52} Krier and Gillette, Op. Cit., p. 429  
\textsuperscript{53} Barry, Op. Cit., p. 456
that focuses directly and extensively on the construction of technological change that underpins it. The latter is the really significant element insofar as the depoliticisation of climate change is concerned, rendering the mainstream, growth-centred approach plausible, while delegitimizing “radical” attacks. This part of the discipline is normally referred to as Environmental Economics, and should be distinguished from the Ecological Economics of Daly et al, which falls onto the side of strong sustainability.\footnote{See for instance Robert Costanza and Daly (1992), ‘Natural Capital and Sustainable Development’ in Conservation Biology, Vol. 6, 37-46; Maite Cabeza Gutiés (1996), ‘The Concept of Weak Sustainability’ in Ecological Economics, Vol. 17, p. pp. 147-156; Nicholas Georgescu-Roegen (1971), The Entropy Law and the Economic Process, Cambridge, MA: Harvard University Press}

Environmental Economics ‘provides the underpinning for mainstream environmental policy in multilateral and national institutions.’\footnote{Castro, Op. Cit., p. 203} Castro sums up the \emph{modus operandi} of this approach to environmental degradation reasonably succinctly:

The role of the government, in the view of environmental economics, is to come up with the goals (the right amount of pollution, for example, based on cost-benefit analysis), create a market that will achieve these goals, and enforce the meeting of these goals. According to this view, the market will fulfil the environmental goals at a lower cost...In general, environmental economists argue that solving environmental degradation by prohibition, the “command and control” approach as they call it, is too costly, and it is better to use market mechanisms.\footnote{Ibid., p. 203}

As we shall see in chapter two, this ‘induced innovation’ approach is growing in popularity insofar as climate change is concerned.\footnote{See for instance Adam B. Jaffe, Richard G. Newell and Robert N. Stavins (2002), ‘Environmental Policy and Technological Change’ in Environmental and Resource Economics, Vol. 22, p. 41} Indeed, as some of its foremost theorists argue, climate change itself has significantly increased the interest of policy-makers in methods by which energy-
efficient technologies can be productively incentivised.\textsuperscript{58} As will be shown in chapter two, these models and their approach to technological change have been criticised, but very rarely by those on the strong sustainability side, and never in a particularly convincing manner. The only direct criticism of which I am aware is that of Arveson et al who charge that the models fail to account sufficiently for “ripple” effects. This means that they neglect the ‘interactions between physical and social sub-systems’ and thus systematically produce ‘overly optimistic assessments.’\textsuperscript{59} “Ripple” or “revenge effects” have been a well-known part of technology studies since at least Edward Tenner’s \textit{Why Things Bite Back},\textsuperscript{60} but it is far from certain that this is a plausible use of the phenomenon. For instance, Arveson et al talk about the effect increased energy efficiency will have on prices, describing something called “Jevons paradox” (without in fact referencing it).\textsuperscript{61} The effect it describes is the tendency for the consumption of energy to go up when the efficiency of its production increases, a logical result of the lowered prices caused by the latter. However, it is difficult to see why an induced innovation strategy that puts a price on carbon or limits pollution cannot also set a minimum energy price, or meter usage on an inclining cost per unit scale. More generally, all of the problems they cite seem to have rather obvious solutions, or instead point to definite problems of a fairly minor order. In short, it does not appear that arguments that accept the essential premises of economic theory are capable of fundamentally undermining the implications of it in this regard. One of the arguments of this thesis is that until the understanding of how technological change operates is itself subjected to critique, what are

\textsuperscript{58} Jaffe, Newell and Stavins (1999), ‘The Induced Innovation Hypothesis and Energy-Saving Technological Change’ in \textit{The Quarterly Journal of Economics}, August, p. 941
\textsuperscript{59} Arveson \textit{et al}, Op. Cit., pp. 7452-3
\textsuperscript{60} Edward Tenner (1996), \textit{Why Things Bite Back: Predicting the Problems of Progress}, London: Fourth Estate
\textsuperscript{61} Cf. William Stanley Jevons (1866), \textit{The Coal Question}, London: Macmillan
commonly called “radical” alternatives, including a repoliticisation of the problem, will always be insufficient.

That said, at intermittent periods between 1971 and the present, some engagement with an aspect of this theory, premised on the work of Georgescu-Roegen, did occur. Rather than basing their critique on the existence of variables that are apparently not being taken into account, as Arveson et al do, a small group of ecological economists, led by Georgescu-Roegen and Herman Daly, criticised the technological optimism of the mainstream theory of growth in relation to its conceptualisation of natural resources.62 I discuss this extensively throughout the thesis, but put briefly, the most significant theory of growth during the latter half of the twentieth century was that originally developed in 1956 by Robert Solow.63 This was the theory to which Georgescu-Roegen addressed his original critique, and it was Solow’s later efforts in the 1970s, in response to the Limits to Growth discourse, that prompted the brief dispute that took place in the journal Ecological Economics in the late 1990s. Solow’s first paper had not been concerned with resource depletion at all, applying a Cobb-Douglas production function wherein the elasticity of substitution between natural and man-made capital is implicitly assumed to be unity or more.64 In other words, the idea was that humanity could continue to replace declining stocks of natural resources by adding to the stock of resources it makes itself at an equal or increasing rate. Solow maintained this assumption in his later paper on resource depletion, and thus, supported by fellow economist Joseph Stiglitz, argued that since the two kinds of stocks are interchangeable, declining natural stocks, though they would eventually

64 Gutés, Op. Cit., p. 148
reach zero, are not a threat to continued growth since they can be replaced with man-made stocks. Hence, they could claim, the notion that growth might be limited by the availability of natural resources is bunk.

Prior to the later, ecologically concerned papers, however, Georgescu-Roegen had already criticised Solow’s theory for its technological optimism. In his book *The Entropy Law and the Economic Process*, and a later paper based on it, he criticises the Solow growth model for its treatment of natural resources. His core point is that this work clashes with the second law of thermodynamics and as far as natural resources are concerned, is abstracted from the ‘Garden of Eden’ as opposed to the real world. His point is well stated: firstly he criticises the ‘indiscriminate attachment (of neoclassical economics) to the mechanistic dogma;’ that is, the idea (long thrown-out in physics) that a life process can work in continuous flow; that all actions are reversible (recyclable). The falsity of this assumption is revealed by the Second Law of Thermodynamics, namely the entropy law: that ‘available energy is continuously transformed into unavailable energy until it disappears completely.’ Georgescu-Roegen notes that this is the only natural law which ‘recognises that even the material universe is subject to an irreversible qualitative change.’ The economic model of continuous substitution of resources along a line approaching infinity is therefore impossible, because the natural resources involved in creating man-made capital must lose energy in the very process of doing so: hence, substitution can only be less than unity.

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69 Ibid., p. 352
70 Ibid.
This argument, though, never really reached the heart of the matter. Solow simply responded that of course on a time-line to infinity natural resources would deplete, but that he was only dealing with a time-line similar to that of *Limits to Growth*—i.e., a hundred years or so—over which the noticeable effect of the entropy law would be miniscule.\textsuperscript{71} However, this does not defeat Georgescu-Roegen’s point entirely, for the perfect substitution over this shorter period still relies on technologies capable of making this possible. Later Daly and Costanza, followers of Georgescu-Roegen, follow up his position by rejecting the notion that man-made and natural stocks are completely interchangeable. They argue that, if the two were perfect substitutes, then the reverse would work also. This cannot be the case since, as they put it, ‘fishing nets, refineries, saw mills, and the human capital skill to run them (do) not substitute for, and would in fact be worthless without, the natural capital of fish populations, petroleum deposits, and forests.’\textsuperscript{72} Moreover, production is really a ‘transformation process,’ manufacturing and human effort are simply what effect this transformation, hence, ‘the relationship is overwhelmingly one of complementarity, not substitutability.’\textsuperscript{73} What this debate comes down to in its essentials, then, is a belief that near-infinite growth is at least possible against one that foresees a point at which growth will ‘cost us more than it is worth.’\textsuperscript{74}

Solow no doubt realises that we cannot replace fish with technology, rather he is arguing that technology can do enough so as to make depletion too small to be worth modelling. Once more then, at the heart of the dispute is technological possibility, with weak and strong sustainability advocates separated by their respective judgements of this variable. Crucially though, the critiques of Georgescu-Roegen et al, whatever their plausibility, are not

\textsuperscript{72} Costanza and Daly, *Op. Cit.*, p. 41
\textsuperscript{73} Ibid.
\textsuperscript{74} Ibid., p. 43
able to address the core of the argument they are opposing: that ingenuity, however unlikely it seems under current technological conditions, can be expected to provide a constant stream of solutions to the problems facing growth. That is, the critique does not get to the basis for this confidence within the discipline. The aim in this thesis is to undermine this very core.

Overall, the weak-sustainability arguments we have seen so far have all been underpinned by a particular reading of technological change and, based on this reading, all point towards a vision of progress: that of increasing prosperity. Each has had their own, largely specific critics, but the question remains: having briefly examined each of these disparate technological optimisms, should we consider them unified in some way? That is, ought we to proceed on the basis that there exists what might be called a “governing concept of progress,” which revolves around technological change, and which has caused these individual sproutings in various disciplines at various times over the past few decades? This is the approach implied by the concept of ecological modernisation and indeed, developed in the work of Jurgen Habermas who, as we shall see in chapter three, would relate each to an ideology of progress, which he considers to be the dominant ideology of modernity.

Alternatively, should we view each instance of technological optimism as potentially related, but only through far-removed ancestors, with each instantiation of this particular vision of progress having its own particular history, leading it to take the form it does today? This thesis will argue, in chapter three, that we must examine technological optimism within climate change policy as a single case. Moreover, as a result of the genealogy pursued thereafter, it will also argue that the notion of a governing ideology, at least one responsible for each instantiation, is a very insecure conceptualisation of the problem of progress.
Whatever the case, though, until the allure of a technological fix for climate change is diminished, it will never be possible to present a convincing case for an alternative approach. Both the Habermasian and Foucauldian methodologies offer the possibility of a repoliticisation of the problem as the end result of their respective critiques. Whether one shows technological optimism to be the result of a widespread ideology of progress or instead, a central part of a disciplinary rationality, the “truth” of economic models is still undermined when the basis of these models is shown to be other than scientifically determined. It weakens their theoretical power. Moreover, space then opens up for a discussion about whether the harms of climate change are too great to allow economic growth to continue unchecked. Alternative political economies such as those offered by Milani, Barry and others,\(^7\) which provide blueprints for sustainable economies that are not premised on the infinite capacity of human ingenuity, thus come into much sharper focus. Without this critique of their conceptualisation of technological change, the ability of economists to produce optimistic truths about future technologies, and the obviously pleasant thought that climate change can be solved without the need for economic reorganisation, will defeat any alternative propositions. Indeed, the concrete result of the power of the orthodox vision lies in this very adjective: approaches to climate change premised on an economics that rejects the growth paradigm are classed as “radical,” while the orthodox or mainstream and, implicitly, “reasonable,” approach is centred around a continuation of the status quo. The solidity of this rhetorical presentation ultimately depends on the conceptualisation of technological change

offered by orthodox economics and therefore it is to this that we must
direct our focus.

In this chapter I argued that technological optimism has the ability to
reconcile progress with environmental degradation. This is effectively what
is meant by the term ‘sustainable development,’ particularly in its more
recent incarnation: ‘ecological modernisation.’ I looked at three different
manifestations of this kind of technological optimism and the criticisms
each has faced and noted how ineffective they were as a result of their
failure to really challenge the underlying causes of this technological
optimism. I then asked, finally, whether we should approach each instance
as an effect of a greater causal belief, or as an individual technological
optimism with its own unique histories. My answer, as we will see in
chapter three, is that in the case of climate change modelling and
subsequent policies, we must examine the individual history of the
underlying technological optimism. One of the major contributions of this
thesis is in showing that the latter is not the result of a careful process of
scientific development, but rather the effect of a hidden, very particular and
largely metaphysical disciplinary framework. We will now move to
examining the instance of technological optimism of primary concern to
this thesis.
Chapter Two

Technological Optimism in the Economics of Climate Change

This chapter is about the technologically optimistic modelling literature that makes possible the current mainstream debate about climate change. It is a debate that revolves around one simple premise, marginalising any contribution that fails to accept it: that a (least-cost) way can and must be found to reconcile boundless economic growth with the bare minimum of environmental sustainability needed to prevent catastrophe. I argue that, in the final analysis, it is the underlying assumptions around technological change, more than any other single factor, that permit this myopia. Even the Intergovernmental Panel on Climate Change (IPCC), inclined as it almost invariably is towards a very cautious interpretation of data, produces findings that inspire tremendous confidence in a future of low-carbon economic growth. These have allowed heterodox challenges to this framing – which, for instance, advocate a much more fundamental reappraisal of both personal and societal sustainability – to be more or less entirely sidelined. To put this plainly, the modelling of technological change endorsed by the IPCC assists most crucially in defining as such what is currently regarded as “radical” environmental action. Meanwhile, it renders plausible technologically optimistic approaches that in fact rest on crippling levels of uncertainty. It is the purpose of this chapter, in the identification and portrayal of this optimism, to encourage a radical reappraisal of what we currently understand as “radical” environmental policy.

I begin with the IPCC and the scenarios that make up the greatest part of its contribution to climate change mitigation policy. From discerning in these the remarkably extensive role to be played by technological change, I move to discuss the modelling approaches that underpin scenario building,
noting the decisive influence of neoclassical economics upon the shape technological change takes in these models. Hence, I then show how the techniques it uses to map the future of the “technostructure” both obscure, and rely most crucially, upon the process of invention; something nevertheless always deemed unpredictable. This contradiction then moves into wider frame and we see the strange determination of climate-economy modellers to stress both the reliability and the uncertainty of their efforts. This tension can seemingly be resolved only if an essential, and utterly unfounded, optimism is introduced regarding the nature of human ingenuity. It is concluded that: firstly, we must examine economic growth theory for the roots of the rationality that sustains this optimism; and secondly, that what is meant by “radical” and “pragmatic” in terms of climate change mitigation, must now be re-opened to political discussion.

First of all, though, to define technological optimism: it is herein recognised as operative when the grounding of expectations regarding technological change moves beyond the evidential and into a place where the presence of faith can be discerned. As noted above, I regard the policies of the USA and EU as easy targets, but even still, their approaches are only less rigorous versions of those employed by the IPCC.76 Moreover, while the EU rarely mentions the IPCC and long-term forecasting (the US discusses them much more often), even if neither relied upon any of the modelling approaches discussed below, we would still have to recognise the defining influence of the IPCC. For if, say, the IPCC found that technology could not be relied upon to mitigate climate change in the long-term, the impact on the climate change discussion would be tremendous. It is, after all, by far the foremost organisation addressing the problem and was set up

by all the states of the world. We cannot, of course, argue that it entirely
governs state action, but its findings define how the problem is
approached. It represents the apex of orthodoxy and is buttressed by the
most extensive academic review process in history, which naturally induces
cautions. It cannot thus be seen as representing a soft-shoulder insofar as it
reflects the discipline of economics as a whole.

The IPCC is very careful to avoid overt policy-recommendations,77 which
is not surprising given the choppy political waters it navigates, where lines,
sections and indeed entire projects are continuously subject to member-
government veto.78 Hence, while Working Group I attempts to ascertain
the extent of future climatic change if no mitigation efforts were
undertaken, Working Group III’s futurology lies in the much trickier
sphere of preventing it, and thus economic growth, technological change,
demographic trends etc., all fall under its auspices. While a non-political
Working Group III might deliver its prognostications with probabilities
attached,79 the IPCC argues that the future is too changeable to justify this.
Instead of predictions, therefore, it calls its scenarios ‘projections,’80 and at
the heart of them are four major storylines, each with a very different
‘image of the future.’81 With forty potential scenarios divided amongst
them,82 these storylines are designed to ‘provide policy makers with a long-
term context for near-term decisions.’83 All have a supposedly equal
likelihood of occurrence. Quite crucially then, the extent to which the

77 IPCC (2007), Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment
Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A.
Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 32
78 Bastien Girod, Arnim Wiek, Harald Mieg and Mike Hulme (2009), ‘The evolution of the IPCC’s
emissions scenarios’ in Environmental Science & Policy, Vol. 12, p. 112
Intergovernmental Panel on Climate Change, Cambridge: Cambridge University Press, p. 304
81 Ibid.
82 The IPCC declined to create new scenarios for the Fourth Assessment Report, hence the 2000 SRES
Special Report is still the major reference point. New scenarios are expected prior to the publication of
the Fifth Assessment Report, anticipated in 2013/14
IPCC can be said to be giving policy-advice, as opposed to policy options, lies in the trends one can discern across these scenarios. That is, one must parse the scenarios carefully to identify any discernible biases that could influence how policy-makers act.

The storylines are in the first instance political projections, and only then economic and environmental ones. That is, they assume four different global political futures – named in the literature as High Growth/Globalisation (A1) Global Regionalization (A2) Sustainability (B1) Regional Stewardship (B2). Within these they explore the more quantitative uncertainties: that is, population growth, technological change and so on, and how variations in these might affect carbon emissions under a given storyline. The storylines are not to be thought of, though, as merely fictionalised accounts of the future and are certainly not thought of as such by the IPCC. They are tested for consistency – for example, the rate of technological change is modelled in proportion to, for one, economic growth – and as such, are considered scientific projections. On the face of it, this is a very rigorous recognition of uncertainty; however, from Pielke et al’s analysis of the baseline assumptions made across the forty scenarios, we can see that, at least insofar as technological change is concerned, uncertainty is given far less scope than might be assumed at a glance. Their work compared the scenarios to a “frozen technology” alternate baseline, and it gives some much needed clarity to the IPCC statement: ‘significant technological change and diffusion of new and advanced technologies (is) already assumed in the baselines.’ In fact, in the median of the reference scenarios, 77% of the reduction in emissions needed to meet the stabilisation target is expected to occur spontaneously, and even in the

84 Bastien et al, Op. Cit., p. 112
87 550 parts per million in volume of carbon dioxide by 2050
most high-carbon scenarios, a 57% spontaneous reduction is assumed.88
This is an outlook that is overwhelmingly shared in the modelling literature
the IPCC reviews.89 Moreover, while there are nominally four major
storylines, the A1 storyline is normally broken down into four further sub-
storylines, each characterised by a different major energy-producing
technology.90 Investigating these storylines further makes Pielke et al’s point
resonate more clearly. Technological change is hindered in the A2 and B2
scenarios as a result of political choices: the former representing an anti-
globalisation trend, which naturally hurts economic growth rather severely,
and the latter an eco-friendly, localised world, where emissions are much
less of a problem anyway. For those scenarios wherein economic growth is
pushed – i.e. all of the plausible scenarios from our current juncture – the
development of energy technologies is rapid. It is also worth recalling that
these scenarios are designed to be policy-free; that is, no government action
to mitigate climate change is included.91 Yet the roughly half of A1
scenarios which end up with fossil-fuel dependent economies are still
characterised by major improvements in emissions intensity;92 none of
which can be traced back to specific technological changes.93 If we take the
literature the IPCC draws upon as our guide, we can expect ‘a significantly
more rapid decrease (in emissions-intensity) compared to the historical
rates of about 0.3% per year...implying significant and radical technological
changes.’ Rapidity in this case signifies either a doubling or trebling of the

452, pp. 531-2; the IPCC do also provide this information in a certain sense but it is in a much more
scholarship, it decided to produce entirely new work for the purposes of creating its own emissions
scenarios.
92 US Climate Change Technology Program (2007), Strategic Plan,
06/09/2011, p. 31
93 Editorial (2008), ‘Double vision: The need to transform the world’s energy technology is even greater
rate.\textsuperscript{94} How this rate can increase and yet still be based on historical experience, is discussed below.

There can be little doubt, moreover, that the A1 storyline includes the more likely scenarios. That is, while the probability of each scenario is nominally equal, there is a line regarding the A1 scenario group – ‘(this) may be the type of scenario best represented in recent literature’\textsuperscript{95} – that effectively gives the game away. Moreover, we must bear in mind that the four technology sub-groups in the A1 (globalisation) scenario were chosen by ‘design,’\textsuperscript{96} rather than by a working through of each of the models. That is, each of these sub-storylines was given their main energy-provider as an assumption, and then asked to work through the development of GHG emissions with this main provider artificially held in place. However, it is readily apparent from the more recent literature that the IPCC draws upon, including the work of its lead author, that this is not expected to be the case; renewables are predicted to be much more dominant than the two fossil fuel sub-storylines indicate.\textsuperscript{97} Given this, it is hard to believe that the higher emissions scenarios will be taken very seriously by policy-makers and as a result the ‘balanced’ and ‘renewables-dominated’ sub-storylines are likely to be the ones focused upon. These range towards the high end of the autonomous emissions reduction scale, making the target seem far less daunting than it otherwise might. From a technology point of view an overall message is immediately discernible: as long as economic growth and politics stay where they ought, we can largely rely on the kind of vastly greener energy production expectations which Pielke \textit{et al} observe, and which are defended by reference to an apparent trend towards

\textsuperscript{94} IPCC (2007), \textit{Op. Cit.}, p. 220
\textsuperscript{95} SRES, \textit{Op. Cit.}, p. 180
\textsuperscript{96} Ibid., p. 235
decarbonisation. It seems vital, therefore, to understand how the modelling process can produce such results.

In the early 1990s, the contentious debate within the literature on climate change mitigation was the technological pessimism associated with macroeconomic (or “top-down”) assessments. The more traditional, parsimonious macroeconomic models then used tended to conclude that climate change mitigation would involve enormous costs. This was not merely in the short-term: assumptions around long-term technological change in the energy-demand sector were far from optimistic and indeed early models even concluded that recarbonisation would occur following a few decades of slight decline. As a result, and while some emissions reduction – around 10% – was assumed to be reasonably straightforward, anything beyond this involved a steeply inclined cost-curve. Given the then greater uncertainty about the likely impacts of climate change, macroeconomic modellers tended to imply, therefore, that immediate moves towards mitigation would not be advisable.

This was the beginning of what is (or was) known in modelling literature as “the gap.” Models using an alternative approach to mitigation analysis found that costs were far lower than these macroeconomic models were projecting. Indeed, they found that there was significant scope for

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98 Several Working Group III authors responded to Pielke’s criticisms with this retort, see Quirin Schiermeier (2008), ‘Are the IPCC scenarios “unachievable”? ’ in Nature, Vol. 452, pp. 508-509
emissions reduction at low, no or even negative costs.\textsuperscript{105} This was the systems engineering or “bottom-up” approach which, more than anything else, is notable for its high level of technological detail. It thus offered an obvious alternative to macroeconomic models, where technologies are typically aggregated into no more than two or three, mathematically manageable, units – say mature, incremental and radical – with no particular technologies being specified.\textsuperscript{106} Moreover, while the macroeconomic approach involves modelling the entire economy in order to see how given exogenous variables such as a carbon tax might affect how it develops, bottom-up models revolve around ‘identifying potentials’ in particular economic sectors.\textsuperscript{107} Insofar as climate change is concerned, this means areas where high-carbon technologies can be substituted for low at no more than a certain cost. Indeed, scholars following this methodology tend to discover significant inefficiencies in the energy-supply status quo, meaning that the up-front costs of acquiring low-carbon technologies would be paid for, to a significant though somewhat uncertain degree, by energy efficiency savings.\textsuperscript{108} This is contrary to the findings of most macroeconomic modelling, wherein efficiency in the use of resources is taken as basic premise for long-term forecasts. Even more significant were the long-term predictions, which attacked the assumptions regarding energy efficiency potential that underpinned these early macroeconomic models. In effect, the bottom-up analysts found that technological change would substantially reduce the carbon-intensity of energy production through an increase in its efficiency: i.e. the same amount of energy output

\textsuperscript{107} Wilson and Swisher, \textit{Op. Cit.}, p. 251
would require a far lower fuel input, naturally resulting in reduced carbon-
dioxide emissions as increasingly less fuel is burned on average.109

These findings tended to be dismissed, though, by macroeconomic scholars
as the results of an approach that is intrinsically incapable of accounting for
the complexities and costs of an entire economy.110 They put the optimism
of the findings down to this latter deficiency. Interestingly, however, it
seems that the long-term part of the bottom-up objection was ultimately
accepted, despite the fact that, given the emphasis they place on detail,
bottom-up studies are much less credible as longer-term projections.111 In
any case, macroeconomic assessments of long-term mitigation costs
certainly became far more optimistic. To examine this, let us take perhaps
the most significant macroeconomic model: the Global 2100 model
created by Alan Manne and Richard Richels. This has been regularly updated and
plays a major role in the most recent IPCC scenarios.112 It is what is known
as a “computable general equilibrium” (CGE) model: a form that employs
standard neoclassical premises113 and is ‘considered to be the “gold
standard” in contemporary economic policy discussions.’114 This is
recognisable by the fact that models of this variety make up the majority of
the six IPCC SRES models.115

109 Ibid., p. 448
110 Grubb (2002) ‘Trends in the economics of climate change mitigation’ in Paper to 10th symposium of the
accessed 21:22 21/05/2012 p. 3
111 Jae Edmonds, Joseph M. Roop and Michael J. Scott (2000), Technology and the economics of climate change
policy, Prepared for the Edmonds et al, Op. Cit. Center on Global Climate Change,
of greenhouse gas abatement: a meta-analysis of post- SRES mitigation scenarios’ in Environmental
models of environmental policy: a survey’ in Ecological Economics, Vol. 43, pp. 107-8
114 Stephen J. Decanio (2005), ‘Descriptive or Conceptual Models? Contributions of Economics to the
Climate Policy Debate’ in International Environmental Agreements, Vol. 5, p. 417
115 Barker et al 2002, p. 7. Indeed all of the post-SRES scenarios now include a CGE element, ibid., p. 10
Originally (1991), Manne and Richels found that the cost of IPCC-recommended abatement was too high to really be considered plausible, arguing instead for, at most, a 20% reduction in emissions.\(^\text{116}\) Yet by 1999 they were finding that, as long as the optimal market course was taken, long-term emissions-reduction costs for the United States were almost negligible.\(^\text{117}\) However, predictions for near-term abatement were still exorbitantly high; indeed, this was the basis for their critique of the Kyoto protocol.\(^\text{118}\) Their analysis was based on allowing emissions to rise in the near term, on the presumption that the costs of mitigation would substantially decrease. This would occur as long as ‘market mechanisms [are] chosen over “command and control” approaches,’\(^\text{119}\) i.e. neoclassical conditions were allowed to prevail. Hence a tremendous shift had taken place, not just in this model, but in virtually all macroeconomic climate-economy models, to the degree that by 1999 an editorial in the journal \textit{Climatic Change} could be entitled: ‘Crying no wolf: why economists don’t worry about climate change and should.’\(^\text{120}\)

A major factor responsible for the different results of the two studies is the introduction of carbon trading on an unconstrained level in the later one. This, however, is only effective if it leads to a reduction in overall emissions. Emissions cannot be traded away indefinitely; at some point major abatement must take place. Hence the biggest difference between the

\(^{116}\) Manne and Richels (1991), \textit{Op. Cit.}, pp. 87-108. It is occasionally argued (David M. Driesen (ed.) (2010), \textit{Economic Thought and U.S. Climate Change Policy}, London: MIT Press) that this study was strongly biased against action on climate change because of the influence the US energy lobby had on its creation. This is assumed from the fact that the authors’ research was funded by a grant from the Electric Power Research Institute (EPRI). However, the model is completely open to public scrutiny, as are the assumptions underpinning it. Moreover, far from being closed to duplication, the model is now the macroeconomic basis of many other studies. Lastly, other macroeconomic studies (see Nordhaus, \textit{Op. Cit.} (1991), for instance) found similar results. In the end the allegations must be rejected for a lack of evidence.


\(^{118}\) Ibid., pp. 1-9

\(^{119}\) Ibid., p. 9

two studies, and the one that accounts most for the change in stabilisation-level findings, is the size of the coefficient applied to the autonomous energy efficiency improvement (AEEI) rate (more upon which below). While in 1991 Manne and Richels were insisting that ‘Econometric investigations of the U.S. post-1947 historical record show no evidence for autonomous time trends of this type’ and set it at an annual average rate of 0.4% for the world,\textsuperscript{121} by 1999 they had more than doubled it (0.98%) and were advocating an approach whereby the US was spared genuine near-term abatement so that it could avail of the lower-carbon technologies to be expected in the future.\textsuperscript{122} In other words, they advocated ‘a gradual transition to a less carbon-intensive economy.’\textsuperscript{123} This is not to say that the authors were advocating no action at all on climate change for several decades – indeed they advocated, for a start, extensive emissions trading – rather my intention, as stated above, is simply to show the degree to which discernible policy-implications are predicated on assumptions regarding future technological change.

Interestingly, though, while this new-found optimism in regard to long-term technological change may have been inspired by the findings of bottom-up investigations, or at least the disconcertingly large gap between the two methods may have motivated a reappraisal, the dominant approach to modelling technological futures remained the macroeconomic one. This is because all climate economy models adopted from the start a vital part of the standard neoclassical treatment of technological change, derived in the first instance from Robert Solow: a set rate of technological development that impacts upon the model but is not itself affected by what goes on within the dynamics of it.\textsuperscript{124} This is known as autonomous or exogenous

\textsuperscript{121} Manne and Richels (1991), \textit{Op. Cit.}, p. 94
\textsuperscript{122} Manne and Richels (1998), \textit{Op. Cit.}, p. 9
\textsuperscript{123} Ibid., p. 8
\textsuperscript{124} Christer Berglund and Patrik Soderholm (2006), ‘Modeling technical change in energy system analysis: analyzing the introduction of learning-by-doing in bottom-up energy models’ in \textit{Energy Policy}, Vol. 34, p. 45
technological change: ‘the costs of abatement technologies are defined as input data and do not vary explicitly with the level of investment, incentives, and market penetration in the model.’\footnote{125} For decades it was the only tool climate economy models had to account for changes in the technological environment.\footnote{126} At its core, it revolves around extrapolating ‘the future as a marginal and gradual extension of the past.’\footnote{127} There are variations in how it is applied, however. The basic standard is the very simply AEEI – an autonomous rate of energy efficiency improvement – which is simply entered into the calculations every year at a given rate in order to account for improvements in energy usage in proportion to GDP (this is separate from improvements in energy efficiency which result from increases in price). However, there are many other employments for this concept: bottom-up modellers often apply it to single or groups of technologies to effectively decrease their cost over time; and in certain macroeconomic models, for instance the DICE model created by William Nordhaus (versions of which are also included in the IPCC SRES), it is utilised in relation to a “backstop” technology. The latter is a low-carbon alternative that, as a result of technological change, gradually decreases in cost over the course of the modelled time-line, thereby making the replacement of high-carbon energy technologies more cost-effective in the future.\footnote{128}

Also derived from macroeconomics is the increasingly common endogenous approach to technological change (discussed in detail below),

\footnote{126 Hourcade and Robinson, Op. Cit., p. 867}
which forms a part, major or minor, of most recent models. Both are ideas originally found in the literature on neoclassical growth theory. Indeed the ongoing debate between exogenous and endogenous approaches to climate change mitigation modelling reflects the debate that has been progressing in that sub-discipline since the advent of “new growth” in the mid-1980s. Moreover, while the origin of bottom-up modelling itself is the completely separate discipline of systems engineering, this really only means that it was conceived out of the general dissatisfaction of engineers trained in this approach with macroeconomic estimates of the costs of future energy provision. In order to model how one technology replaces another, a microeconomic framework needed to be adopted. The result of this was that models with a large degree of technological detail, married to neoclassical principles where the rules of equilibrium, partial or general, came into being.

In addition, the distinction between top-down and bottom-up is becoming increasingly anachronistic. All of the post-SRES models now include a CGE module to manage the macroeconomic side of the models. This involves trading away some specificity, but macroeconomic analysis is a necessary part of any sophisticated scenario building due to the general inapplicability of bottom-up studies to long-term, economy-wide modelling. Scenario building is, according to Grübler et al, the ‘main application’ of top-down modelling. For instance, two nominally bottom-up models that are part of the IPCC modelling group, the Asian Pacific

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134 Barker, Op. Cit., p. 10
136 Ibid., p. 546
Integrated Model (AIM) and The Mini Climate Assessment Model (MiniCAM), employ a revised ERB model which can ‘estimate interactions between energy sectors and economic sectors.’ Both introduce technological change exogenously into this model and the latter processes the technological elements of both in order to produce the final scenario picture, although the rates of change in the AIM are determined by the bottom-up element. Of course, the reverse is also true and bottom-up modelling is playing a larger role in models that were previously just macroeconomic. In general, therefore, the more recent climate-economy models are rendering the former top-down/bottom-up divide increasingly anachronistic.

However, while in 1993 Grubb et al were able to confidentially assert that ‘almost all the abatement costing studies to date model technology development as “exogenous,”’ as the millennium approached more and more studies began to include endogenous technological change, albeit to varying degrees. In addition, while most of the technological change modelled for the IPCC’s 2000 scenarios was still applied exogenously, some endogenous elements had come on-board. Hence, just as the old top-down versus bottom-up division was beginning to become irrelevant, the advent of endogenous technological change opened a brand new breach within the modelling literature. This new breach also divided optimist from pessimist, albeit from a much more optimistic starting point. The centre-ground, in other words, had shifted onto what was previously

142 SRES, Op. Cit., p. 211
the optimistic end of the spectrum, and now those who favoured endogenous technological change carried the torch for radical technological possibilities. There are a number of different elements to endogenous technological change, but insofar as the future is concerned, all of them are premised on the same fundamental idea as their exogenous counterparts: that the past is a reliable guide to the future. As the IPCC notes, ‘assuming that technologies in the future improve similarly to that observed in the past enables experts to quantify the cost impacts of technology improvements in controlled modelling experiments.’ This is where a large element of displacement enters. While exogenous technological change is scorned for its failure to account for the real-world mechanisms by which technological change takes place, with the result that it apparently underestimates the possibilities, endogenous technological change really only focuses the lens just a little closer to the object. That is, it also applies the notion of a rate of change, only in a more complicated way. Take for example “learning-by-doing.” This concept, once endogenised in the model, ‘describes how cumulative production experience with a product leads to reduced production costs.’ In the IMAGE model used in the IPCC SRES, the ‘general formulation of learning-by-doing is that a cost measure, \( y \), tends to decline as a power function of an accumulated learning measure, \( Q \).’ In effect, this means that the cost of a given technology is still gradually reduced over time in accordance with a set rate determined by empirical studies; for instance 20\% over a given time period, as is the general rule of thumb. Of course, the actual potential for cost reductions embodied in a given technology cannot in fact be known, though guesses

147 Kohler, Op. Cit., p. 31
might be considered more accurate if informed by bottom-up engineering analysis. Still, the explicit process by which this learning takes place is, naturally, not known, meaning that while the endogenous approach is theoretically more exact in the rate of change it applies, it is still only a prediction based on past experience. As it is put in Grüber et al, the procedure is about ‘identifying systematic properties of technologies in the historical record, which include learning curves and characteristic learning rates, and then applying these to existing technologies.’¹⁴⁸ To use the language of the discipline, this merely means that rather than one black-box on the outside of the model, there are a number of black boxes scattered around inside.¹⁴⁹ The real-world learning process is not actually described. Additionally, and this is indeed a significant change, endogenising technological change allows for policy-makers to “induce” technologies into existence. That is, it allows them a framework by which it is claimed they can roughly predict a particular improvement in a given technology in proportion to a certain amount of money or a particular regulation.¹⁵⁰ What might be called a money-to-technology ratio is then applied. For instance, in the Imaclim-R model ‘the rate of decrease of the price of non-carbon energies doubles when investment in those technologies is multiplied by four.’¹⁵¹ Or in the case of, say, a carbon-tax which increases the price of energy, ‘the rate of global energy efficiency improvement doubles if the energy prices increases by 60%, and the energy mix can be decarbonized up to 100% by 2100.’¹⁵² Depending on the rate applied, therefore, it is clear that anything from very modest to remarkable technological changes can be envisioned. Moreover, endogenous technological change is premised,

¹⁵¹ Renaud Crassous, Jean-Charles Hourcade and Olivier Sassi (2006), ‘Endogenous Structural Change and Climate Change Targets: Modelling experiments with Imaclim-R’ in The Energy Journal, Special Issue on Endogenous Technological Change, Vol. 0 (Special I), p. 149
¹⁵² Ibid.
crucially, on the idea of increasing returns to investment. This means that, again depending on the rate applied, relatively modest policy-proposals on the supply-side – such as investment in research and development (R&D) – can deliver rather vast results. This, as will be discussed in much more detail below, is very problematic when one considers the level of uncertainty that must be attached to the projections. For example, ‘varying the initial costs from 10,000 to 30,000 for a mean learning rate of 30% delays the economic break-even point of the revolutionary technology by more than five decades.’\textsuperscript{153} This is a rather enormous, and potentially wonderful/devastating, consequence to fall on the back of a predicted rate of return on investment. It is particularly so because R&D, the single greatest weapon in the endogenous arsenal, ‘abstracts entirely from what kinds of new machines or processes might be yielding these changes.’\textsuperscript{154} Finally, two consequences of the development of endogenous technological modelling are worth noting: the first is that, as it is increasingly deployed, scenarios are likely to shift even further to the optimistic side of the scale because, in addition to background rate of change, direct responses to climate change can now be modelled. For instance, some, admittedly outlying, economists argue that the threat of climate change is rendered negligible when the processes of endogenous technological change are introduced into a climate-economy model.\textsuperscript{155} Technological change is shown to accelerate to such a degree in a particular direction that it allows growth to be decoupled from carbon dioxide with relative ease and trifling costs. Indeed, even if this rather worrying finding is widely disputed, we can still expect the next IPCC emissions scenarios report to be have significantly more technological progress included in the baselines. The second is that the impact of neoclassical growth theory upon

\textsuperscript{153} Grübler \textit{et al} (1999B), \textit{Op. Cit.}, p. 272
\textsuperscript{154} Jaffe \textit{et al}, \textit{Op. Cit.}, p. 470
climate change modelling is reinforced. Regardless of the wide variance within the structures of these models – in terms of production functions, levels of technological detail or anything else – it is fundamentally the contribution of that economic sub-discipline that has most shaped how climate change mitigation is approached. And in the end, at its heart lies the idea that past technological developments are our guide to solving present day problems.

This is, however, a far greater problem than one would immediately grasp from the framing that one encounters in the literature, where discussions are predominately about improvements in existing technologies. Between the optimism derived from developments in past technologies; the potential of existing ones; and the thrill of new modelling techniques; it seems that the scale of the challenge involved is easily missed. Edmonds et al wisely remind us that when ‘most of the debate in the literature is about whose forecasts of climate change impacts are most realistic, there is a tendency to lose sight of the fact that all future prognostications of technological change are ultimately derived from assumptions.’\textsuperscript{156} These assumptions rest on enormously complicated real-world processes around technological change, which must not be downplayed. The most significant of these, without question, is the role of invention.

In a distinction that is traceable back to Schumpeter, technological development and change, particularly in economics, is usually broken down into three separate processes: invention, innovation and diffusion. These are essentially: the original idea or prototype; the development of the technology to a marketable or broadly useful level; and the process by which it is adopted in the marketplace.\textsuperscript{157} The first of these is by far the most unpredictable, as indeed is recognised in the literature. For instance,

\textsuperscript{156} Edmonds \textit{et al}, \textit{Op. Cit.}, p. 22
Grübler et al state that ‘the inventor's mind, which must deviate from predictable conventions to discover novelty, is intrinsically difficult to model and anticipate.’ However, these caveats, on balance, seem to obscure more than they reveal: nowhere are the enormous ramifications of this admission spelled out. In other word, that explicit inventions cannot be predicted or induced on requirement is recognised, but the level of invention involved in the baselines of emissions scenarios is never discussed in the literature.

This problem essentially arises from the idea of extrapolating from the past in order to map the potential of the future. As noted above, this is done in a rather diverse number of ways in climate-economy modelling. Still the most common (although that is increasingly changing) is the exogenous approach, which is reflected in the AEEI coefficient. At its least sophisticated, and it is heavily involved in the IPCC emissions scenarios at this level, it simply translates into an annual rate of non-price induced decline in the energy required for each unit of GDP. However, there are some obvious and rather immense problems with this, which have led it to be criticised so heavily in the literature. The first is that, by ignoring the vast swathe of processes that might be underpinning its rate of technological change, it must necessarily average them out in a very rough way. Taken over a long enough time-line, which in climate-economy modelling must necessarily be the case, it is potentially incorrect by a very significant degree in either direction. When the goal is as tight, in both time-scale and emissions reductions, as is the case with climate change mitigation, huge inaccuracies can lead to an insufficient effort with remarkable ease.

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159 SRES, Op. Cit., p. 201
More important, though, is the fact that the data it has to work with hardly presents itself as a reliable guide. Climate models normally run for a period of around a century, but even if run for only half of that, an exogenous rate such as this is still taking in some incredibly unique changes. For instance, the move from a coal dominated economy, to one including far more oil and gas, raised energy efficiency tremendously. However, this is a one-off change driven by inventions and discoveries in the science of fossil-fuels, an equivalent for which we cannot possibly anticipate occurring within the restricted climate stabilisation time-frame, if ever. Much of the change came out of basic research, which even more so than invention, cannot be relied upon to deliver in any specific direction and yet has provided the greatest part of the truly radical technologies that we use today, and which is commonly recognised as vital for a transition on the scale contemplated by climate-economy modellers. Moreover, the advent of computerised Energy Management Systems will necessarily have formed part of the AEEI figure. Indeed, computing changed productivity and energy efficiency in remarkable ways, but again there is no way to predict whether an analogous invention in terms of effect on energy efficiency is in the offing. A vast exogenous variable like the AEEI takes no account of this. Finally, as Kaufman has discerned, the annual, deterministic rate-of-change described by exogenous modelling is an enormously misleading characterisation of the history it purports to be based on. Only when swept into a time-scale of such lengths can the process seem at all deterministic. Looked at in its particularity, the history of energy efficiency improvements are actually remarkably random, involving large periods of


stagnation and completely unpredictable leaps forward, new technologies and discoveries like those discussed above.\textsuperscript{164} Hence, any expectation that such a “trend” might be predictive is not at all well-founded empirically. In sum, we are talking about transformation on a scale greater than anything seen in history. Nothing like it has ever been achieved without remarkable leaps in basic science and invention, and these are by their nature unforeseeable.

Insofar as the exogenous approach relates to individual technologies, such as in the sectors modelled by bottom-up research, we are facing a number of related problems, most of which also apply to the newer endogenous approach. Part of the difficulty is that conceivably, no energy technology is really bounded to any great extent. Since the improvements are essentially unknowable, they might be able to improve a given technology by any imaginable degree. That means that it is all too easy to assume we have the technologies we need now, even though, assuming it is possible to decarbonise to the degree needed while maintaining economic growth, the technologies that will really do most of the work have yet to be invented.

Effectively we are encountering an unanswerable question about what is possible, which techniques like the money-to-technological change ratio greatly obscure. This is the difficulty with both the bottom-up approach and much of the endogenous: it appears to model innovation (often married to an AEEI value to cover invention), and thus to eschew the problems outlined above. But this appearance is tremendously misleading. Few, if any, technologies are isolated from previous inventions. This is known as path-dependency, and it essentially means that we can build our new technologies only on what we know already. As a result, it becomes clear that the record of innovation is in fact strewn with complimentary inventions that were necessary to make any given innovation possible. For

\textsuperscript{164} Ibid., pp. 82-83
instance, the development of machine-tools or miniaturisation techniques, though primarily inventions themselves, allowed for innovations, often quite modest, in a vast number of areas. Hence, while the introduction of microprocessors (which were made possible by the development of miniaturisation) into a range of products counts as an innovation, it was in fact dependent upon invention, and therefore any long-term rate which includes such changes falls into precisely the same deterministic and misleading trap as that described above.

As noted, though, it is these and other problems that have led exogenous technological change to be increasingly replaced in the literature by a variety of endogenous techniques. These apply a rate of improvement discerned from research on the nature of the processes by which technological change occurs (for example, the learning-by-doing effect discussed above). Many of the same problems involved in this are involved in applying a simple AEEI to a given technology. For instance, in modelling innovation one can tend to ignore the innumerable technologies that did not develop as might have been hoped, focusing instead of the success stories. This is very hard to address, given that if they were included in the average, these failures would bring it down tremendously. They are therefore excluded and only technologies that met with successful innovation, to whatever degree, are utilised.\textsuperscript{165} This necessarily means, however, that projections based on case studies are rather misleading as a guide to the future. If we consider the case of the Alcoa process we begin to see this more clearly: ‘many modelers once assumed the future availability of the Alcoa process, an energy-saving alternative to the Hall process for producing aluminium. However, after nearly 20 years of research and development, researchers have abandoned the Alcoa

process.\textsuperscript{166} Thus learning-by-doing rates are rather misleading, since any potential success is still ultimately in the balance. We are talking, however, about a process wherein a large number of technologies are required, and thus this problem becomes more acute. This is, however, recognised only to a degree in the literature, for instance when it is noted that ‘only an unknown few’ will ultimately succeed.\textsuperscript{167}

However, this recognition introduces its own problems. For instance, when Grübler \textit{et al} choose to treat only of a radical-technology aggregate, rather than a specific technology, they are doing so as a result of this issue. However, it means that their 30\% learning rate, ‘which is consistent with historical experience,’ cannot be informed by any specific information related to the technologies likely to be used. It must instead be based solely on experiences which were themselves facilitated to a tremendous degree by invention. To put this latter more clearly, we are being invited to imagine a process wherein the energy efficiency of a given technology improves simply due to greater familiarity. Of course, part of the gain from familiarity is the recognition of places where existing, but not yet utilised, complimentary technologies might play a role in further increasing efficiency. This is then amalgamated into a historical rate of learning-by-doing. Of course, the complementary technologies upon which this rate is based have already been applied to, say, photovoltaic cells, which is referred to as an example. In other words, this, or any comparable technology, such as wind-turbines, will have already benefited from the improvements in energy grids, the application of computing, upgrades in power management and so on, that led to these learning rates being achieved in the first place. Hence, the expectation must be that a continuous stream of inventions with a similar effect will prevail over the

\textsuperscript{166} Edmonds \textit{et al}, \textit{Op. Cit.}, p. 22
next century, just as they did over the previous one. However, given this fact, we must recognise that radical technologies as they are today and radical technologies of the past are at entirely different levels. First of all, like all technological processes, there is the certainty of a low-hanging fruit problem. That is, those working with the technologies have learned from previous technologies how to effect greater efficiencies generally and it is safe to assume that these lessons have already been applied to new inventions from the start. This means that future improvements will be more difficult to come by. More significantly, contemporary versions, such as PV cells, have accumulated the kind of additional technology improvements that could only have been imagined by the developers of their predecessors – such as microprocessors and so forth – and thus face an entirely unpredictable, and presumably much slower, rate of development. In other words, it is assumed that new low-carbon technologies are comparable in terms of their level of development (and thus what additional levels of improvement we can expect) with previous energy technologies when they were at a similar stage of usage and had been worked on for a similar period of time. However, since all the lessons learned developing these predecessors will have been incorporated into new technologies from the start, they are in fact far more developed than their predecessors at a similar stage. Indeed, to a great extent, they ought to be viewed as relatively developed. Hence the only way they can be deemed to be at similar stages in their development, thus allowing learning rates to be applied, is if similarly tremendous complimentary technologies, and general efficiency learning, is to continue into the future. Yet given, as discussed and widely admitted by the literature itself, the completely unpredictable nature of invention, this renders the rates themselves inherently unreliable. In the end then, what we are seeing is the fact that, in the first instance, the success and failure of technology is remarkably
difficult to predict and, in the second, that invention must play a tremendous role in any attempt to model it.

None of the above, however, should be read as an argument denying any hope of a technological fix. However, this is, in the final analysis, a question of plausible policy, and there must come a point at which risk—particularly involving the unknown and unknowable, as Ulrich Beck has argued extensively—increases to a level at which the policy is quite fairly adjudged to be reckless. The remarkable thing is, however, that the larger part of this uncertainty is explicitly noted in the modelling literature, even if not to the full extent of invention’s hidden role. Still, it is certainly recognised, as noted above also, that ‘of all the aspects of technological development, the process of invention is least well understood, and even less well predicted.’ Moreover, the necessity of invention to the futures described is also generally well-understood: ‘real-world inertia suggests large obstacles in implementing climate policy in a world without major technological breakthroughs,’ though the timing and character of these are ‘still shrouded in mystery.’ Hence we can see that the difficulties presented by technological lock-ins are well-understood, as indeed is the path-dependence quandary discussed earlier. Most importantly, the scale of the challenge has not gone unnoticed: ‘the amount of energy generated with the emission of fossil carbon needs to increase by something like a factor of ten.’ However, disparities between modelling approaches are rife, with wildly varying estimates of the autonomous rate of change ‘often the single largest source of difference among predictions of the cost of achieving given policy objectives,’ while amongst those who favour

\[^{168}\text{Ulrich Beck (1992), Risk Society: Towards a New Modernity, London: Sage}\]
\[^{170}\text{Jansen, Op. Cit., p. 23}\]
\[^{172}\text{Ibid., p. 262}\]
\[^{174}\text{Jaffe et al, Op. Cit., p. 463}\]
endogenous change it is accepted that ‘the mechanisms by which this happens and the strengths of the effects not yet clear.’\textsuperscript{175} Indeed, even the evidence on R&D is described by a proponent as ‘mixed, partly because of the difficulty of measuring the output of the basic research process.’\textsuperscript{176} It is unsurprising, therefore, that the IPCC would describe the various models it surveys as having ‘a weak empirical basis and often conflicting’\textsuperscript{177} or state regarding technological change itself that the ‘process is fundamentally uncertain: outcomes cannot be predicted.’\textsuperscript{178} It was in explicit response to these problems that, as noted earlier, the IPCC chose to employ scenarios without reference to probability. However, in spite of all this, we cannot help but remember the very substantial agreement across these scenarios regarding the extent of future, non-policy, technological development and its enormous impact on emissions reductions. Moreover, when attacked on this very point, the lead author of the Third Working Group’s contribution to the Fourth Assessment Report responded that:

The embedded technological change in the reference scenarios included in the IPCC’s Special Report on Emission Scenarios was based on historical information. The assumptions about the rate of technological change in these scenarios have been thoroughly reviewed and are accepted by the community of technological-change experts. They confirm well-known facts about, for instance, the enormous improvements in computers over much shorter time-frames than expected. The assumptions also reflect that high economic growth normally goes hand in hand with high rates of technological change.\textsuperscript{179}

I have addressed the historical point already and will just point out the obvious fact that supporting a claim by reference to expert opinion based on an example where expert opinion was wrong, is not enormously persuasive, even if it could be reasonably argued that the development of computers can be extrapolated to fit utterly different technologies. This

\textsuperscript{175} Kohler, \textit{Op. Cit.}, p. 35
\textsuperscript{176} Jaffe et al, \textit{Op. Cit.}, p. 473
\textsuperscript{177} IPCC (2007), \textit{Op. Cit.}, p. 93
\textsuperscript{178} SRES, \textit{Op. Cit.}, p. 140
\textsuperscript{179} In Schiermeier, \textit{Op. Cit.}, pp. 508-9
latter point betrays a lack of understanding regarding the heterogeneity of technologies, which is indeed pervasive in the literature. However, it is the argument that we can accept these predictions because they are based on expert findings, despite the fact that these findings are so qualified by those very experts, which is most puzzling. Indeed, this tension is prevalent in nearly every technical paper published on the subject. For instance, Grübler, Victor and Nakićenović, the latter of whom is a major contributor to the IPCC’s Third Working Group and the lead author on the upcoming Fifth Assessment Report, assert very strongly the robustness of their research on photovoltaic (solar) technology’s potential,\textsuperscript{180} and yet elsewhere maintain that ‘although technology is central, technological change is typically among the least satisfactory parts of global-change modeling.’\textsuperscript{181} How can this seeming disparity be explained?

We can, perhaps, understand how by analysing an article written by Nakićenović himself. Entitled ‘Freeing Energy from Carbon,’ the article is one of the few published in a non-technical journal – in this case, with some poetic irony, \textit{Daedalus} – by a major IPCC figure. The article betrays a deeply-held faith in the decarbonisation of economic growth, to a degree that belies the practical relevance of the ubiquitous “uncertainty” reservations one finds in technical papers. Decarbonisation, for Nakićenović, is more than simply an achievable policy option; instead it is ‘emblematic’ of the energy system’s ‘entire evolution.’\textsuperscript{182} To be sure, he supplies sufficient evidence to make the case that decarbonisation is a definite trend – although, over the historical time-scale he describes, this is hardly controversial – and notes the potential of many lower or non-carbon producing energy sources. Some of these have lost their lustre in recent

\textsuperscript{180} Grübler \textit{et al} (1999B), \textit{Op. Cit.}, p. 254
\textsuperscript{182} Nakićenović (1996), ‘Freeing Energy from Carbon’ in \textit{Daedalus}, Vol. 125, p. 96
years (biofuels)\(^{183}\) or have proven spectacularly overhyped in the past (nuclear fission and fusion), but he leaves us in little doubt that, regardless of which technologies are ultimately successful, our time of arrival at ‘the non-carbon future’ is broadly knowable.\(^{184}\) There is a circular logic to this entire argument though. Rates of historical decarbonisation are used to justify the idea that low-carbon technologies will develop in line with economic need, since further decarbonisation would definitely require their deployment. At the same time, the justification for the expectation that this decarbonisation trend will continue is the existence of low-carbon technologies which could conceivably allow it to do so. The causality here can only work one way: low-carbon technologies may allow decarbonisation to continue – though they are themselves dependent for success upon increases in their cost-effectiveness – but the reverse can be premised only on some idea that decarbonisation is “meant to be.” Indeed, there is a definite teleology about the piece. Nakićenović at one point describes how methane can serve as a bridge to the carbon-free sources of energy which ‘would conclude the global trend towards decarbonisation and the resulting major transformation of the industrial ecosystem.’\(^{185}\) Again, the exact technologies might be uncertain, but in case we are in any doubt, he reassures us that ‘decarbonisation has asserted itself already as a widespread, long-term development, driven by deepening, strengthening forces.’\(^{186}\) Finally, it should be noted that this prediction is repeated in co-authored technical papers.\(^{187}\)

There is, it must be noted, more than a touch of historical naïveté to this prediction, as indeed there is with all teleology. Time has abandoned many


\(^{185}\) Ibid.


a vaunted trend, be it class revolution or the triumph of liberal democracy. There are, of course, many possible “ends,” and the possibility of no knowable end at all. Trends can level off or even reverse themselves, as has indeed been the case with decarbonisation recently. Invention, as all the modellers have noted and then ignored, is a wildly unpredictable phenomenon. Nevertheless, it is worth remembering how Neil Postman, the much-revered sociologist of technology, wisely put it, ‘anyone who has studied the history of technology knows that technological change is always a Faustian bargain: Technology giveth and technology taketh away, and not always in equal measure.’ Does this, however, bring us any closer to understanding how assumptions regarding technological change that are repeatedly qualified and downplayed, can also be so strongly defended as scientific projections? The only sensible answer is that the degree to which uncertainty is assumed is much less great than one might imagine from the statements above. In other words, while the exact degree of technological change is in doubt, that the required technologies can indeed be expected is not. This is recognisable in the nature of the scenarios themselves: the degree and, crucially, the direction of technological change alter in direct proportion to the political realities in play. The meaning of this, whether conscious or not, is that the power to change technology in the ways we require is very much in our hands, regardless of the amount of admittedly unpredictable basic research and invention that may be involved. Indeed, this is perhaps the only way that scenarios make sense as an approach: there would be little point to outlining merely “conceivable” futures. Yet even beyond this we can see an understanding of technological change that is entirely at odds with Postman’s observation: it is not a capricious,

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unpredictable force, but rather a deliberate, systemic and harmonious actor, the willing and tireless subject of human need.

Nevertheless, and to conclude, we should bear in mind that qualifications regarding uncertainty can only go so far before they reach a point wherein the uncertainty is far too great for a particular approach to be considered viable. Clearly, by the very existence of the reports, the modellers do not feel that this point has been reached. Instead, while they recognise that their predictions are tenuous, we must assume that on the whole they have faith in them. This is made clear by the Nakićenović article. While the IPCC might insist that uncertainty has led it to prudently refuse to predict, underneath that prudence lies a very significant optimism in the future pace and direction of technological change. As we have seen, the assumptions are themselves based on a tremendously dubious characterisation of how invention operates, one that originates in the basic theory provided by the economic growth literature. This latter preceded recognition of the problem of climate change but, as the status quo at the time, found itself applied to the problem or made to fit it. A distinct rationality about how technological change operates is evident in the IPCC’s work, one imbued with a discernible optimism.

Without investigation into the nature of the theory underpinning it, this distinct rationality will be hard to grasp fully. Further research, therefore, must involve a genealogy of the conceptualisation of technological change within this literature. The next chapter will examine how this might proceed, comparing it with an alternative approach, one that would instead read the problem as an ideological one. In any case, as long as this conceptualisation remains scientific – isolated from its historical origins – its claims to truth will be very difficult to challenge. Finally, and to return to our starting point, it is vital to recognise that there were, and remain, other policy options, including major lifestyle changes or a simple declaration of
technological change’s essential unreliability, which would let the debate about how to tackle the problem of climate chaos take a realistic course. That this was eschewed in favour of a belief in human ingenuity says something about the approaches: it was felt that this was a knowable quantity and that therefore the approach was practical.

The term “radical” almost necessarily invokes an idea of redundancy. That act which can be painted as “radical” is nearly by definition excluded from “sensible” political discourse. Hence we must pay very close attention to any purportedly scientific process during which particular courses of action are deemed radical and others, by the same means, are granted “pragmatic” status. To this end, I first analysed the scenarios the IPCC provide by way of policy advice, noting the very extensive role they reserve for technological change: that of reconciling economic growth with environmental sustainability. In order to grasp how this position was reached, I then examined the modelling processes that underpin it, noting the determining influence of neoclassical growth theory in shaping how technological change is modelled. I then showed how invention, despite being recognised as fundamentally unpredictable, still occupies an indispensable position in making the projections possible. The inherent contradiction in the entire approach, where uncertainty and confidence are both repeatedly stressed, was then discussed. From this it becomes apparent that a very particular rationality is in play, one that involves a conception of technological change that necessarily produces strikingly optimistic conclusions. Wrapped in the cloak of science, this rationality requires its historical particularity to be reintroduced; only in this way can the site of resistance be moved to a neutral location. Nevertheless, the argument presented above is designed to problematise what is currently considered pragmatic insofar as climate change mitigation is concerned, with the effect that previously radical environmental discourse can now re-
enter the political fray washed of its pestilential air. Meanwhile, space is opened up to analyse those previously mainstream recommendations with a view to reapportioning the tag of “radical” to perhaps more deserving candidates.
Chapter Three

The Problem of Progress: Habermasian and Foucauldian Methodological Approaches

This chapter is about the problem of progress and two alternative ways of addressing it. It looks at the work of Jurgen Habermas and Michel Foucault with the aim of teasing out which provides the more appropriate methodology for a critique of the technological optimism found in the major western climate change policies. It is shown that Habermas would sweep this latter problem into his general critique of scientific-technical progress as an ideology, whereas Foucault would try to understand what made this individual progressive claim possible. Ultimately I argue that in his attempt to save ‘the project of modernity,’ Habermas renders this kind of progressive claim immune to his critique. Foucault’s genealogical approach, on the other hand, is shown to avoid this failing precisely because he rejects the understanding of modernity that illuminates Habermas’s work. I also show that the failings Habermas ascribes to Foucault’s method are the product of a misreading of Foucault’s relationship with the Enlightenment and thus, finally, that a Foucauldian methodology is not only the more appropriate, but well-suited to undertake this kind of critique.

I begin by discussing Habermas’s critique of modernity and show that, while it might be appropriate on the surface, it ultimately fails to offer any insights into the problem of technological optimism within climate change policy. I then examine his critique of Foucault, but conclude that Foucault can avoid Habermas’s charge of crypto-normativism. This feeds into my

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outline of Foucault’s approach, drawn in contrast to Habermas’s, showing how the former can meet the challenges over which the latter stumbles. I argue that a Habermasian methodology is always potentially problematic for a critique of progress due to its desire to retain substantial progressive claims of its own. Finally, I outline the Foucauldian approach that underpins the rest of the thesis.

Habermas’s critique of progress is really an attempt to rescue it. Of all the Frankfurt School’s major scholars, he strays least from the optimism at the core of the Enlightenment project: the idea that reason is our servant in creating a better world. With Adorno, Horkheimer and Marcuse, he thinks that reason has become something other than what was imagined it would be: it has become the root cause of a technological domination of both man and nature that has withered earlier dreams regarding its emancipatory potential. Unlike them, however, he does not think that reason-as-rationality has consumed the ethical dimension of society; rather it has rendered it irrelevant, particularly insofar as government and politics are concerned. His life’s work can thus be seen as an attempt to explain how this irrelevance come about, the exact nature of it and how it might be reversed, placing mankind’s feet firmly back on the road to emancipation. For Habermas, the concept of progress has been subverted and used to justify domination, but that does not mean that modernity is a fatally flawed movement, simply that it has lost its way. Habermas’s critique of progress, therefore, is designed not merely to disparage the emperor, but to clothe him anew.

The heart of Habermas’s critique of progress is found in his early essay ‘Technology and Science as “Ideology.”’ Naturally, the theme of progress is one upon which Habermas has an awful lot to say in all of his publications. However, in this essay he focuses on technology much more

centrally, as Feenberg has also noted,\(^\text{192}\) and the parts of this essay that respond most directly to the notion of technological optimism are not substantially elaborated upon in his magnum opus *The Theory of Communicate Action*. That said, I do draw on additional works by Habermas where appropriate. In this early essay, though, he sets as his point of departure Marcuse’s work on rationalisation and society, inspired itself in the first place by Weber but also by other Frankfurt School thought of the first generation. Marcuse’s point is that, rather than simply increasing the number of areas of human life guided by rational (as opposed to traditional/mythical) principles, the rationalisation that Weber identified in fact involves a particular kind of rationality, an inherently dominating kind where human autonomy is viewed in the same light as an autonomous part in a machine might be: unnecessary, sub-optimal and potentially destabilising. In other words, the rationality employed is increasingly a technical kind of rationality (as opposed to an ethical kind), operations using which Habermas calls ‘purposive-rational action.’\(^\text{193}\) Habermas follows the Weberian tradition by distinguishing between three kinds of rationality: the technical rationality as described above, which is often called instrumental rationality and forms the basis of purposive-rational action; moral/ethical rationality which Habermas feels is derived from communication and which he often refers to as ‘practical;’ and aesthetic rationality, the subjective rationality of art and artistic argument which he derides when associated with postmodern politics.\(^\text{194}\) The logic of instrumental rationality is decidedly controlling: ‘it requires a type of action that implies domination, whether of nature or of society.’\(^\text{195}\) This begs the question that drives both the Marcusian and Habermasian critiques: how

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does this domination persist? The answer is that economic growth, coupled with technological advancement, serves as a means of legitimating domination and also of clouding it. As Habermas puts it, ‘the existing relations of production present themselves as the technically necessary organisational form of a rationalised society.’ People come to believe that progress can only be understood in the sense of material well-being and further, that any deviation from a ‘purposive-rational’ organisation of government would jeopardise this progress and would thus be of little merit. Autonomy is therefore curtailed and ethical reflection excluded all in the name of progress. For our purposes, it is worth pointing out the role of technological optimism in this matrix: embedded in it is the idea that man in fact can dominate nature and that instrumental rationality is our means towards the technologies that will continue to make this possible.

Thus far Marcuse and Habermas are in agreement, the latter drawing deeply on the former’s analysis. The point upon which Habermas’s discussion of the elder Frankfurt theorist becomes critique is the nature of instrumental rationality, which Marcuse terms “technology” (understood broadly). Both see the triumph of this rationality as leading away from emancipation; that it is not the best means to enhance the lives of the people it serves. They disagree, though, on the level at which this triumph is ultimately founded. For Marcuse, scientific-technical rationality itself is imbued with a changeable nature. It tends towards domination because it is ideological in its very essence (this essence has been dialectically constructed). Thus the logic which ultimately leads humanity and nature to be dominated enters at the level of instrumental rationality and can only be removed at this level; a malignant form of rationality itself autonomously causes the domination of man. Habermas rejects this and

196 Ibid., p. 83
197 Ibid., p. 82
198 Ibid., p. 86
follows Gehlen by arguing firstly that this dominating tendency is fixed within instrumental rationality by its very purpose – as a response to intrinsic human limitations, it cannot change as long as the capacities of the human as a creature remain fixed\textsuperscript{199} – and secondly, that it does not function autonomously, i.e. devouring other rationalities with no other cause than its very nature (the latter being, for his predecessors, a manifestation of human nature).\textsuperscript{200} He is unwilling to engage in this kind of metaphysical speculation. Instead, the level at which a sub-optimal organisation of human affairs becomes entrenched, for Habermas, is when instrumental rationality becomes the state ideology. In other words, it does not suffer an invasion of ideology; rather it becomes an ideology itself. His position here is very nuanced: he is not arguing that instrumental rationality is devoid of effect except insofar as it is used (i.e., that it is a neutral tool); rather he argues that it ‘characterises the growing potential of self-surpassing productive forces which continually threaten the institutional framework and at the same time, set the standard of legitimisation for the production relations that restrict this potential.’\textsuperscript{201} There is a lot in this quote that must be teased out and, for the most part, this shall be done below, however, broadly speaking, what Habermas is telling us here is that instrumental rationality is seen as the essence of the system of production which has made, and seems likely to continue to make, such significant improvements in material well-being. In a state where tradition has been decimated as a legitimating force by the ascendancy of this essence, scientific-technical progress steps in to fulfil this role. Instrumental rationality, therefore, does not become the dominant decision-making metric as a result of an internal logic, but rather because of a particular historical process. It is the beneficiary of the rise of “progress,” not the

\begin{itemize}
\item \textsuperscript{199} Ibid., p. 87
\item \textsuperscript{200} Theodor W. Adorno and Max Horkheimer (1997), \textit{Dialectic of Enlightenment}, London: Verso, p. 54
\item \textsuperscript{201} Habermas (1970), \textit{Op. Cit.}, p. 89
\end{itemize}
cause, and it can be considered non-neutral only in the sense that it has a bias that encourages people to judge the optimality of a course of action by reference to criteria which leave out the ‘practical’ (normative). Habermas’s project then comes to be the explanation of how this standard became the gold one, how instrumental rationality became the rationality with the most credit in the eyes of humanity. We shall now look at this in order to fully understand the form of Habermas’s critique of progress and thus the approach to technological optimism that logically follows from his work.

First of all, it will make things clearer later on if we take some time now to discuss Habermas’s ontology. The focus of his critique is very much the state, which is characterised by its ‘institutional framework.’ This latter is perhaps easiest understood as the actualisation of an agreement amongst the people of the state about how it should be organised, though of course this should not be thought of as necessarily a free or fully rational agreement. Embedded in it are the class structure, the overarching systems of politics and economics and so on. It is itself guided, or should be and has been, by communicatively agreed upon social norms, but it contains within it subsystems, such as the economic system, which typically involve purposive-rational action, meaning, of course, that they are governed by instrumental rationality. These are not the only kind of subsystems though, ‘family and kinship structures’ are subsystems also, but these are not important for our purposes. Of course, the norms which govern the institutional framework require legitimation; people need reasons to support any particular framework. In pre-modern societies, this legitimation was provided by myth, religion and various other sorts of dogma. For Habermas, traditional societies ‘exist as long as the development of subsystems of purposive-rational action keep within

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202 Ibid., p. 83
203 Ibid., p. 92-94
204 Ibid., p. 93
the limits of the legitimating efficacy of cultural traditions.\footnote{Ibid., p. 95} Hence, once instrumental rationality is given scope to escape from its subservient place and challenge tradition, we have the beginnings of modernity. Initially, of course, this was a bourgeois capitalist modernity which employed ‘a relation of communicative action as the basis of legitimation,’ that is, the notion of justice-as-reciprocity or free and equal exchange in the marketplace.\footnote{Ibid., p. 97} Therefore, rather than having a political system justifying the relations of production, the latter now justified the former. Legitimation which was formerly top down (culture) thereafter became bottom up (work).\footnote{Ibid., p. 99} According to Habermas, this could not last, but it did set a new trend for ideologies: they must now appear ‘in the mantle of modern science,’ and denounce pre-modernity as ideological.\footnote{Ibid., p. 101}

The disintegration of ‘the ideology of just exchange’\footnote{Ibid., p. 100} was almost foreseeable insofar as Habermas explains it. Marx had identified and critiqued the ideological content of bourgeois political economy but the death-knell was really sounded by its failings in practice.\footnote{Ibid., pp. 100-101} These ushered in a new kind of liberal capitalism, our current model, one where the state’s central function is to step in to shore up the economy in periods of crisis and where it enters into a relationship with science and technology which results in the institutionalisation of the latter in order that its advancement is quicker and more assured. Science and technology, for Habermas, are thus embedded within the institutional framework as opposed to being simply a product of work in the economic substructure.\footnote{Ibid., pp. 102-105} The first of these trends leads to the invalidation of Marx’s approach: the critique of society through political economy, which had been necessary when the
base defined the superstructure, is no longer so when the economy is significantly determined by government.\textsuperscript{212} However, this new kind of politics faces a new problem: the old-style had been forced for the purposes of legitimation to define itself in relation to a moral goal, usually some conception of the “good life.”\textsuperscript{213} This new kind of politics has a ‘peculiarly negative character’ however, because it is aimed not at practical goals but rather ‘the solution of technical problems.’\textsuperscript{214} This leaves it with a new difficulty: legitimation. Without any practical goals justifying the institutional framework, there is nothing to bind the masses to it. This is where the second trend, the institutionalisation of science and technology becomes important.

To explain: once upon a time, the potential of technology and science was still clearly linked to work, as opposed to interaction. Now though, with its institutionalisation, this potential has taken on a form which results in men forgetting the difference between work and interaction: ‘with the institutionalisation of scientific-technical progress, the potential of the productive forces has assumed a form owing to which men lose consciousness of the dualism of work and interaction.’\textsuperscript{215} Hence interactive/communicative rationality, which should govern the institutional framework and always had until this point, is replaced by instrumental rationality in the social sphere generally. How does Habermas argue this claim? He starts by stating that ‘social interests’ still determine the speed and functions of technological change.\textsuperscript{216} However, these interests now define the whole social system so much that they effectively become the interest that wants this social system to continue (there was presumably once a separation here) – the technical interest becomes the same

\textsuperscript{212} Ibid., p. 10
\textsuperscript{213} Ibid., p. 103
\textsuperscript{214} Ibid.
\textsuperscript{215} Ibid., p. 105
\textsuperscript{216} Ibid.
as what might be called the *survival interest*. As a result, how capital is used privately and questions about a more equal distribution of profit are no longer considered important to the survival of the social system – only the progress of technology is important in that regard. These former, that apparently ‘guarantee’ the loyalty of the masses, are thus never discussed any more.\textsuperscript{217} We must assume that they are forgotten about for the most part by that class that should be most interested in them. With all other elements removed, progress in science and technology is thus the only variable upon which economic growth, the most important desired outcome of the entire system, appears to depend. Then we have the single most significant sentence in the essay: ‘(thus) arises a perspective in which the development of the social system seems to be determined by the logic of scientific-technical progress.’\textsuperscript{218} This is not at all an adequate sentence from which to be entirely clear on the exact process Habermas is describing, but it appears to be saying that, given how the entire social system is geared towards scientific-technical progress, how its ongoing existence seems to be dependent upon this, its proper governing rationality gets smothered by instrumental rationality. If the social system is merely a support for technical-scientific progress, then it must, in the minds of the masses, be governed by the same rationality. Habermas then moves on to assert that ‘(the) immanent law of progress’ seems (to everyone) to involve demands which any instrumentally-guided political system must obey.\textsuperscript{219} In other words, once we have given ourselves over to the rationality of scientific-technical progress, it will require us to do things which, by that rationality, we must do. This means that rigorous and informed discussion about at least a significant amount of the decisions made by government, are

\begin{footnotesize}
\begin{enumerate}
\item \textsuperscript{217} Ibid.
\item \textsuperscript{218} Ibid.
\item \textsuperscript{219} Ibid.
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deemed unnecessary and potentially dangerous: we must obey the strictures of progress, so no discussion is needed.

Finally we reach Habermas’s conclusion: through this chain of events scientific-technical progress becomes ‘a background ideology that penetrates into the consciousness of the depoliticised mass of the population, where it can take on legitimating power.’\textsuperscript{220} This is what is meant by scientific-technical progress functioning as an ideology. In sum, because politics took on the role of changing scientific-technical progress from, in Habermas’s words, ‘sporadic inventions, which, while economically motivated, were still fortuitous in character’\textsuperscript{221} into something more predictable (Habermas is very unclear on how “bottled” we can now consider invention to be) it is demanded of a social sphere now thinking instrumentally as opposed to communicatively, to tend to this system in the functional way it necessarily requires, without need for ongoing discussion and consent. The ideology of scientific-technical progress is thus responsible for detaching ‘society’s self-understanding from the frame of reference of communicative action and from the concepts of symbolic interaction’ and replacing it ‘with a scientific model.’\textsuperscript{222} Men, therefore, self-reify under categories of purposive-rational action, and the culturally defined self-understanding, which had existed previously, is forgotten. Indeed, this sphere of ‘linguistically mediated interaction’ is dissolved by instrumental rationality and the difference between the two is lost to everyone. For Habermas, the ‘concealment of this difference proves the ideological power of the technocratic consciousness.’\textsuperscript{223} Moreover, it facilitates man’s self-objectification as machine-like and thus his

\textsuperscript{220} Ibid.
\textsuperscript{221} Ibid., p. 104
\textsuperscript{222} Ibid., p. 105
\textsuperscript{223} Ibid., p. 107
domination within a state and society governed by instrumental rationality (which is, as we remember, antithetical to autonomy).²²⁴

Let us briefly re-state, then, the over-riding argument of Habermas’s essay. The process of domination, unlike with Marcuse, Adorno and Horkheimer, is not an autonomous one where rationality comes to consume other forms of reason, but is rather a process begun by a concrete action: the institutionalisation of the scientific-technical process. This is an important point, not least because it means that, in relatively straightforward way (by comparison to his Frankfurt predecessors), this is a development that can be reversed. However, from the point of view of this chapter, it is important because it means that in contemporary modernity, the level at which the concept of technological progress becomes a problem, and thus needs to be critiqued, is the ideological. Habermas is clear that this progress, even conceptually, only begins to direct us away from emancipation at the point at which it begins to function as an ideology. As he says, scientific-technical rationality ‘can be a potential for liberation if and only if it does not replace rationalisation...at the level of the institutional framework,’ a scenario only made possible by its establishment as an ideology.²²⁵ It is the ideological level at which an institutional framework dominated by instrumental rationality is ‘made plausible’ to the masses,²²⁶ thereby allowing it to move beyond its potentially liberating role. This ‘technocratic consciousness,’ engendered by the ideology, is different from previous ideologies, however, in a very important way: it is not ‘a rationalised, wish-fulfilling fantasy.’²²⁷ In other words, it does not work by misleading a particular class into accepting the status quo. It is not purveying untruths about what is this class’s “real” interest. Instead, it functions merely by severing ‘the criteria for justifying the organisation of

²²⁴ Ibid., p. 106
²²⁵ Ibid.
²²⁶ Ibid., p. 104
²²⁷ Ibid., p. 111
social life from any normative regulation’ by virtue of the fact that its governing rationality – the instrumental variety – is intrinsically incapable of allowing into consideration this side of life.\textsuperscript{228} Therefore, as an ideology that creates a consciousness also governed by this rationality, it simply renders ‘practical interest’ invisible by its very nature.\textsuperscript{229} However, the direct result of this move to rehabilitate instrumental rationality is the neutering of any putative Frankfurt School critique of technological optimism. What follows is an explanation of why this is the case.

It seems likely that modern economics, for Habermas, would be biased by the governing ideology in the same way as the previous ideology colonised classical economic theory: from natural law into Smithian economics, as Habermas has it, the ideology of the self-regulating market was made scientific, until attacked by Marx, who showed up its ideological content even as it began to collapse in practice.\textsuperscript{230} Indeed, in \textit{Theory and Practice} Habermas states that the social sciences ‘no longer proceed hermeneutically, but rather analytically. They can furnish technical recommendations for effective instrumentalities, but can no longer normatively give any orientation with respect to the goals themselves.’\textsuperscript{231} In this way the ideology of the modern state, wherein just exchange is replaced by technical reason itself as a legitimating force, seeps into economics. This ideology tells us that only by the organisation of society along the lines of purposive-rational action can the best possible material well-being be ensured, if not material well-being altogether. If we do not make all problems technical problems, all decisions of the state by reference to instrumental rationality, then we shall sacrifice our well-being and progress will be less, or no more. Technical reason itself, however, does not tell us this, it merely harbours the dominating logic, of either man

\textsuperscript{228} Ibid., p. 112
\textsuperscript{229} Ibid., p. 113
\textsuperscript{230} Ibid., p. 101 and also Habermas (1973), \textit{Theory and Practice}, London: Beacon, p. 110
\textsuperscript{231} Habermas (1973), \textit{Op. Cit.}, p. 114
or nature, by its very structure. Hence, this ideology, now embedded in economics, leads to a scenario wherein the only really conceivable course of action is a technical one, the only attitude to nature that can be employed is one of domination. Any other course of action, according to the ideology, would sacrifice our well-being. However, to explain technological optimism we must make an additional leap, from the domination of nature as a general truism, to the ability to dominate specific natural problems whenever the need arises. This potential analysis, however, contradicts an important point of Habermas’s general thesis: that unlike the previous ideology, this one simply functions as a means of clouding the possibility of governmental decision-making being made by reference to an alternative rationality, namely the practical kind that exists within spheres of communicative rationality: ‘the new ideology is distinguished from its predecessor in that it severs the criteria for justifying the organisation of social life from any normative regulation of interaction, thus depoliticising them. It anchors them instead in functions of a putative system of purposive-rational action.’232 As we have seen, Habermas is arguing that, unlike its predecessor, the ideology of modern capitalist societies does not make any false claims regarding its own capacities. It does not say, unlike the bourgeois capitalist ideology that preceded it, that the system it is supporting is both just and autonomous – it is not grounded in natural law or myth – but rather it eschews all normativity and works by referring the minds of the people towards a particular kind of rationality, instrumental rationality, thereby clouding the importance of the normative by virtue of the narrowness of the rationality it is elevating. This is because technical rationality, for Habermas, does not have an ideology

232 Ibid., p. 112
supporting its ascendancy *per se*, it ‘also take(s) on the role of an ideology’ itself.\textsuperscript{233}

As a result, we do not have a misleading ideology, simply a rationality functioning as an ideology which, naturally, cannot see beyond its own fetters; in this case, an instrumental approach to government. Habermas is even unwilling to deny the veracity of the claims to progress that purposive-rational action advances: he does not think, as Marx did, that technology could be used more productively were it not for the ruling ideology; merely that we are not allowed sufficient choice over how we might want technology to be employed.\textsuperscript{234} In short, Habermas accepts a tremendous amount of modernist orthodoxy. We would do well to remember at this point that besides Critical Theory, Habermas is also heavily influenced by American Pragmatism and this, perhaps, has made him unwilling to engage in the kind of metaphysical reasoning that characterised the approach of his predecessors. In any case, we are thus allowed only two logical conclusions from Habermasian thought insofar as the problem of technological optimism is concerned: that economics is correct in its claim that we can invent our way out of environmental problems, at which point Habermas’s work is no longer useful as a critical methodology, or it is incorrect, requiring us to engage in an examination beyond that offered by Habermasian Critical Theory, since it becomes a problem not of a central, dominating rationality, but rather a flaw of some kind within the discipline itself. We can see, therefore, that Habermas’s innate conservatism, his unwillingness, in contrast to Marcuse, to insist upon the ideological content of the rationality itself, has come back to haunt him. That the ideology might direct us towards solutions that try to control nature is perfectly plausible under his schema; that it would

\textsuperscript{233} Ibid., p. 104
\textsuperscript{234} Ibid., p. 119
necessarily find that nature can always be controlled is not, or at least not
without an amendment to his theory which argues for an inherent unreason
or mythology (a step back towards Adorno and Horkheimer) within
instrumental rationality itself. Given Habermas’s epistemological adherence
to the mores of analytic philosophy, this element is unlikely to appear and
difficult to imagine. We must therefore conclude that a Habermasian
explanation can do little or nothing to illuminate the problem at hand. His
methodology, which at first glance would seem to explain technological
optimism in climate change policy as yet another manifestation of a
governing, universal ideology of technological progress, is in fact unable to
critique the particular emanation within the social sciences that leads
directly to this policy approach.

There is at least one critique of Habermas’s position on the question of
progress from within the Critical Theory tradition, however, which seeks to
salvage his work from this sort of irrelevance. Andrew Feenberg reads
Habermas’s account as one in which “pure” instrumental rationality is
increasingly the metric by which public decisions are made. Feenberg
responds that this is too simple and that all decisions regarding, say,
efficiency must refer to values and objectifications which are themselves
determined by society.235 In other words, the purity of rationality lasts right
up to the instant it is applied; once theoretical, empty, determining objects
are replaced by real, socially constructed ones, the process of rational action
is determined in accordance with them. Feenberg thus sees Habermas’s
critique as being wide of the mark – that the rationality/progress Habermas
critiques is in fact never operational – and instead sets out to make these
objects emancipatory ones by ‘reversing (their) biases,’ as he would have
it.236 We can see that he is very close, though he never goes quite that far,

235 Feenberg, Op. Cit., p. 52
236 Ibid.
to rejecting the notion of a universal rationality altogether.\textsuperscript{237} His failure to do so in fact renders his critique null however. Firstly, though, it is difficult to imagine that this line of critique did not occur to Habermas. It seems likely that he would respond by pointing (from his perspective) to the cavernous gulf between the results of an instrumental decision-making framework, even determined by these social objects and values to whatever degree, and a “practical” or moral framework determined by the same. In short, he could logically respond that social objects only shape the rationality so far. For instance, from Habermas’s point of view climate change policy would likely be understood as governed by instrumental rationality coiled around discursive objects like nature, humanity and the economy as they are currently understood in the mainstream, but the results of this are very different from what they would be if the rationality in play was of the communicative variety.\textsuperscript{238} The latter, of course, would only ever be possible in a world where the ideology of instrumental rationality was absent, allowing people to formulate such an approach without being driven by their mindsets to instrumental tools. For Habermas, as seen, the existing ideology is motivated by the seemingly progressive logic of instrumental rationality, which promises the control of nature and an increase in material well-being, and it results in the practical/moral being rendered redundant in more and more spheres of human action. In order to achieve truly emancipatory ends, then, the various rationalities must be balanced because the status quo places huge constraints on the potential horizon of action in any decision-making environment. However, the universal or “pure” rationality, which Feenberg disparages as implausible,\textsuperscript{239} is what functions as the genesis of the ideology.

\textsuperscript{237} Ibid., p. 50
\textsuperscript{238} That Habermas is aware of the mediating role played by values and objects within an instrumental framework is admitted even by Feenberg; he justifies his critique by pointing to a dubious inconsistency that seems to me based on Habermas neglecting to repeat himself. See Feenberg, \textit{Op. Cit.}, p. 53
\textsuperscript{239} Ibid., p. 45
that sustains the encroachment of purposive-rational action. Feenberg says nothing about the ideology, though, either as an influence on the framework’s increasing application or as a potential factor determining how people construct or choose the objects and values around which any framework operates. This is a fundamental part of Habermas’s work that cannot be ignored. Essentially, Feenberg’s attempt to introduce constructivism into a Critical Theory framework fails because he cannot explain why anyone would start operating in the way he suggests, reconstructing objects in an emancipatory way or including more emancipatory values into the instrumental framework, as long as the ideological fetters described by Habermas, Marcuse and particularly Adorno and Horkheimer, continue to operate. He cannot work from the bottom up therefore, as he would like to, but instead needs to address domination from the top down, just as his forebears did.

That said, and though Habermas has an obvious response to this kind of critique when framed in this way, the fact remains that Feenberg’s instincts, if not his method, are both plausible and important. Was he instead to adopt a Foucauldian analysis, which he misunderstands and then dismisses,\textsuperscript{240} he would indeed be able to, as it were, localise rationality. However, Habermas himself is famously aware of the Foucauldian challenge to his work, characterising it broadly as an ‘unyielding criticism of modernity.’\textsuperscript{241} From this basis he rejects Foucault’s claim to provide a critical methodology, arguing that having the resistance of power, and the promotion of its inverse, freedom, as the ‘normative basis of his critique,’ is contradictory, when Foucault apparently ‘sees himself as a dissident who resists modern thinking’ within which Habermas encloses entirely the idea

\textsuperscript{240} Ibid., p. 57
of freedom.\textsuperscript{242} In other words, Habermas ‘cannot accept a concept of truth that is grounded in power, because such a claim implies that all norms and standards are ultimately relative.\textsuperscript{243} As a result of this, Foucault is argued to be ‘crypto-normative’ and incapable of justifying why anyone would ever wish to resist domination, since, given the apparently value-free nature of Foucault’s work, we have no criteria by which to decide what is desirable and what undesirable. This entire line of criticism misses a very important nuance in Foucault: that his work, as Dreyfus and Rabinow tell us, is neither entirely subjective nor entirely objective.\textsuperscript{244} Foucault is not trying to establish an objective criterion like “freedom” by which to judge what most needs to be examined critically. Nor, though, is he simply expressing his own personal dissatisfaction with a particular state of affairs. The role of the intellectual, and indeed the essence of modernity, for Foucault, lies in the spirit of critique. As opposed to Habermas’s quest to reinvigorate the values espoused by the historical Enlightenment (vague as they were), for Foucault the relevance of the Enlightenment is in its birthing of this ‘attitude of modernity.’\textsuperscript{245} As he argues, ‘the thread which may connect us with the Enlightenment is not faithfulness to doctrinal elements but, rather, the permanent reactivation of an attitude...a permanent critique of our historical era.’\textsuperscript{246} One’s criteria for what one critiques is not that which can be considered objectively unfree or perniciously freedom-reducing, but rather that which is ‘a source of personal distress and social danger.’\textsuperscript{247} Presumably, it is not unreasonable to suggest that one finds the most social danger in, and hence is most personally distressed by, those practices which

\textsuperscript{246} Ibid., p. 312
\textsuperscript{247} Dreyfus and Rabinow, \textit{Op. Cit.}, p. 116
involve the most domination. Nevertheless, Foucault’s calm yet careful attention to empirical rigour prevents this from being merely the excoriation of subjective dislikes. More explicitly, as to why one would prefer freedom over domination: simply because the first produces incomparably less distress in the mature thinker who, in the spirit of modernity Foucault identifies, is very much concerned with the present situation of the world.

Habermas’s critique, though, points us to the fundamental difference between the two thinkers, which ultimately explains their distinctive critiques of progress: while Habermas is dedicated to both truth and freedom, Foucault has accepted that these are fundamentally irreconcilable. As the latter says: ‘the claim to escape from the system of contemporary reality so as to produce the overall programs of another society, of another way of thinking, another culture, another vision of the world, has led only to the return of the most dangerous traditions...we have to give up hope of ever acceding to a point of view that could give us access to any complete and definitive knowledge.’ It is this difference which leads in the end to Habermas’s inability, in contrast to Foucault, to critique the problem of technological optimism within climate change policies. This is because, for Habermas, the path to truth, as with the orthodox understanding of the modern project he has invested entirely in saving, can only be traversed by reason. Of course, Habermas is Kantian enough to accept that transcendental truth is not accessible to finite beings, but that does not prevent him from pursuing its functional equivalent: the truest. This can be achieved only in an ‘ideal speech community’, which it is the purpose of Habermas’s critique to point to and, in the right conditions, to engender. His goal is to put the three branches of reason – primarily the two with

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248 Ibid.
250 Dreyfus and Rabinow, Op. Cit., p. 110
251 Ibid., p. 110
which he is concerned however – in their right places: instrumental rationality to be confined to its compatible, indeed desired, subsystems (and given licence to dominate nature), with communicative rationality restored to the primary position it is supposed to hold.\textsuperscript{252} With this in place, the project of modernity can restart and ever more emancipation can be attained, both through the further domination of nature and, most significantly, the emancipatory conclusions of a process of politics which is governed by the appropriate kind of reason functioning at its best. Habermas, therefore, wants us to be freed from the domination of instrumental rationality but to be subject to the government of an emancipatory communicative counterpart.

This is precisely Foucault’s implicit critique of Habermasian Critical Theory. The idea that truth is emancipatory is a contradiction in terms to Foucault: truth is knowledge and knowledge is by its nature, dominating. It produces practices, ways of being and so forth, all of which constrain autonomy. As he argues in \textit{The History of Sexuality}: ‘truth is not by nature free... its production is thoroughly imbued with relations of power.’\textsuperscript{253} Claims to universality of any kind, then, are the same as any other truth claims: products of a will-to-knowledge and dangerous to freedom. In the absence of any validity for these claims that is not a part of that same dominating system of thought, Foucault cannot see any way to pursue the concept of a universal rationality; therefore he must forget the notion of an overriding malaise of our times and treat knowledge as it appears to him, embedded in discernible systems of thought which possess their own rationalities: never “reason in general”… but always a very specific type of rationality.\textsuperscript{254} Thus reason cannot be singular or universal, as these are effectively the same, and therefore, if we are to characterise anything as

\textsuperscript{252} Habermas (1981), \textit{Op. Cit.}, p. 11
\textsuperscript{253} Foucault (1978), \textit{The History of Sexuality, Vol. 1: The Will to Knowledge}, New York: Pantheon, p. 60
reason, it must be particular and hence, plural: a function of the interrelationship of knowledge, and characterising a system of thought, rather than a route to knowledge. This is why he speaks, referring to systems of thought, of ‘the forms of rationality which organise their ways of doing things.’

Thus, with Foucault, in contrast to Habermas, we might recognise something like “progress” in the spirit of critique that unsettles the domination these systems necessarily involve, and therefore allows for a little more freedom. He therefore avoids the situation in which Habermas finds himself in relation to our problem: that by preserving universal reason so that emancipatory truth can be attained, the validity of certain problematic truth claims cannot be questioned. Habermas was always trying to escape from the legacy of Adorno and Horkheimer, for whom true reason was forever lost, problematic in the first instance and eventually, and perhaps irrevocably, consumed by instrumental rationality.

In order to save universal reason, in its enlightenment character if not its enlightenment meaning, Habermas had to reject the conceptualisation of instrumental rationality on offer. He could not accept its ability to destroy any hope of emancipatory truth. For if it could be consumed by myth, both it and any hope of right reason would have to be jettisoned, which would, in his own terms, make modernity impossible. He thus had to tame it, make of it almost a tool; albeit a tool possessed of a threatening, controlling nature. He achieved this by restoring to it its ability to claim truth, although only helpfully in its appropriate subsystems. The result of this, however, is that economics cannot be critiqued except in its own terms: it can be logically wrong or, perhaps, internally flawed in some way. It cannot, though, fall under the remit of Habermas’s critique of ideology. His pursuit of a universal reason of emancipation led him to identify a universal reason of domination as the focus of critique, but also

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forced him to redeem the latter. As a result, at least one sphere of domination has escaped beyond his grasp to critique. We must therefore conclude, alongside Foucault’s insistence that no project can pursue freedom when it also pursues truth, that Habermas’s attempt to do so also removes its usefulness in at least one significant instance. Perhaps even more notable, for the methodological concerns of this chapter, is that it pushes us very much in the direction of a localised critique of how knowledge like this came to be produced. In other words, even from Habermasian premises, we are pushed towards a Foucauldian genealogical methodology.

Overall, though, how does all this relate back to the critique of the concept of progress more generally? It is clear that both the Habermasian and Foucauldian critiques of progress flow from their relationships with the Enlightenment, and thus their conceptualisations of modernity. Habermas is much more within Enlightenment orthodoxy, and thus sees ‘the modern project’ which flowed from the period as having been dangerously side-tracked into the pursuit of a scientific-technical conception of progress, which is the major subject of his analysis. His critique of progress is thus the critique of a universal conception, into which he would fit a particular occurrence of technological optimism, without consideration of any particularity. For Foucault, the concept of progress as we have traditionally understood it, and as Habermas uses it, must be left behind. Indeed, the idea of an intrinsically dominating rationality is impossible. It exists as the counterpoint to the “good” reason, communicative in Habermas’s sense, from which truth can be derived; in effect, it arises from a conception of the significance of the Enlightenment for scholarship with which Foucault profoundly differs. While he could accept that these, obviously, can exist as ideas, they would have no necessary effect, as opposed to what Habermas believes. In other words, instrumental rationality, without its universal
status and power, ascribed to it by the Frankfurt School generally, could not be responsible for the emanation of a belief in technological progress which infiltrates all other disciplines simply as a matter of course. Rather, if instrumental thought is to be known to have had an effect, it must be contextualised within the practices and discourse under examination. Thus we cannot critique technological progress on a universal level, considering all emanations to be of a similar kind with an identical, universal, cause. Rather we must examine the specific systems of thought in which each particular instance of progress is advanced. To critique, we must show how this claim is sustained, the knowledge which made it possible and the practices which give it effect. In sum, for our purposes, we must examine the discipline of economics itself in order to discern from where its technological optimism arrived.

So far I have spoken in very general terms of what a Foucauldian approach to this problem would look like. For our final point, let us examine more specifically the conceptual tools we can draw from Foucault to assist us in our critique of the present. This must be approached carefully, however, because we do not wish to turn a useful inspiration for thought into a constricting grid of analysis into which a significantly different investigation must be fit. Indeed, Dreyfus and Rabinow, authors of a guide to Foucault's work of which the man himself approved, explicitly warn against this.257 That said, practically everyone in the social sciences is aware at this stage of Foucault’s exceptionally felicitous ‘tool-box’ quote, wherein he appears to give wholesale permission for the complete disassembling and re-appropriation of his work.258 Moreover, his own refinements, or restatements, of his own conceptual apparatus, and the general dispute over what he “meant” by any particular phrase or statement, both give whatever

258 Claire O'Farrell (2005), *Michel Foucault*, London: Sage, p. 50
further permission might have been needed for this effort. Indeed, this entire point is a cliché within the social sciences at this stage, for one can hardly count the number of academic works that note somewhere in the introduction or methodology something along the lines of “I took what I wanted from Foucault, as he said I could, and anyway, who is really sure what he meant?” I think, perhaps, there is reason to be a little less gung ho than this.

Certainly, it would probably not be helpful to pore over the practically infinite number of texts on Foucault, as well as his own extensive writings and presentations, in order to construct a definitive “Foucauldian critique,” given that anything approaching an exhaustive effort in this regard risks the sub-plot over-shadowing the plot; that is, the critique getting lost in the methodology. However, Foucault had important epistemological reasons for proceeding as he did, and to ignore them is to risk internal contradiction. For instance, any genealogy seeking to undermine the “truth” of a particular subjectification only to follow this with an account of what humans are “really like,” would be engaged in evident self-critique. This is quite an obvious example, but more subtle ones may well go undetected. Greater faithfulness minimises this risk. Moreover, it would be hard to rigidly follow Foucault’s path in this project if only for the simple reason that it does not examine a like-problem. Foucault’s concern was, primarily, with how the subject came to be constituted as such within a system of thought. Only part of this, however, is relevant for our concerns. That is, while Foucault examined the discursive and non-discursive practices that produced real bodies as particular subjects – be it through disciplinary regimes or the confessional – I am not concerned with this effect of power. Whether people see themselves as inventive beings as a partial result of economic theory is not of concern. There does not appear 259 Ibid.
to be any evidence to suggest that this might be the case, nor indeed does the critique require anything like it to be uncovered in order for it to be effective. In short, Foucault was mostly examining concrete forms of domination practiced on the body, I am examining how a particular knowledge came into being, one not directly or obviously linked to the kinds of ‘mechanisms of coercion’ that interested Foucault. Naturally, there is huge overlap – Foucault’s efforts could be said to contain my own – but the focus is different, and this naturally affects which tools are needed. Lastly, whatever about raiding his tool-box, Foucault would hardly have condoned using the spoils in the production of further domination. Hence, while there are certainly conceptual tools within Foucault’s work that the genealogy below does not employ, there is, I think, a broader spirit to his methodology, a discernible yet blurred path that I do attempt to follow.

Most fundamentally, this path revolves around Foucault’s triumvirate: power, truth and the subject. For what motivates Foucault is not the validity of knowledge or approaches to knowing, but rather the effects of power that these have. How truth functions as power in the creation of a ‘procedure of coercion,’ how the subject is constituted by this knowledge in such a way as to permit coercion, which is thereby seen as rational and efficient. As noted, my genealogy does not lead to an explicit ‘procedure of coercion;’ its effects of power are rather in the depoliticisation of the problem and the delegitimisation of alternative approaches to it. What guidance, therefore, does Foucault provide? At its broadest, a Foucauldian critique is ‘a history of the present,’ a strategic use of history that assists contemporary struggles (such as those around climate change). As Dean tells us: ‘A history of the present is concerned with that which is taken-for-

261 Ibid., p. 47
262 Ibid., p. 59
granted, assumed to be given, or natural within contemporary social existence, a givenness or naturalness questioned in the course of contemporary struggles.\textsuperscript{263} The approach works in two interrelated parts. First of all, Foucault encourages us to ask what he calls \textit{archaeological} questions. Most significantly: what conditions of acceptability facilitated the ascent of a particular system of thought into dominance over empirical reality? Foucault has already done much of this archaeological work in \textit{The Order of Things},\textsuperscript{264} analysing the ‘nexus of knowledge-power’\textsuperscript{265} that led to the rise of modern economics. However, he neglects technological change in this work and thus obviously, for our purposes, there is much more to be done, particularly in charting how the objectification of ingenuity develops up to the present day. Moreover, as we will see, the formation of the discipline and the nature of its rationality cannot really be understood without accounting for technological change.

As a result, we must return to the foundations of the discipline in order to re-examine the knowledge/power that allows it to function as a singularity, a unified system, and which shapes its developing form. What is important about this analysis is that it is ‘capable of making a singular positivity intelligible precisely in terms of that which makes it singular.’\textsuperscript{266} In other words, we should aim our analysis at that which unifies the discipline, trying to ascertain what makes it a coherent whole. For Foucault, the conditions of acceptability perform this role. He recognises that knowledge comes into being through the interpretation of particular empirical experiences (madness, sexuality or ingenuity) but that not all knowledge attains power.\textsuperscript{267} The knowledge that does attain dominance, and which comes to form a particular rationality, is able to do so because of particular

\textsuperscript{264} Foucault (1970), \textit{The Order of Things: An Archaeology of the Human Sciences}, London: Routledge
\textsuperscript{265} Foucault (2007), \textit{Op. Cit.}, p. 61
\textsuperscript{266} Ibid., p. 64
\textsuperscript{267} Foucault (2000A), \textit{Op. Cit.}, p. 311
conditions of acceptability that permit and shape its ascendancy. This notion plays a particularly important role for us in our analysis of the triumph of Ricardo’s approach to economics over that of Malthus. However, Foucault refines it further by telling us that ‘[the] identification of the acceptability of a system cannot be dissociated from identifying what made it difficult to accept.’\footnote{Foucault (2007), \textit{Op. Cit.}, p. 62} For Foucault this search shows up the arbitrary nature of the knowledge, and is linked to his insistence that what we take as given could have been otherwise. I note this also when examining alternative accounts of technological change within economics; accounts that the discipline defeated. In addition, we can re-appropriate his phrase and understand ‘conditions of acceptability’ in a secondary sense, as the conditions that must be met for a statement to be given the status of “truth” and, conversely, the barriers that exclude other statements from power. It is the task of an archaeology to understand the process by which the rationality in question allows certain statements to function as true and others not.\footnote{Foucault (2000B), ‘Truth and Power’ in \textit{Power}, \textit{Op. Cit.}, p. 131} This has two parts to it: firstly it keeps the rationality a coherent whole, by limiting what economics can produce, but also, resting on the power the rationality has attained, it delegitimizes statements from outside the discipline that contradict the rationality.

In charting the movements of the singularity and its rationality up to the present, the shifts and ruptures involved, we perform a genealogy, in which the archaeology is contained. This is a very specific kind of critique though, so it is reasonable to ask what it can accomplish that others cannot. I have already cast doubt upon the veracity of the IPCC’s projections, as have others; why is this insufficient? Because, as Foucault tells us, ‘the history of various forms of rationality is sometimes more effective in unsettling our certitudes and dogmatism than is abstract criticism.’\footnote{Foucault (2000A), \textit{Op. Cit.}, p. 325} It is so in this case,
where our empirical challenge merely adds one more criticism to a handful of objections. Arrayed against these is a plethora of supporting efforts, all of which, as we have seen, broadly accept the difficulty of modelling technological change, yet nevertheless consider their efforts scientifically rigorous and significant. This leads us to the key point: that the implied history behind the existing approach to climate change is one of progressive scientific discovery. The conceptualisation of technological change is presented to us as the end of a strictly rational process of development. A genealogy, however, seeks to undermine this truth. It attacks the idea, visible within all scientised disciplines, that the history of current knowledge is that of ‘the progressive realisation of an already-given truth.’

It exposes contingency of this knowledge by revealing to us the unscientific history of the rationality: how its particular objectifications were created and how the assumptions that made its knowledge possible were hidden. The most important of these is the subject.

Inevitably, when investigating discourses pertaining to the actions of people, a particular subject of knowledge lies at its heart. In other words, an objectification of the individual is always needed to sustain the system’s version of reality. As Foucault points out, the representations involved in this objectification are frequently manipulated in order for them to be able to carry out specific functions; that is, the objectified individual ‘should be able to carry out all the tasks demanded of it.’ This will prove a fruitful area of investigation, for at the heart of technological optimism in economics is an ingenious subject, the creation of which we must chart. By committing itself to the dissipation of identities, however, genealogy helps to destroy our understanding of ourselves as any ‘kind’ of being (inventive),

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271 Dean, Op. Cit., p. 35
272 Objectification is not a term always associated with Foucault, although he does use it (see Michel Foucault (1979), Discipline and Punish: The Birth of the Prison, London: Penguin, p. 101). I follow the example of Dreyfus and Rabinow (see Dreyfus and Rabinow, Op. Cit.), who use it more frequently.
273 Dreyfus and Rabinow, Op. Cit., p. 149
which through this essence, does certain ‘kinds’ of things (invents) or is able to do them and hence can be relied upon as a capable entity, almost a tool, in the resolution of problems like climate change.\textsuperscript{274} A genealogy, in other words, examines the history of the production of a particular type of subject, and thus destabilises the rationality right at its very fulcrum.

Moreover, as Foucault tells us, no history of this type avoids ‘unsteady victories and unpalatable defeats;’ that is, moments of contingency where what we take for truth overcame alternatives.\textsuperscript{275} We are thus directed to look closely at the clashes that every system of thought must have overcome, to unpick the reasons why the dominant rationality was victorious, or how it might have been amended as a result of a defeat. What we will find, Foucault tells us, are very unscientific reasons for the emergence of the rationality in question: for instance, the use of power to defeat alternatives or the messy merging of knowledge in response to circumstances. Revealing these further disturbs the credibility of any notion of a smooth, scientific process of discovery.

What is the desired end of a genealogy? We have hinted at this already, but it essentially rests on the recognition that knowledge is a productive form of power because it causes people to act in particular ways.\textsuperscript{276} It shapes how society views and responds to experiences like madness or problems like climate change. Hence, the reward we receive for breaking down the truths that underpin this power, for showing the contingent history of the rationality that controls the truth of these experiences, is to make ‘intelligible the possibilities in the present.’\textsuperscript{277} In other words, it would allow us to discuss how society should respond to climate change without having this discussion pre-determined by the power of a particular rationality.

\textsuperscript{274} Foucault (1977), \textit{Op. Cit.}, p. 161
\textsuperscript{275} Ibid., p. 144
\textsuperscript{276} Foucault (2000B), \textit{Op. Cit.}, p. 131
\textsuperscript{277} Dean, \textit{Op. Cit.}, p. 21
The major argument in this chapter was that Jurgen Habermas’s desire to preserve the central tenets of ‘the project of modernity’ renders his work incapable of providing an effective critique of the technological optimism underpinning the major western climate change policies. Michel Foucault’s methodology, which rejects the sweeping conception of progress at the heart of Habermas’s approach, is instead found to be the more appropriate, providing the requisite conceptual tools without an equivalent weakness. I began the chapter by outlining the parts of Habermas’s work that are of the most interest to my research question, showing that ultimately he is unable to be of real assistance due to the internal mechanics of his argument. I argued that in locating the problem of modernity not in rationalisation itself, but rather in the use to which it is put, Habermas is unable to critique the products of economic discourse on anything other than their own terms. In contrast, and having rejected Habermas’s critiques, I argued that Foucault is able to overcome the difficulties which would beset a Habermasian approach. Finally, I sketched the essence of the Foucauldian approach I take in the remainder of the thesis. Using his methodology, we are finally able to envision a critique of technological optimism that eschews the contortions and contradictions of Critical Theory.
Chapter Four

Adam Smith: The Theological Origins of Growth Economics

The purpose of this chapter is to show how the technological optimism we can see in contemporary neoclassical economics became possible and began to develop into the form it takes today. I begin by outlining Smith’s account of how nations become wealthy, identifying the crucial role technological change plays in this system. I then examine mercantilist and Physiocratic thinking in regard to technological change and note that neither attempted to develop it as a factor within the economic sphere. From this, it is safe to assume a clean break with the past and contemporaries insofar as Smith’s contribution in this regard is concerned. This serves to highlight his work in turning what had been a very particular concept into a regular and undifferentiated conceptual buttress for a systematic theory of economics. In other words, taking its focus on certain humans’ creative efforts at certain times and generating from this the discursive object of ingenuity, an abstract and reliable construct upon which economic theory could depend. Having explored the nature of technological optimism within Smith, I turn to its conditions of possibility by discussing what might be deemed the “inventive turn” of the sixteenth and seventeenth centuries, when the champions of industry and artisanship, most notably Francis Bacon, attacked the Scholastic valorisation of Aristotelian virtue and abstract thought. I show how this movement, with its faith in man’s technological ability to drive progress, became fused in Smith with a metaphysical base in Stoic natural law, leading to the creation of a self-interested but also creative subject which has been subsumed into neoclassical economics in the form of *homo oeconomicus*. I argue that in this subject we can detect a natural law residue in the form of a reliable ingenuity insofar as systematic treatment is concerned. In addition, I
maintain that it is this creature, emerging from within the Enlightenment, that motors the distinctly automatic conception of progress exemplified by the discipline of economics. For this to be the case, though, a new form of economic time had to be created, where the past, present and future operations of the economic system are made identical, and thus progress known and assured in advance. I conclude that, further genealogical work notwithstanding, we can begin to explain the technological optimism within contemporary economic theory as derived from the divinely ingenious subject lying right at the heart of its system.

**Smithian Economics and Technological Change**

The aims of this first part are twofold: firstly, to outline Smith’s understanding of the nature and causes of the wealth of nations and secondly, to identify technological change’s role in this and how it is conceptualised as a result. I start by discussing broadly Smith’s theory of economic growth and the place that technology occupies in this and in doing so bring out a debate within the literature about Smith’s supposedly ‘passive’ treatment of it. What we realise is that Smith’s work is less a modern growth theory and more an inquiry into the optimum conditions for human progress in a material sense. There is a subtle difference between the two. I then examine the opponents that Smith implicitly and explicitly sets his work against: the politics and theory of mercantilism and Physiocracy, firstly, and secondly the entire academic idea that, if we are to establish the good society, we must utilise our reason and restrain our passions. The result of this, having established the centrality of technological change to Smith’s work, is another question: why is Smith so certain that progress will occur as long as the natural harmony of the
market is allowed to prevail? In other words, now that we can see that technological change is the means of progress for Smith, how is he so sure that, in order to produce it, all we must do is allow man’s self-interest to act freely? The answer, as we will discuss in the later section, is that Smith envisages the truly free market as another layer of natural law, beyond merely justice, and as such, divinely inspired. As a result, the truths of the economic process are made the same for all time, and thus the future entirely predictable.

In the final analysis, as Rosenberg notes, ‘Smith’s long-term prognosis for capitalism is centred upon its capacity for generating technical change and thus substantially raising per capita income.’ This was all part of a system for Smith: it was the division of labour, the breaking down of production into individual tasks, each to be carried out by different workers, which led to the rapid increases in production – in effect, gross domestic product – that he could see in his lifetime. In previous eras, the production of a particular item was accomplished entirely by one worker. Smith’s example is pin manufacture: previously one blacksmith would manufacture each pin using millennia-old techniques, with extremely slow rates of technical improvement. By dividing up the multiple tasks involved, new machinery came to be invented. This sped up the process and reduced the amount of labour required to accomplish it. In the first instance, this technological change is brought about by the workers themselves. When devoting all their time to one simple task, they easily come up with ways of, as Smith would have it, ‘abridging their labour.’ They invent new techniques and devices and improve the old ones, which leads to more efficient production and thus cheaper prices: ‘men are much more likely to discover easier and

278 Nathan Rosenberg (1965), ‘Adam Smith on the Division of Labour: Two Views or One?’ in Economica, Vol. 32, p. 128
readerier methods of attaining any object, when the whole attention of their minds is directed towards that single object, than when it is dissipated among a great variety of things.\textsuperscript{280} Moreover, the simpler each task becomes, the easier it is to mechanise, further reducing the labour and costs involved: ‘as the operations of each workman are gradually reduced to a greater degree of simplicity, a variety of new machines come to be invented for facilitating and abridging those operations.’\textsuperscript{281} However, there are a few other methods by which invention occurs, for Smith: the factory owner himself can spot an opportunity to abridge the labour he employs, which again is more likely to happen when the task is made straightforward; the manufacturer of machinery can come up with ways of improving his devices (it is always “his” with Smith); or ‘philosophers,’ who may be travelling around observing various facilities, can see an opportunity to combine or integrate various techniques or machinery. All of this leads to more money being acquired by the owner of the business, with the result that he invests in the fixed capital required to increase either the scale of production (benefitting from economies of scale) or purchase new machinery invented elsewhere: ‘Economic growth in the Wealth of Nations is characterised in part by the introduction of improved organisation and new techniques, representing the application by the firm of newly-developed knowledge; and in part by the introduction of techniques only profitable, or financially possible, at a larger scale of operation.’\textsuperscript{282} Of course, the latter is, at the end of the day, ultimately dependant on the former; that is, there comes a point at which the marginal utility of scale increases has run out; or in other words, at which the new techniques which incentivise increased scale have all been employed. At this point, either innovation is required to reset the benefits of increased

\textsuperscript{280} Ibid., p. 7
\textsuperscript{281} Ibid., p. 50
\textsuperscript{282} Samuel Hollander (1973), The Economics of Adam Smith, London: Heinemann, p. 211
scale or non-scale related techniques are all that remain worthwhile. Thus we are taken by Smith from rudimentary production right up to the factory system that was to dominate the industrial revolution, all of it made possible by a transformation in economic organisation and realised by technological change.

There is, however, a rather large question of causality in all of the above. One has essentially three major factors: technological change, the division of labour and capital. Much time has been given over to discussing the question: which of these is primary in Wealth of Nations? Schumpeter, for instance, clearly thought that the division of labour is, and indeed it is easy to get this impression from the text, for example by simply reading the first paragraph. Thus he states: ‘nobody, either before or after A. Smith, ever thought of putting such a burden upon division of labour. With A. Smith it is practically the only factor in economic progress.’ 283 Indeed, as Smith states, the greatest part of technological change flows directly from an optimally organised workforce: ‘(it) is the great multiplication of the productions of all the different arts, in consequence of the division of labour, which occasions, in a well-governed society, that universal opulence which extends itself to the lowest ranks of the people.’ 284

However, another of Smith’s most prominent critics, John Rae, is sure that Smith’s emphasis (incorrectly in his view) is really on the accumulation of capital. This analysis presents itself because unlike some modern theories of economic growth discussed below, in Smith’s system, ‘technical change...must be “embodied” in the capital structure.’ 285 It is endogenous rather than exogenous. Getting past the slightly esoteric language, what this means is that invention comes as a result of the logical processes of the

market, rather than external “bolts from the blue,” as it were. In other words, it comes solely from the interactions fostered by the free market. (This is not quite true of Smith though; as we have seen, external inventions by “philosophers” are described by him, but since this is a major part of the next chapter, we shall leave it for the time being). Rae thus argues that, for Smith, ‘capital accumulation is primary, and technical change follows passively.’ Extending upon the Schumpeter discussion above, the same could be said of the division of labour, so the following analysis counts for both.

Taking Brewer’s synopsis of Rae’s critique then, he seems to think that Smith did not regard technical change as significant, arguing that particular policy prescriptions of his would have said more on the subject ‘had he regarded innovation as at all important.’ This is an odd reading of Wealth of Nations: firstly, because right from the third paragraph of the text, Smith spends a considerable amount of time discussing how central the development of machines to abridge labour is to the entire growth process; and secondly, because it confuses importance with primacy, and they are different. To put it another way, if we really want to discuss primacy, we must recognise that, for Smith, economic growth is first and foremost dependant on allowing man’s desire to better his condition to thrive, and the economy grows in proportion, roughly, to the extent to which that is allowed: the ‘effort of every man to better his condition, the principle from which public and national as well as private opulence is originally derived, is frequently powerful enough to maintain the natural progress of things toward improvement in spite both of the extravagance of government, and of the greatest error of administration.’ Obviously, the less of these errors there

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287 Ibid., p. 4
288 Smith, Op. Cit., p. 10 (my italics)
are, the more growth occurs. So insofar as passivity is concerned, capital accumulation follows passively from this effort, just as the division of labour follows passively from capital accumulation and so on. This does not mean that any of them are unimportant. The difficulty seems to lie in Brewer’s attempt to pull a modern economic doctrine out of Smith, failing to really understand that Smith is not a neoclassical economist, but a political economist, of a school which thought the two could not be separated. Hence his re-appraisal of Rae’s critique and framing of it as attacking Smith’s (supposed) ‘claim that economic growth is the result of saving.’ Saving is, of course, crucial to every conception of economic growth, facilitating as it does investment in new businesses, expansion or new technologies. However, given Smith’s description of technical change as only in some instances connected with the savings made by capitalists, it is hard to be persuaded by Brewer’s argument. In sum, what connects all of these attempted critiques is a particular framing, one which renders conditional an individual element of Smith’s system – and the element in question varies with the critic – while the others are portrayed as systematic and passive, as following automatically from the agency found only in the conditional part. The simple truth is that for Smith, as long as man was left alone from all but the very few necessary interventions of government, everything follows passively. Sources for this in the text are manifold and discussed in much more detail below. However, as it will be argued that it is Smith’s conception of technological change that has been taken forward, albeit amended, to modern economics, it is worth showing that this addition to economic thinking is entirely Smith’s contribution. None of his predecessors possessed a discernable theory of technological change.

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Smith’s Predecessors

To take the earliest, it is hard to know whether mercantilist thought failed to develop a theory of technological change within economics because it thought the way that it did, or whether it thought the way that it did because of this failure. In general it seems that mercantilist thought, usually propounded just ‘to provide a background for policies designed to foster the interests of the class’ from which the writer came, was hostile to technological change. As Hecksher notes: “every opportunity was taken to render it impossible to introduce a novelty without expensive and tedious conflict...the system normally penalised innovation.” At its heart, mercantilism, both theory and practice, was a system which claimed to speak ‘in the interests of national advancement’. National advancement, however, was not thought of in the sense of gross domestic product, as Smith would try to develop. Rather the aim of mercantilism was to strengthen the state by ensuring that it had more “treasure,” i.e. gold and so forth, than its rivals. As a result, any trade which diminished the stock of gold in the home state in relation to another was to be considered dangerous, and tariffs and monopolies were established to favour home produced goods in the internal market and to protect them from domestic competition in both external and internal ones.

It did, however, emphasise the importance of the merchant’s profit, since obviously this increased the net amount of bullion coming into the state. One might suggest, then, that the efficiency that technological change

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290 Erich Roll (1938), *A History of Economic Thought*, London: Faber and Faber, p. 76
293 Ibid., pp. 66-67
294 Ibid., p. 65
might produce, even under a monopoly, would be of use to the state and thus worth pursuing. However, though thinkers like Petty lamented the lack of support for invention, no effort to conceptualise it as, for example, a quantity theory of money was conceptualised, ever seems to have been attempted. 295 A number of reasons why this might be suggest themselves, though none is conclusive. Firstly, the fear of competition which supported the setting up of monopolies – i.e. that an industry must be protected from competition else it might fail, seems logically antithetical to promoting efficiency. One is concerning oneself with ensuring the survival of a producer, assuming that business is fundamentally weak, rather than assuming that it is fundamentally strong and then looking at ways of improving it. Alternatively, there may just be a simple fear of change involved. Any new technology may, somehow, cause the dominant position which your producer now has to be undermined. Technology was thus never seen in a positive light economically, and thus not something worth theorising. Thirdly, the fact that one might compete with a third party for the business of another state was obviously understood, but this does not seem to have promoted the idea of making things more cheaply, although it did generate, in late mercantilism through Thomas Mun, the idea of selling more cheaply in such a circumstance. 296 Though this would seem to encourage thinking about technological change to out-price your rival, maybe it just indicates that it never occurred to them that the conditions of possibility for technological change might be knowable. In other words, that they thought this way because they never conceived of it. From this, and lastly, it is easily possible that the Baconian ideal of spreading opulence throughout society through technological change that Adam Smith took up was simply never considered; that mercantilism was too orientated to protecting the rich and established groups in society to ever take up this

296 Roll, Op. Cit., p. 80
thread and make of it what Smith did. In order to spread this opulence one must begin focusing on output, which immediately sends one to ideas of scale and the technological change needed to produce cheaply and in great supply. With a focus purely on bullion via the rich and for the state, this logical line of thinking could never get started, with the result that Smith’s vision for the role of technological change was never reached.

Insofar as the Physiocrats, best exemplified by their principal thinker Quesnay, are concerned, they were never likely to produce a theory of technological change within their economic thinking for a number of reasons far more obvious than with the mercantilists. Physiocracy was also heavily critical of mercantilism, although its alternative prescriptions were, in the most significant respects, very different from Smith’s. While both agreed to a large extent on free trade and indeed that the market had a natural law basis, Quesnay et al favoured a strong state to ensure these tenets were applied correctly just as Locke favoured a strong security element to the state to ensure property rights. This is very different to Smith’s natural harmony, likely because it follows a different conception of natural law. This will be discussed in greater detail below but, like Locke, it seems apparent that Quesnay followed an Ockhamian version of natural law, where the law was only explicable by de facto reasoning, not from the innate essences of the beings involved. Hence natural law never became natural harmony. Instead, what we can observe around us contains the fundamental precepts and we must use right reason to determine what is acting with natural law and what is against it. To make this clearer, while for a classical Stoic conception of natural law there is a natural way of

doing things that when realised allows the divine element of the world to flower, for an Ockhamian there is no divine element to natural law within society. It is simply imposed externally and thus while it can be perceived through right reason, there is nothing making it work. In other words, there is no divinity struggling to get out: we have free choice and can choose to follow God’s law or not with equal ease. We cannot expect to find a neat and easy harmony, God’s purpose is not meant to be understood by men. Indeed, leaving people to their own devices is a recipe for chaos, as far as Quesnay is concerned. As McNally tells us, for the Physiocrats, ‘(the) only solution to the conflict of competing partial interests within civil society is to construct the state as an autonomous and universal power in society, free from the influence of particular wills, able to impose order and harmony upon society from above. Any conception of the state and the social order as in some sense constituted by the free interaction of individual interests would doom society to faction and conflict.’ Hence for Quesnay, as for Ockham, harmony needs to be imposed from above. This shall be expanded upon below because it is tremendously important for understanding how Smith’s notion emerged.

However, it does make it easy to understand why, despite being a supporter of free trade, particularly rhetorically, the Physiocrats were happy to advocate a strong state. It is probably the dominance of the Smithian conception that makes that seem incongruous today. Beyond this, Quesnay identified land as the only productive investment and thus was happy to argue for state power to enforce this, just as Locke clearly saw property as fundamental with the same result. Moreover, Quesnay, in his *Tableau Economique*, criticised Colbert, a former equivalent of a minister for finance, for his support of manufacturing, arguing that he “tried to bring about the

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generation of wealth from the work of men’s hands, to the detriment of the very source of wealth.” 301 In contrast to Smith, this is about as unBaconian as one can be, but moreover, it contains in its bias against mechanics, in a similar vein to those Bacon attacked, a strong hint that it is unlikely to see the importance of a theory of technological change. Indeed, as with the supporters of the ancients, for the Physiocrats, ‘industry was considered an unwholesome pursuit.’ 302 Whether the cause or effect of this bias, Quesnay in any case focused entirely on primary produce as the only means of generating wealth for France: in other words, farming produce. 303 Certainly Smithian technological change, which relies on a division of labour that is even to this day not present to any great extent in farming, is thus unlikely to follow, but it becomes clear that Quesnay was not interested in technology beyond adoption in any case. Fundamentally, Quesnay’s was an idea of production with an end point. It argued that there was a most advanced stage of agriculture visible in places around him which he described as *la grande culture* and that the best policy that could be followed would be to turn the majority of farms in France from their more primitive version of production into this. The best technology, for Quesnay, already existed and needed to simply be adopted. It was thus not about technological change and open-ended linear increases in production. As Vaggi points out, ‘at a certain point growth comes to a standstill’ 304 and as Barna observes, the ‘Tableau is concerned with statics, the description of an economy in equilibrium, perpetually reproducing itself,’ ‘development takes the form of a discrete jump from a lower to higher level of technology’ and at the end of the process, modernisation is ‘completed.’ 305 This static, non-

302 Philip Fontaine (1993), ‘The Concept of Industrie from the Physiocrats to J.-B. Say’ in *Contributions to Political Economy*, Vol. 12, p. 91
304 Ibid., pp. 84-85

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temporal focus, which Smith appropriated from the Physiocrats, is very important for our understanding of the former’s system, but insofar as technological change is concerned, it is abundantly clear that it was of limited interest and that Smith’s work in this regard is a clean break from the past.

What, though, of the other major Physiocrat? There are a striking number of similarities between Smith and Anne-Robert-Jacques Turgot – a contemporary regarded by Schumpeter as the superior thinker – and indeed one question that is often asked of Wealth of Nations is the extent to which it knew its predecessor, Turgot’s Reflections, and thus the extent to which it may have been influenced by it, right up to the point of accusations of plagiarism. Certainly, Smith has similarities in his approach to interest and his rejection of Quesnay’s singular focus on agriculture as the only truly productive element of the economy. Moreover, they were in remarkable agreement philosophically: Turgot was equally committed to natural liberty and the rejection of mercantilist protectionism. They both clearly believed quite strongly in the certainty of progress and placed it within the remit of natural law. However, in spite of the fact that Smith met Turgot and that each was impressed with the other, there is little evidence beyond speculation that Smith knowingly drew from Turgot’s economic writing. In any case, try as one might, one cannot locate a theory of technological change within Turgot. His approach is the same as the Physiocrats; in modern economic language, they deal with a single production function. In non-esoteric terms, this means that they deal only with the possibilities for economic growth at a fixed level of technological

306 Schumpeter, Op. Cit., p. 245
307 Ibid.
308 Ibid., pp. 248 and 233
advancement. Brewer’s analysis, which is a mathematical model based on Turgot’s writings, explicitly assumes ‘that production takes one period of time, in which all tools and materials are used up.’\(^\text{311}\) Schumpeter speculates that the effects of technological change would simply have been seen as obvious by Turgot, and that the fact that his work only stands up in a state of fixed technological knowledge ‘goes without saying.’\(^\text{312}\) This is not problematic for modern economists, because it is essentially a theory that treats only of distribution in a single economic cycle; however, as a result, it cannot assist with a discussion of the genesis of technological optimism within economics simply because it does not concern itself with development. In his non-economic work, Turgot explicitly notes the importance of mechanical progress against those who ignore it in favour of, broadly speaking, philosophical or moral progress.\(^\text{313}\) As a result, we can safely assume that he recognised the importance of this for economics; however, he either thought of it as inexplicable within an economic model – too random, in other words – or he never got time to develop this part of his work. It has been noted by several authors that his major economic text was hastily written due mainly to his efforts to right the disastrous economic situation France found herself in during his lifetime and commitments to other noteworthy tasks within the French civil service.\(^\text{314}\) In the end, it was Smith’s work that ultimately would go on to be the major progenitor of the discipline of economics as we know it, perhaps because, as Schumpeter believed, ‘intellectual performance is not enough; finish counts; and so do elaboration, application and illustration.’\(^\text{315}\) That said, Turgot’s influence on the marginal school, particularly Marshall and


\(^{312}\) Schumpeter, Op. Cit., p. 261

\(^{313}\) Nisbet, Op. Cit., p. 220

\(^{314}\) Schumpeter, Op. Cit., pp. 245-8

\(^{315}\) Ibid., p. 249
Menger, through Say but also on his own, is very significant, if not really related to technological change.\textsuperscript{316}

Having established its originality, let us now look a little deeper at Smith’s conception of technological change. Many commentators have remarked upon the vision of man that Smith presents us with. It is one in which people are not very different: ‘many tribes of animals acknowledged to be all of the same species, derive from nature a much more remarkable distinction of genius, than what, antecedent to custom and education, appears to take place among men. By nature a philosopher is not in genius and disposition half so different from a street porter.’\textsuperscript{317} Essentially, Smith’s view of the uniformity of human beings, which none of the theorists of the Scottish Enlightenment doubted,\textsuperscript{318} extended to human capacities also. He has it that “nurture,” as it might be expressed today, explains societal difference entirely, with nature relegated to a common base: ‘the very different genius which appears to distinguish men of different professions, when grown up to maturity, is not upon many occasions so much the cause, as the effect of the division of labour...(difference) seems to arise not so much from nature, as from habit, custom, and education.’\textsuperscript{319} Obviously Smith means the term “genius” in a broader sense than it is commonly used today, but just as obviously, he also meant it insofar as invention is concerned. Genius, for Smith, is equally innate in all of mankind, albeit some use it more than others.

This is extremely problematic for some of Smith’s critics and is related to Rae’s critique. Essentially, it is argued that Smith fails to discuss the

\textsuperscript{317} Smith, \textit{Op. Cit.}, p. 13
\textsuperscript{318} Christopher J. Berry (1997), \textit{Social Theory of the Scottish Enlightenment}, Edinburgh: Edinburgh University Press, p. 70
\textsuperscript{319} Smith, \textit{Op. Cit.}, p. 12
likelihood of invention.\textsuperscript{320} Indeed, later economists like Schumpeter and Spengler have been quite critical of Smith’s account of technological change. Spengler is particularly unhappy with Smith’s failure to place the inventive spur within ‘a minority of creative leaders’ and they both disapprove of the way Smith apparently takes ‘the flow of improvements...for granted’ and how the ‘element of risk is scarcely discernable.’\textsuperscript{321} What this critique fails to appreciate, however, is why Smith makes no attempt to enquire about the irregularity of invention and innovation. The real source of their confusion is thus the second criticism – that Smith takes technological change for granted. This arises from their failure to recognise that for Smith, agency is not at the heart of invention. As long as economists keep interrogating the substance of his description, looking for empirical support, they will inevitably come to the conclusion that Smith was simply naive or lax. This is because economists have always assumed that, for Smith as for all subsequent economists, progress happens because humans invent. In fact, as we shall see, it is the reverse: invention happens because progress is inevitable, and it is speedier under the right conditions. What Smith is providing us, therefore, is a final cause. This is the reason why Smith never seeks to enquire about why invention takes place irregularly: he is not concerned, because as long as the “natural” conditions for it are met, it will occur in the most optimal way. It is in asking ourselves what really is, for Smith, the major condition of possibility for invention that we get to the heart of his theory: his implicit belief in a natural law based entirely on the market. The productivity of people’s interactions with each other in terms of technological progress is, for Smith, not simply fortunate – as most economists would have it – but was in fact designed to be so. No man or limited group of men is thus responsible for this progress; the natural harmony underpinning the

\textsuperscript{320} Hollander, Op. Cit., p. 212
\textsuperscript{321} Hollander, Op. Cit., p. 212
success of their interaction in fact works through them. This discussion is at the heart of this section and is outlined in detail below.

Despite this, however, man is quite capable of undermining natural harmony. This aspect of Smith’s economics is known best through his attack on mercantilism, but on a deeper level it is an attack on the over-privileging of reason in social organisation and the tendency in much of the history of western thought to view “the passions” in a solely negative light. As we shall see in the discussion of Bacon, there was a class dimension to such thinking that was overcome in the early modern period through a valorisation of technology coupled with a species of utilitarianism. Smith is clearly influenced by this and, as we have seen, puts it on a systematic footing in the first part of his work. Unsurprisingly, then, he goes on to utilise this ‘natural order’ as a critique of the status quo, wherein the role of technological change in producing opulence is once again central.

Primarily in Smith’s sights is the dominant mode of economic organisation, referred to now as mercantilism. He puts tremendous amounts of blame for the world’s problems on this system, which supports protectionism and a zero-sum understanding of trade. Presaging Kant and Angell, he hints that it is responsible to a significant degree for the hostility existing then between Britain and France, since it promotes the idea that if one country is doing well, the other must be losing out proportionately. This is based on the notion of the “balance of trade” as all-important: to succeed economically, one needs to import much less than one exports. The amount of gold in one’s country is the measure of one’s wealth. It does not, thus, encourage cooperation in the economic sphere and moreover arouses the fear of a rival’s strength that often leads to warfare.322 For Smith, this entire idea is ludicrous: ‘Nothing, however, can be more absurd

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322 Smith, Op. Cit., p. 132
than this whole doctrine of the balance of trade, upon which...almost all the (regulations) of commerce are based.\textsuperscript{323} He explains how in fact trade with one’s neighbours is beneficial to a country and rejects the idea that bullion itself is the measure of wealth. For Smith, gold is simply a commodity to be traded, and as long as one’s country is producing enough goods with which to trade, the benefits of gold as a medium of exchange can be easily procured. The real measure of the wealth of a country, then, is the market price of the goods produced in the country annually, and as he explains, this is enhanced by trade and hindered by protection.

Take the following argument, which is an attack on the mercantilist doctrine that, should something be able to be manufactured in the home country, then before imports are admitted every effort should be made to ensure that all of this capacity is used, for example, by maintaining corn tariffs: ‘according to the supposition, that commodity could be purchased from foreign countries cheaper than it can be made at home. It could, therefore, have been purchased with a part only of the commodities, or, what is the same thing, with a part only of the price of the commodities, which the industry employed by an equal capital would have produced at home, had it been left to follow its natural course.’\textsuperscript{324} The argument is that the capital employed on this venture – to produce something at home more efficiently produced elsewhere – could be employed in another venture much more efficiently, and thus with greater output. Smith is at pains to point out what we take for granted today: that the basis of a county’s wealth is not the total stock of bullion it possesses, but the market value of its annual output. In the final analysis, thus, the value of the output a state would produce when employing this particular capital most efficiently would therefore be sufficient to purchase from somewhere else.

\textsuperscript{323} Ibid., p. 136
\textsuperscript{324} Ibid., p. 131
the same amount of output as would have been produced in that state if
the capital was used in the original less-efficient venture, with at least some
amount left-over, potentially a considerable amount. All the time Smith is
defending his original proposition: that when left alone, people’s innate
desire to better their own condition will produce far better ends than any
alternative economic doctrine that can be dreamed up through reason. So
in this example, by incentivising someone to get into a protected but really
inefficient industry, his natural desire, which would send him to the place in
which he is most useful (and thus can make the most money), is
circumscribed. The result is a scenario in which the best outcome is
perverted. All the time, though, the growth in output that technological
change produces under competitive conditions is at the heart of justifying
this.

Hence, just as Locke would argue that there are natural laws of justice
which are routinely ignored despite this fact, Smith argues in a similar vein
that the market has been abused: ‘But though this natural order of things
must have taken place in some degree in every society, it has, in all the
modern states of Europe, been, in many respects, entirely inverted.’

Smith is talking here about the natural development of states, through
progressive stages, into liberal, free-trading economies, and though he is in
no doubt that not one of these exists entirely, some are far closer to the
‘natural order’ than others. In these latter, particularly, for Smith, China, the
‘manners and customs which the nature of their original government
introduced...forced them into this unnatural and retrograde order.’

Hence he is at pains to attack the political forces in society which he sees
underpinning this inversion. In particular, landlords and merchants are the
target: these two groups have been especially assisted by mercantilist

325 Ibid., p. 87
326 Ibid.
thinking, and given how this helps them at the expense of the wider community, Smith is clear that such opposing of the natural order is unacceptable: ‘what improves the circumstances of the greater part can never be regarded as an inconveniency to the whole.’

The opposition Smith is setting up though is, at its heart, one between a theory that sees man’s intrinsic desires as harmonious and one which sees them as a danger to be constrained by reason. If we take an earlier quote again, that the ‘effort of every man to better his condition, the principle from which public and national as well as private opulence is originally derived, is frequently powerful enough to maintain the natural progress of things toward improvement in spite both of the extravagance of government, and of the greatest error of administration,’ we can see that really this is an attack on overly-valorised reason. While Smith seems to simply be criticising egregious government, he is in fact saying that we do not need the wisdom of great thinkers to devise state structures that will make the economy and society work well. Indeed, reason privileged at the expense of the passions, where schemes contrary to human nature are devised in order to correct the supposedly negative tendencies of the latter, can in reality be seen as the root of the general problem they are designed to fix. In other words, again, there is a harmony to man’s interaction with man, firstly because human nature is ultimately social and secondly because the market is natural rather than a rational construct. Tampering with it needs to be done very carefully and applied in a fashion complementary to these naturally harmonious tendencies. As Smith says:

All systems of preference or of restraint, therefore, being thus completely taken away, the obvious and simple system of natural liberty establishes itself of its own accord. Every man, as long as he does not violate the laws of justice, is left perfectly free to pursue his

327 See for example ibid., pp. 115, 135, 141
328 Ibid., p. 42
own interest in his own way, and to bring both his industry and capital into competition with those of any other man, or order of men. The sovereign is completely discharged from a duty, in the attempting to perform which he must always be exposed to innumerable delusions, and for the proper performance of which no human wisdom or knowledge could ever be sufficient; the duty of superintending the industry of private people, and of directing it towards the employments most suitable to the interest of society.\textsuperscript{329}

Reason is over-rated: there is simply too much to know and in any case, man’s innate tendencies will create harmony without assistance. It is this incredible confidence in man’s intrinsic economic sociality, and the certainty of progress when this is given free reign, both supported by and in turn supporting a theory of economic growth at the heart of which is technological change, which must be addressed if Smith’s technological optimism is to be understood. It is time to begin explaining how this came to exist.

\textbf{Smith and the Scientific Revolution}

The sixteenth century is a crucial starting point. Around this time, a turn towards valorising human industry and inventiveness – the artisanship of the common man – began to occur. The idea that humanity possesses an intrinsic genius, an inventive ability to change its material relationship with nature and advance its comforts and well-being, started to replace the previously dominant idea: that man should seek a harmony with nature and moreover, that common artisanship – invention and mechanics – was the business of the low-born and that abstract academic thought and civic

\textsuperscript{329} Ibid., p. 165
virtue were the real basis of the good life. In short, the trappings of industry were scorned and a higher human purpose advanced.

Paolo Rossi’s book has been invaluable in enabling me to follow the intellectual trends of the early modern period regarding technology which brought about this change. He describes an academic environment of genuine hostility, with the established scholastic thinkers arrayed against a new breed of empirically-minded, often lower-born scholars, who rejected the notion that to be involved in the mechanical arts – to invent, in other words – was to engage in a vulgar activity not worthy of the virtue-minded European gentleman. The dispute was generally a class-based one, as well as a methodological one, and the extremes that both sides often went to would be rejected by later thinkers such as Bacon and Leonardo Da Vinci. For example, on the one hand, the accepted method of the professional academic was an entirely theoretical, bookish one; essentially the derivation of knowledge from Aristotelian premises.\(^3\) In response, Palissy argues that the approach of the Sorbonne professors, against whom his invective is primarily aimed, ought to be entirely thrown out, and replaced with a “scientific primitivism” which eschews ‘books in the name of nature and theory for an empiricism as exhibited on an artisan level.’\(^4\) Palissy also rails against the traditional view of the scientific enterprise – one to be engaged in by men of leisure – which explicitly disregards the knowledge of the artisan, and thereby maintains a monopoly on respectable knowledge for the better-off, who can afford such luxuries as bountiful free-time.\(^5\) The riposte was cutting: Richelet’s *Dictionnaire*, for example, defining “mechanic” as “the opposite of liberal and honourable; it has the connotation of baseness and of being little worthy of an honest person.”\(^6\)

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4. Ibid., p. 3
5. Ibid., p. 9
6. Ibid., p. 12
The scholastics clung to ‘the Aristotelian distinction between free men and slaves in order to array scientific research against the work of the technician.’ In other words, they argued that since Aristotle had allocated the technical role to non-citizens and slaves, it could not be seen as an honourable one or indeed of more than facilitative merit. Of course, Bacon, for one, would later recognise the importance of the theoretical side of research in tandem with empirics, but nevertheless, the fallacious nature of this logic does not need much elaboration nor was it missed at the time: to use Aristotelian distinctions in order to judge what was essentially an attack on this very practice is hardly persuasive, but we must not forget that an indoctrinated audience would likely have seen this as legitimate. Moreover, Aristotle was always strong ground, particularly in France where an attack on him veered very close to an attack on Church doctrine, something which would risk a violent response. There was thus likely a knowing-sophism to this argument.

Overall, there is a fascinating context to the struggle: no doubt improving literacy rates and the ease of publication associated with the printing press played a significant role on the side of the artisan, as indeed did the humanist and later reformist attacks on Aristotelian Catholicism (Luther, for one, was a noted Platonist and admirer of Erasmus). However, the confidence to begin this advocacy of a new kind of learning, particularly significant when we consider the rigid class distinctions of the time and the often brutal penalties for straying from orthodoxy (Palissy himself probably died in the Bastille), came firstly with the discovery of the American continent, which showed up the ignorance of the ancient geographers, and secondly with the invention of a number of noteworthy devices – not least of which, of course, the press – leading to a, at the time, radical departure from the generally accepted idea that the “golden age” of man had ended.

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334 Ibid., p. 56
with the fall of Rome. Humanism promoted man’s well-being, rather than merely his virtue, as an acceptable end, thereby lending a new-found importance to the mechanical arts which allowed him to alter his material circumstances for the better. The increasing economic importance of traditionally technical industries such as metallurgy, also added to their stature. As Rossi observes, the ‘rejection of the myth of a golden age of the human race and of an ancient, unreachable, arcane wisdom was born of this recognition of the revolutionary significance of the great inventions of the moderns.’ The result of this change was a new attitude to artisanship in general and invention in particular: ‘In these centuries there was a continuous discussion, with an insistence that bordered on monotony, about a logic of invention conceived as venatio, a hunt – as an attempt to penetrate territories never known or explored before. This logic of invention was itself viewed as an instrument; it seemed comparable, and in fact was often compared, to tools.’ This reification of the inventive act, the forging of it into an intellectual object, is a difficult thread to follow explicitly, but it seems likely to have found service within the new optimism of the 17th century, where it interacted harmoniously with the idea of nature as a constraint against man’s well-being, leading to the technological confidence of the scientific revolution, which saw man’s future as one of continuous progress in this journey to dominate nature.

As Rossi sums up then, by ‘their polemics against the Aristotelian conception of science, their defence of the dignity of the mechanical arts...Palissy, Vives, Agricola, and Vesalius (as later Bacon and Boyle), independently of their particular intentions or opinions or political prejudices, contributed to the destruction of a once venerated view of the

336 Rossi, p. 31
337 Ibid., pp. 75-76
338 Ibid., p. 42
world’ and the emergence of one where technological optimism was possible in any sphere of knowledge.  

Into this environment was Francis Bacon born. Indeed he may even have enjoyed a lecture from Palissy during his trip to Paris as a teenager and there is an oblique reference to the latter, it seems, in Bacon’s seminal *Novum Organum*. It is hard to overstate the importance of Bacon for the scientific revolution and of course he played the major villain of the piece in the early pages of Adorno and Horkheimer’s *Dialectic of Enlightenment* for precisely this reason. He has often been described more as a propagandist for the scientific method than a practitioner but then this, allied with his respectable position in European society (he was for a time Lord Chancellor), probably allowed him to play a more influential role in the development of thought than many a more hands-on, less well-positioned scholar did. He should not be read though, as he often is, as a simple champion of the mechanic enterprise. His contribution is much more varied.

For a start, he was not, like many who lived after him, a believer in what is often now called “a theory of everything,” a systematic explanation that at one stroke provides a total view. Rather he highlighted the cumulative nature of progress in the mechanic and scientific spheres, the insight that each idea or discovery in science builds on those that came before. For Bacon, then, invention and discovery were not teleological enterprises (as Adorno and Horkheimer have him espousing) but rather an endless process of human advancement, often slow but nevertheless sure. No matter how great the advance, he predicted, improvement could be made to it by subsequent scholars and artisans. Firstly, it should be noted that

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343 Ibid., p. 86
this was certainly not in accord with contemporary common sense, as it would seem to be today. Bacon had to set his work in opposition to those who would stubbornly accept only that knowledge which had been provided by antiquity, arguing that the consequence of this latter is a path leading ‘to an acceptance of the characteristic position of the past: the transformation into ontology of one’s own technical inadequacy. The Aristotelians had placed “whatever is beyond their own or their master’s knowledge or reach…as beyond the bounds of possibility.”’ In contrast, Bacon rhetorically observed that: “The thunderbolt is inimitable, said the ancients. In defiance of them we have proclaimed it imitable, and that not wildly but like sober men, on the evidence of our new engines.”344 Of course, as we can see from the likes of Palissy above, Bacon was not the first to argue the case that we can be optimistic about our technological and scientific future, but as Rossi notes, this ‘conception of science, which found its first expression on a “philosophical” plane in the work of Francis Bacon, played a crucial role in the formation of the idea of progress.’345 Bacon provided the academic credibility this increasingly widespread idea lacked, and this was to prove tremendously important.

It is essential for our understanding of the systematising efforts of Adam Smith to note that Bacon did not found a cult of the inventor. He ‘repeatedly asserts that his projected method of science does not reserve a great role for the genius of the individual and, as it were, equalises minds: “But the course I propose for the discovery of sciences is such as leaves but little to the acuteness and strength of wits, but places all wits and understandings nearly on a level.”’346 As we have seen, something similar is levelled as an accusation against the Scottish Enlightenment, though with probable verity, namely that all people are viewed as being little different.

344 Ibid., p. 85
345 Ibid.
346 Ibid., pp. 83-84
For Bacon, this is possibly a reaction against the valorisation of the great geniuses of antiquity, such as Aristotle and Archimedes, whose reputations were sufficiently colossal to defeat the evidence and arguments of living men. Moreover, Bacon was explicitly trying to bring into the sciences the same collaborative and linear progressivist method stumbled upon in mechanics, where individual genius was not seen as the primary architect of discovery or invention. As we shall see, this formulation of technological change is crucial to the birth of the discipline of economics as we know it.

In any case, as a proponent of the cumulative vision of progress, he recognised that the opposition set up between technical and scientific knowledge was harmful to this end. He maintained that in his system: ‘the work of mechanics and empiricists will be conjoined with that of the philosophers.’ Thus Bacon cannot be read as a naïve champion of empiricism alone; rather he explicitly calls for the integration of the “rationalist” and the “empiricist” schools. In other words, he did not favour uncritically absorbing empirical evidence, but rather preferred his ideal philosopher to ‘digest and assimilate it for storing in the understanding,’ i.e. to build a picture of the world from it rather than solely on it. The turn around in perception here is notable. Far from decrying artisanship and invention as dishonourable and unintellectual, Bacon holds up mechanics as the example for the rest of human knowledge to trail, albeit with a nuanced appraisal of how best to follow its lead. His impact then is predominantly two-fold from the point of view of this thesis: his optimism in regard to human inventiveness, and his espousal of it as central to the future well-being of humanity, was not only a huge contribution to the acceptance of this point of view in European society, but particularly, as we shall see, a crucial influence on the outlook of the major Scottish Enlightenment figures. Moreover, he favoured, rather than a

347 Ibid., p. 86
vulgar myopia of the machine and the inventor, a careful integration of technics into a wider philosophical understanding of the world.

However, Bacon’s legacy is not a tale of unmitigated triumph. As Toulmin observes: ‘In the three hundred years after 1660, the natural sciences did not march along a royal road, defined by a rational method. They moved in a zigzag, alternating the rational methods of Newton’s mathematics and the empiricist methods of Bacon’s naturalism. The triumph of Newtonian physics was, thus, a vote for theoretical cosmology, not for practical dividends...Many people found Francis Bacon’s concern with ‘human goods’ vulgar, or even sinful: it was enough for scientists to find the laws ruling natural phenomena.’ This is, of course, an unfair reading of Bacon, but what he is thought to have meant is more important, in a certain respect, than what he actually said. Essentially, then, the nuanced empiricism and humility of the 16th century humanists, and particularly Bacon, was replaced by a Cartesian and Newtonian quest for certainty; a rationalism that strove for total and systematic explanations and rejected the uncertainty of Baconian methodology. Smith, for one, and the Scots in general, as we shall see, work towards rectifying this error and thus attempt to synthesise Bacon’s supposed empiricism with Newtonian systemisation, an enterprise of which the former would probably have approved.

There is no doubt, as Berry argues, that along with Newton and Locke, Bacon’s influence on the Scottish Enlightenment was due to a reorganisation of the curricula of Scottish universities during the eighteenth century. Aristotle and later Descartes were removed and replaced with this triumvirate and their influence is readily apparent in the Scots’ work.

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349 Ibid., p. 86
350 Berry, p. 52
As we have seen above, Bacon felt that the most important aspects of human history, which had always been downplayed, were those in which mankind further extracted itself from the constraints of nature. He understood natural history as the history of ‘nature wrought,’ in other words, of man’s interactions with it and use of it to better his material conditions.\footnote{Ibid., p. 53} This ‘(narrowed) the distance between natural and civil history,’ the latter being the history of supposedly important human acts.\footnote{Ibid.} However, the Scots’ ‘universalistic conception of history,’ wherein the economic and technological aspects of life were put front and centre, can be seen ‘as effectively assimilating them.’\footnote{Ibid.} In other words, what the Scots created was a project with the essence of Baconian progress as its driving force: the idea that history is motivated by, and can only really be understood through, man’s creation and use of technology to improve his material conditions. More than this, as Berry describes, the Scots always saw themselves as following Bacon’s “scientific” spirit. They respected his ‘commitment to actual human experience as the touchstone of true knowledge’ as exemplified by Smith’s use of empirical examples throughout the \textit{Wealth of Nations}.\footnote{Ibid., p. 47} Hence, given that probably Bacon’s most salient assertion was that the ‘real and legitimate goal of the sciences is the endowment of human life with new inventions and riches,’\footnote{Ibid.} it should come as no surprise that the “science” that the Scots, and Smith in particular, created with their economics, placed the spreading of opulence throughout human society at the heart of their efforts. Both of these factors – humans understood as creatures with an innate desire and ability to improve their lives through technology and the idea that science should facilitate this: the union of the arts and science – are present in Smith’s
‘conjectural history.’ As Stewart notes, this approach ‘rests on two pillars – the principles of human nature and external circumstances.’ It is history with a normative end: to explain how these principles within human nature, interacting with external constraints, led to man overcoming the latter, thereby presenting a science of the conditions of possibility for human improvement. Hence conjectural history ‘as a way of conducting social science was integral to the Baconian temper of the Scottish Enlightenment.’ The appearance of man in Smith’s work characterised as self-interested, technologically creative and ultimately on the path to material progress, is thus readily explained by the centrality of the Baconian project – in which these features are manifest – to the entire Scottish Enlightenment canon. However, as Berry observes, it is only by coupling the “Baconian project” with ‘the aspiration to emulate Newton’ that we have a ‘succinct characterisation of the Scots’ approach and ambition.’

What this means is that they focused on creating an entire knowable system, ‘to achieve for the moral or social sciences what he (Newton) had done for natural science.’ Smith had already systematised rhetoric, language and astronomy in his earlier work; now his focus was on doing the same for political economy. The Aristotelian view of the social world, which was waning but still the act to follow, had been a disorganised one characterised by innumerable final causes and individual explanations for everything; what the Scottish thinkers wanted to do was replace this with a simple and elegant system in the mould of Newton’s. As Smith himself says: “Philosophy is the science of the connecting principles of nature...(it) endeavours to introduce order into this chaos of jarring and discordant

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356 Ibid., p. 66
357 In ibid.
358 Ibid., p. 68
359 Ibid., p. 54
360 Ibid., p. 52
appearances, to allay this tumult of the imagination, and to restore it, when it surveys the great revolutions of the universe, to that tone of tranquillity and composure, which is both most agreeable in itself and most suitable to its nature.”\(^{363}\) This is why it is only ‘partially correct to present Smith as a materialist’ in the Baconian sense of only seeing matter as important in explaining events,\(^{364}\) because in creating this system Smith would maintain the spirit of his Newtonian inspiration while in reality following a very different conception of natural law. As we have seen, Smith’s focus was on the material, the interactions of men with each other and nature that Bacon highlighted, but beneath this he would observe innate impulses in men – essences – that would bring order to the seeming chaos of material interactions.

**Smith and Natural Law**

The likes of Fitzgibbons, Viner, MacFie and Berry, amongst others, all identify the natural law element within Smith: ‘the “naturalness” of human social existence, especially its appetitive source, was typically seen as part of a Providential order.’\(^{365}\) This is not unchallenged, and we shall discuss that challenge later, but natural law has never been a united theory since Aquinas modified the original Stoic conception. The mistake that is often made though, and the thinkers above are examples, is assuming that Newton and Smith followed similar conceptions of natural law. In reality, they operated under very different frameworks, and while there is no doubt that Smith wished to emulate Newton’s simplicity, this should not be taken

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\(^{363}\) Ibid., p. 77

\(^{364}\) Ibid., p. 19

to mean that Smith, a former lecturer in jurisprudence, would automatically assume Newton’s voluntarist framework. In fact, as we shall see, Smith’s work is underpinned by a classical Stoic conception of natural law. Indeed this is the only version that fits with the system, and its material justifications, that he ultimately created. More even than that, it is the only thing that really explains it.

Newton, however, along with Locke and Descartes also, was a follower of William of Ockham,366 the man perhaps most responsible for cracking the scholastic monopoly. Aquinas had been both troubled and impressed with the Stoic conception of natural law; its belief that God is immanent in man assisted him in combating Augustinian pessimism; but in only believing in an immanent God it was also incompatible with Christian notions of a transcendent, omnipotent creator. However, Aquinas’s compromise, in which the two were essentially meshed, was rejected by Ockham and indeed by the latter’s followers, ‘the scientific virtuosi.’367 The Stoics had believed that the essences of things essentially explain the world; that each body has an internal logic or drive to it and that the interaction of these drives causes the world to function as it does. Moreover, it viewed nature fundamentally ‘as an intelligent organism’ wherein the result of all the exchanges was not simply a disorganised jumble of different actions, but the organism itself now in totality.368 This is a pantheistic view of God, which effectively sees each part of the totality as a divine appendage that, left to its own devices, will play a vital and complementary role in the totality. Each part has a portion of the divine whole within it and by allowing that part to interact with the other parts as it would freely do we allow the divine to form most completely and thus function most effectively, with the result that the good of all parts is realised. If any one

367 Ibid., p. 436
368 Ibid., p. 433
part is restricted, the others cannot interact with it enough and are thus themselves restricted. Hence, by allowing freedom to reign, we allow the divine to flourish: ‘Unlike the Christians, who worshipped a transcendent God, the Stoics believed that God worked through Nature.’ While we cannot immediately see the totality, only the different parts of it, once we ‘know the nature of things we also know their mutual relations with one another.’ Therefore, finding the essence of each being, and ensuring that societal structures facilitate their proper interaction, was essentially the goal of law from this point of view. There is, of course, more than a hint of Aristotelian teleology to this.

As Fitzgibbons argues, this is the conception of natural law followed by Smith – ‘a system of nature.’ He maintains that Smith was ‘committed to the ancient Stoic ideal of a natural life harmonious with the cosmos and obedient to God... (he) believed that God was manifest in the world as Nature’ and that ‘society would be lasting only if it confirmed to the laws of divine nature.’ However, while there are numerous hints of this basis, to the point at which it is strongly implied, it is never very clearly expressed by Smith. For example, ‘every part of nature, when attentively surveyed, equally demonstrates the providential care of its Author; and we may admire the wisdom and goodness of God even in the weakness and folly of men.’ What he is getting at here is the underpinning for his faith in what is often called man’s self-interest. He is telling us that this is not merely a fortunate feature of human nature which he has empirically ascertained will lead to harmony. Rather it is an expression of a divine essence in man striving towards his own and every other person’s well-being, though only

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369 Fitzgibbons, Op. Cit., p. 30
371 Fitzgibbons, Op. Cit., p. 17
372 Ibid., p. 29
able to achieve this when left at liberty to interact with the identical essences within everyone else. It is this, as we shall explore more below, which achieves the totality of God in the world and through this harmony progress is achieved.

Ockham, however, entirely rejected this as incompatible with biblical truths. Whereas the Stoics saw the world as an organism, the renaissance view that followed Ockham ‘conceived the world analogically as a machine.’\(^{374}\) That is, instead of ‘being regarded as capable of ordering its own movements in a rational manner, and, it might be added, according to its immanent laws, the world, to such a view, is devoid of both intelligence and life, the movements which it exhibits are imposed from without, and “their regularity...due to the ‘laws of nature’ likewise imposed from without.”\(^{375}\) This came about because Ockham and others before him felt that even watered-down Thomistic immanence ‘endangered the freedom and omnipotence of the Semitic and Christian God.’\(^{376}\) Basically, it was thought that placing some of the divine within man – in the total immanence of Stoicism but also in the Thomistic sense of divine ideas detectable in men’s minds – was to limit God’s will. If man even possessed only some of God’s mind within his own when it comes to morality and truth, God would presumably be unable to re-determine the moral from the immoral or to make the truth untrue. For anyone determined to hold to an idea of an omnipotent God, this was an unacceptable restriction on His power. Instead it was argued that nothing in the world existed or continued to exist except by His desire to have it so. He did not so much plan as impose; God’s intellect, in other words, was thoroughly subordinated to his will.\(^{377}\)

\(^{374}\) Oakley, Op. Cit., p. 433
\(^{375}\) Ibid.
\(^{376}\) Ibid., p. 438
\(^{377}\) Ibid., p. 445
As a result of this, the ontological basis of the Stoics, or even Aquinas, was thrown out. Whereas these had talked of essences or forms which were true and immutable, the ‘doctrine of imposed law, on the other hand, adopts the alternative metaphysical theory of external relations. Individual existents are regarded as the ultimate constituents of nature, and these ultimate constituents are conceived to possess no inherent connections with one another...the relations into which they enter are imposed on them from without, and these imposed behaviour patterns are the laws of nature...these laws cannot be discovered by a scrutiny of the characters of the related things.\textsuperscript{378} This is obviously incongruous with Smith’s methodology if not yet immediately with his aims. Smith had tried to show that a man’s inherent desire to improve his own condition, interacting with like motivations within other men, was the basis for his deduction that a natural harmony would assert itself once these tendencies were left to roam freely. However, it does not yet follow that this harmony cannot occur; just that it does so from God’s will rather than from a necessary internal logic. Nevertheless, the fact that ‘the world did not proceed by any necessary emanation’ but was simply ‘called into being by the autonomous \textit{fiat} of His will’ tells us that whatever human nature might be, it cannot be shown to be intrinsically good or bad, and there is certainly no reason to leave it to its own devices.\textsuperscript{379} A ‘necessary emanation’ would be exactly that, the world progressing according to a logic emanating from its component parts, and this is exactly what is being ruled out.

Ockham also holds that ‘we can in no way deduce the order of the world by any \textit{a priori} reasoning, for, being completely dependent upon the divine choice, it corresponds to no necessity and can be discovered only be an examination of what is \textit{de facto}.\textsuperscript{380} This is an approach which puts reason

\begin{footnotesize}
\begin{enumerate}
\item \textsuperscript{378} Ibid., p. 435
\item \textsuperscript{379} Ibid., p. 451
\item \textsuperscript{380} Ibid., p. 442
\end{enumerate}
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right back in the driving seat. Unlike with the Stoic conception, natural law is not an underlying harmony struggling to get out. Instead, the world must be observed and the discovered natural law filtered out from all that is contrary to it. Moreover, we cannot utilise a rule of thumb wherein innate tendencies are to be trusted and institutional constraints mistrusted: there being no necessity to natural order, nothing can be ruled in or out, including the state. If it is God’s will, the discovered natural law will lead to a harmony of sorts and indeed this seems to have been the approach of the Physiocrats, Habermas arguing that they are ‘to be distinguished from the liberals in a decisive point: the desired harmony would not result naturally from the egoistic interplay of immediate interests, but only from enlightened self-interest.’

The idea that everything could essentially be left to its own devices, and that natural law would assert itself as a result, rang too close to the idea of ‘a necessary emanation,’ or the existence of God, as it were, in the machine. Right reason was to be our guide to natural law and it would not be a straightforward case of leaving everything to be; institutions would be required, such as the Physiocrats strong state, to control the passions which were no longer possessed of any privileges.

However, Ockham’s logic goes further, supporting a very different conception of progress. Unlike the Stoic framework, there is no necessary basis for this; again there is no harmony struggling to get out. Moreover, there is no obvious plan to follow for those interested in progress, as there would be with an idea of freeing an innate positive tendency. Stoicism obviously had a sense of an overarching good of man at its heart, something understandable with man as its referent. There are no such certainties with Ockham. To be sure, man is intended to be good, but beyond simply obeying the deity and ascending to heaven, what is in this for man is not entirely clear. In other words, since there are no universal

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goods or evils, nothing intrinsically so because it produces a certain outcome which is defined as bad, but instead, simply, things are good and bad as a result of God’s will that they be so regardless of whether people suffer or not as a result, there is no reason to believe that natural law will produce the kind of progress that Bacon, for example, had in mind: ‘The dictates of natural law, the infallibility of right reason, the very fact that it is virtuous to act in accordance with right reason – all of these amount to nothing more than inscrutable manifestations of divine omnipotence.’ To put it simply, we know a lot of what we ought to do, but if there is a positive City of Man end to the dictates of natural law, it has not been revealed to us and there is no reason to suspect that it will be, given that the world is overwhelmingly subject to the will, rather than the intellect, of God. That said, there is a kind of progress implied in the valorisation of reason, a form of progress that contains more freedom perhaps. That is, if we observe natural law as Ockham would have us and it is quite limited rather than totalising as the Stoics thought, then improving the lot of man is quite an open-ended process. However, there is also no foundation for it, no explicit course to be followed to produce it and certainly no necessary logic to history which can be simply teased out. It is easy to see from this basis the kind of understanding of history that Voltaire produced, but not at all the kind of conjectural history that the Scottish Enlightenment favoured.

Likewise, John Locke who, despite making a ‘paramount contribution’ to ‘the philosophic foundation for economic individualism’ with which Smith is so associated, is one of the most notable followers of Ockham’s

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383 Ibid.
natural law principles, as is readily observable in his work.\textsuperscript{386} Smith and Locke agreed that man’s natural desires were not inherently evil, however the latter went further and argued that “the mind of man is entirely a product of his environment,”\textsuperscript{387} in other words, that there are no ideas innate in man. Man is imbued with “natural tendencies” to be sure, but these are simply the means by which to acquire knowledge, for Locke is explicit in saying that moral ideas do not come from within man.\textsuperscript{388} It is obvious how this fits within an Ockhamian framework, for it clearly rejects the idea of essences or the Thomistic idea of God being in the mind of men. It stresses individuals observing with their senses the outside world and through this observation acquiring moral knowledge and natural law. It is this means that man uses to observe all of the natural law for which Locke is so famous.

Smith agrees with Locke insofar as the importance of the senses are concerned, arguing that it ‘was by the sensible qualities, however, that we judged of the specific Essence of each object.’\textsuperscript{389} Nonetheless, Smith is explicitly critical of an over-reliance on the senses, arguing that these are fleeting and that only the specific essences of things are ‘permanent, unchangeable, always existent, and liable neither to generation nor corruption nor alteration of any kind.’\textsuperscript{390} This indicates to us the difference between Smith and the Stoics and displays one of the elements of the scientific revolution in his work: he does not deduce the existence of these essences, they needed to be empirically determined, as we can see from our discussion of \textit{Wealth of Nations}. Nevertheless, it is vital to note that Smith retains the entirely unOckhamian ‘classical assumption that God [is] in the

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\footnotesize{\textsuperscript{386} Oakley, \textit{Op. Cit.}, p. 441
\textsuperscript{387} Chalk, \textit{Op. Cit.}, p. 69
\textsuperscript{388} Ibid., p. 345
\textsuperscript{389} Fitzgibbon, \textit{Op. Cit.}, p. 80
\textsuperscript{390} Ibid.}

\end{footnotesize}
Indeed, Smith’s own words clearly indicate his rejection of the Ockhamian approach that so influenced Newton and Locke when arguing that philosophy is “that science which endeavours to connect together all the different changes that occur in the world, to determine wherein the specific Essence of each object consists, in order to foresee what chances or revolutions may be expected from it...Universals, and not individuals, are the objects of philosophy.”

Given Smith’s background in medieval law and jurisprudence it is stretching credibility well beyond breaking point to imagine that he was unaware of the full implications of this statement when he made it. Unlike Locke, who treats man as a blank slate shaped by his involvement in the world, man within Smith’s work has the addition of a specific essence which shapes the world around him. It is not hard to see the Baconian influence emerging at this point.

The form that it takes becomes clear when we interrogate what Smith might actually have meant by the specific essence of man. As we have seen in our discussion of *Wealth of Nations*, it is the determination of man to improve his material condition that drives the harmony Smith envisages. Unlike Locke, who sees the passions somewhat ambivalently, for Smith they are more than simply a potentially positive aspect of man as Locke or a modern economist might argue. Rather, they were designed to be so: “Nature...when she implanted the seeds of this irregularity in the human breast seems, as upon all other occasions, to have intended the happiness and perfection of the species.”

The reason why is clear, because it is these ‘which first prompted...(man) to invent and improve all the sciences and arts, which ennoble and embellish human life.’ Smith never leaves his Baconian materialism too far behind: he is clear that it is technology
that ultimately provides for man and that it is only when man reaches a
certain level of economic freedom that this tendency comes to light. For
example, he maintains that slaves fail to invent simply because they have no
incentive to do so, indeed they are positively restricted.\footnote{395} For Smith, this
goes against the natural order. Man is supposed to invent, he has ‘a natural
fascination with machines and an instinctive desire to improve them: “such
is the delicacy of man alone, that no object is produced to his liking. He
finds that in everything there is room for improvement.”\footnote{396} This is key:
Smith’s Stoicism prompts him to look for a natural harmony and his
Baconianism necessitates that it be situated in the everyday actions of
working men; a natural harmony cannot rely on elite action alone in any
case. But Smith is not content with simply arguing, like the Physiocrats,
that man’s aim should be to reach the highest stage of existing
technologies. He is in no doubt, given the use to which he puts notions of
technological change, that much that more is possible. For as a materialist
interested in economic life rather than an ancient, obsessed as they were
with virtue, the perfect existence is not possible while scarcity exists: wealth
and comforts are not in infinite supply as virtue potentially is. Hence, while
Smith attributes to this world ‘underlying notions of order and perfection
that Plato had discerned only in mental heaven,’\footnote{397} his are not immediately
realisable. Nature provides man with desires out of wisdom; she is wise
because it is these that will prompt man to use the other element she
provides: a natural tendency towards improvement. Baconian progress can
thus be put on a natural law footing. Natural harmony will only emerge
when each part of the organism, the specific essence or the element of God
in man, is allowed to function as it freely would: ‘It is the individual
improving or creative element that finds some place in every worker in his

\footnote{396} D.A. Reisman (1976), Adam Smith’s Sociological Economics, London: Croom Helm, p. 151
\footnote{397} Fitzgibbons, Op. Cit., p. 81
degree. This is the drive behind economic growth.\textsuperscript{398} Technological creativity is not simply a fortunate ability; it is an element of the divine within man.

This is not to suggest that Locke believed, pace Aristotle, in man as a political animal or as a necessary pursuer of virtue. Locke was far more sanguine and content for man to choose whatever comforts he wished so long as he obeyed natural law. This led to a theory which fitted comfortably with mercantilism; indeed Locke maintained “an adherence to mercantilism at a time when its foundations were being undermined.”\textsuperscript{399} We should not be surprised at this: mercantilism is the archetypal example of the kind of misuse of reason that Smith so detested. It was, however, entirely in keeping with Locke’s approach. The latter was premised on a very different referent object and a very different approach to enhancing it. For Locke, the good was achieved in limiting government from encroaching on natural law as much as was feasible; any inequality which resulted from this was justifiable as God’s law.\textsuperscript{400} Moreover, the achievement of this end could not happen naturally; it explicitly required the use of reason both to grasp natural law and, particularly, to construct an edifice to enforce it. Smith, on the other hand, was in keeping with his Stoical underpinnings in having a much more egalitarian aim – universal opulence, as we have seen – and in ‘the regulation of behaviour, had little confidence in human reason.’\textsuperscript{401}

Mercantilism could happen for Locke because while there were certain areas, property for example, where the state could not encroach, market regulations beyond this were open to the dictates of reason, whatever it may come up with. However, as Foucault observes, in ‘the middle of the eighteenth century the market no longer appeared as, or rather no longer

\textsuperscript{398} MacFie, \textit{Op. Cit.}, p. 36
\textsuperscript{399} Chalk, \textit{Op. Cit.}, p. 345
\textsuperscript{400} Locke, \textit{Op. Cit.}, p. 27
\textsuperscript{401} Coase, \textit{Op. Cit.}, p. 545
had to be a site of jurisdiction...the market appeared as something that obeyed and had to obey “natural”, that is to say, spontaneous mechanisms...their spontaneity is such that attempts to modify them will only impair and distort them.⁴⁰² For Habermas, this changed the idea of government: “The limits on the powers of all government imposed by Natural Law, which, according to Locke, were carried over from the state of nature into the social state, have become the laws of a natural society, one which is no longer based on upon a contract. The government constituted according to nature, and above all, limited, now comes “out of society”, just as previously it came out of the social compact.”⁴⁰³ This probably goes too far though. Firstly, Habermas appears to be saying that, for Locke, society comes out of the social contract just as the state does. In actuality, Locke held that society had always existed: it never required a contract. This is important for him because he wants to argue for a far more reasonable man than Hobbes did, one capable of living socially without the state. From this he is able to argue that man constructed the state out of reason (the contract), and charged it to enforce natural law. Moreover, it is hard to find any evidence in Smith for this notion of a natural government. Foucault seems far more correct when he argues that government was limited as a corollary of the creation of a harmonious economic sphere, most notably by Smith. It seems much more likely that for the latter, government was what was left over after his second layer of natural law was ascertained, beyond Locke’s and justified in terms of man rather than in terms of God; that is, man’s material well-being.

Unlike Locke, then, Smith historicises the state. It did not start out weak and get stronger, as social contract theory of the Lockean variety would have it, but rather has, unevenly, been getting progressively weaker as time

⁴⁰² Foucault (2008), The Birth of Biopolitics, London: Palgrave Macmillan, p. 31
has gone on and progress towards natural liberty has developed. His critique of its strength, then, is a mixture of utility and natural law, since in his work he essentially fuses the two. In other words, while all Locke needed was to point to observed natural laws to criticise the state, Smith restricts it far more by pointing out the huge dimensions of human life where it is unnecessary and prevents economic freedom and thus enrichment. This nod to natural progress through natural liberty is at the heart of the movement towards ‘frugal government’ which, as Foucault correctly identifies, begins with eighteenth century economic theory. Moreover, we now have reason to suspect what economics says about itself when it assumes this to be a positivist deduction on the part of Smith and his followers. As Smith argues in *Theory of Moral Sentiments*: ‘When by natural principles we are led to advance those ends, which a refined and enlightened reason would recommend to us, we are very apt to impute to that reason, as to their efficient cause, the sentiments and actions by which we advance those ends, and to imagine that to be the wisdom of man, which in reality is the wisdom of God.’ Smith’s belief that his system worked did not arise because he could find empirical evidence to support this; he believed he could find this evidence because the world was designed to work in accordance with natural law. Hence, as Habermas notes, ‘as a system of needs based on the division of labour, society will naturally follow a harmonious development as long as it can be protected against the despotic intervention of government.’ It was not though, as we have seen, merely government that Smith wished to limit. It was the basis of government that people like Locke advocated: government based solely on reason and designed to enforce only a limited conception of natural law. An over-valorisation of reason was in fact a threat to natural

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law for Smith. Reason was not, of course, intrinsically bad. Smith followed Hume in this regard by arguing that it simply could not be separated from the desires and was no more than a tool to facilitate them. Hence some businessmen would happily create monopolies if they had the governmental power to do so.\textsuperscript{407} Instead, reason should assist only by ‘picking out a general structure of human motivations and aspirations’ and thereby distinguishing ‘between social conditions that work against our natural impulses and social conditions that work with them.’\textsuperscript{408} In other words, ‘the theory knew that it was in harmony with the historical process, it did not have to instruct the citizens on how they could organise social progress.’\textsuperscript{409}

Thus we can begin to see the relationship between *Wealth of Nations* and Smith’s other work. In his previous books and essays he propounds a theory of natural law that is critical of those who argue for reason as the basis of progress. He does this by developing the idea of a natural harmony based on man’s specific essence, the surfacing of which reason should be assisting. In *Wealth of Nations* he provides his empirical justification for this based on Baconian materialism. He shows that this essence lies in man’s desire for material improvement and his ability to bring it about using technology and, most importantly, that it is in allowing freedom in this regard that the divine within each man can interact with that of other men, with the result that a harmonious economic sphere is created and progress through technological change is assured. Much of this is only implicit within his economic text, but that should not alarm us. Smith was rather famous for his *Theory of Moral Sentiments* and his audience would have been familiar with him as a result of this work. There would have been no doubt

at the time that they should be read as companions and it is only retrospective readings which raise doubt.

Locke, and vicariously Ockham’s, natural law could never have produced such a theory. While Ockham could be the basis of systemisation for Newton, this was because the objects he studied did not possess reason. Part of the basis for Ockham’s rejection of essences was that it contradicted God’s promise of free will by placing some of God within man.\textsuperscript{410} It follows that man would naturally be shaped by this and the harmony that is created would not be of man’s design. Free reason is the basis of man’s free will and no theory of the good based on reason could produce an automatic mechanism because reason is necessarily singular in each individual: as we have seen above, there are no intrinsic connections between bodies, simply a basic natural law which, following on from these principles, Locke identified in a limited fashion as, to use an anachronism, negative rights. These guarantee a functional status quo, they cannot guarantee progress. Even if mixed with a Baconian conception of man’s technological creativity, a development based on reason guarantees nothing. Until Smith re-introduced Stoicism, natural law only led to Hobessian and Lockean functional states. As Habermas points out, both Locke and Hobbes were ultimately aiming at self-preservation. However, for Hobbes, this required the sword of the sovereign, whereas for Locke, it requires an order of property which protects against hunger and want...the government is only to remove certain risks, so that the natural form of self-preservation can be better maintained.\textsuperscript{411} This solidity was sterility for Smith. Instead, he aimed for ‘the Stoic tradition of equality,’ which Thomism had broken.\textsuperscript{412} “The natural laws of the market assert themselves, with the ascendency of the private, autonomous exchange of commodities;

\textsuperscript{410} Oakley, \textit{Op. Cit.}, pp. 444-5
\textsuperscript{411} Habermas (1974), \textit{Op. Cit.}, p. 98
\textsuperscript{412} Chalk, \textit{Op. Cit.}, p. 332
this will lead to the equalisation of social rank and to the extension of civil rights of equality.\textsuperscript{413} Smith had an ‘evolutionary concept of society’\textsuperscript{414} in opposition to frameworks wherein man’s improvement was limited by his ability to reason. As a condition of possibility for progress, this latter is too unreliable; however, in seeing the divine within man, progress becomes the end for ‘which it is the purpose of his being to advance.’\textsuperscript{415} Thus Smith’s technological optimism is one based upon providence and inventiveness as a Godly essence is firmly established within his economic theory.

As a result, as Foucault notes, ‘the idea of European progress...completely overturns the themes of European equilibrium.’\textsuperscript{416} ‘Europe is no longer covetous of all the world’s riches that sparkle...Europe is now in a state of permanent and collective enrichment through its own competition.’\textsuperscript{417} As mentioned earlier, Smith’s confidence in this outcome is traditionally attributed to faith. For example, Berry states that ‘the “naturalness” of human social existence, especially its appetitive source, was typically seen as part of a Providential order’ and that ‘certainly providence is frequently invoked...the thinkers of the Scottish Enlightenment operate within a theologically underwritten conception of cosmic order and regularity.’\textsuperscript{418} Similarly, MacFie ‘interprets the doctrine that underlies the “invisible hand” as grounded ultimately in faith’\textsuperscript{419} and Jacob Viner argues that what Smith presents is “an unqualified doctrine of a harmonious order of nature, under divine guidance, which promotes the welfare of man through the operation of his individual propensities.”\textsuperscript{420} MacFie in particular cites Smith’s stoic underpinnings,\textsuperscript{421} though he does not develop this reading like Fitzgibbons

\textsuperscript{413} Habermas (1974), \textit{Op. Cit.}, p. 78
\textsuperscript{414} Ibid.
\textsuperscript{415} Smith (1987), \textit{Op. Cit.}, p. 154
\textsuperscript{416} Foucault (2008), \textit{Op. Cit.}, p. 54
\textsuperscript{417} Ibid., p. 55
\textsuperscript{418} Berry, \textit{Op. Cit.}, p. 32
\textsuperscript{419} Ibid., p. 47
\textsuperscript{420} In Coase, \textit{Op. Cit.}, p. 535
\textsuperscript{421} MacFie, \textit{Op. Cit.}, pp. 42-58
does and I have above. Nevertheless, some thinkers, notably Reisman, Bitterman and Fleischacker have cast doubt upon this interpretation,\(^{422}\) and claim that *Wealth of Nations* was never intended to be read in this way, but rather in the more straightforward way familiar to students of economics. The reason for this – aside from the possible discomfort a modern economist might feel at the idea that the discipline itself is intertwined with highly unscientific premises – is most likely the fact that while, as Berry argues, ‘Smith does subscribe to the underwritten conception of order and regularity...his actual explanations proceed without that backcloth becoming an actor on the stage.’\(^{423}\) Therefore it is very easy for a slightly biased or under-read scholar to simply identify Smith’s metaphysics entirely with that of his good friend David Hume, whom he often praised. Indeed, ‘Hume’s idea of science was very similar in spirit to the modern notion of economics’ and thus reading *Wealth of Nations* with him in mind would give one a very skewed picture.\(^{424}\) As for the essays and books (indeed, some even part of *Wealth of Nations*) that do not speak in a way that can be interpreted in this fashion, they are explained away as unclear or a factor of Smith’s supposed inconsistency or even as dating from a period in his life before he had read Hume. As Fitzgibbons demonstrates, citing works both before and after this period, such claims are patently false.\(^{425}\) Indeed, nineteenth century economists, such as the scion of the neoclassical variety, Marshall, did not doubt Smith’s “conformity to nature” but somehow this generally accepted view has gotten lost in recent years as Smith is transformed into a cold, empirical believer in selfishness.\(^{426}\) It is no doubt very close to the truth, as Dickey observes, that a major contributor to this


\(^{425}\) Ibid., pp. 86-88

\(^{426}\) Ibid., p. 89
is the probability that books I and II of *Wealth of Nations* are the only parts of Smith’s work that any economists ever read.\textsuperscript{427}

Nevertheless, having read Fitzgibbons work, Fleischacker, for one, is still very dismissive of the entire providential reading, the Stoic version of this in particular. He maintains that interpreting *Wealth of Nations* as grounded in Stoic philosophy is ‘demonstrably false’ and that ‘Smith provides us with a number of cases in which an individual’s unconstrained pursuit of his or her interest will not benefit the society.’\textsuperscript{428} Essentially, he characterises Smith in relation to the invisible hand as making a small point based upon some empirical examples and that ‘there is no hint that this holds in all cases, much less that it is guaranteed to hold by either empirical or metaphysical laws.’\textsuperscript{429} The problem with all of this argumentation, first of all, is that it assumes that *Wealth of Nations* is based on an entirely different premise from *Theory of Moral Sentiments* and every other book or essay Smith ever published; in effect, that Smith decided that he had been wrong in the previous books and had suddenly decided to become an empiricist, because Fleischacker makes no attempt to reconcile *Wealth of Nations* with his other writings. For him, *Wealth of Nations* is, it seems, an aporia in Smith’s work. Of course, this is rather implausible given the effort Smith put in to keep bringing out editions of *Theory of Moral Sentiments* (upon which he worked far more until his death than *Wealth of Nations*).\textsuperscript{430} Why would Smith continue to work on a book so at odds with his later understanding of the world? In fact, Smith is not at all arguing that unconstrained selfishness is the only thing society needs in order to function. There are natural moral laws just as there are natural economic laws and the good society needs to cleave to both in order to operate effectively; fortunately, they are

\textsuperscript{428} Fleischacker, *Op. Cit.*, p. 139
\textsuperscript{429} Ibid.
reconcilable in Smith’s conception of them. More importantly, even if some basis can be found for Fleischacker’s case, it certainly is not to be found in his own arguments, in which he utterly misunderstands the natural law interpretation. For example, he argues that a Stoic reading makes Smith’s arguments about the correct kind of economy meaningless, since ‘Providence will take care of everyone under any sort of economy.’ The idea of natural law is not to say that “whatever happens, it will be following God’s law,” since that is a meaningless position useful for criticising or organising nothing. Instead, the argument is that there is an innately correct way of doing things, but that this needs to be understood and pursued and can be interfered with or completely ignored, with bad results. This is the basis upon which natural law scholars say some laws are good and others bad.

Beyond this, Smith states in a number of places that no theory can explain every detail of the world (that is precisely what he criticises Aristotle for attempting to do), but that it should rely on general principles. Hence the entire Scottish Enlightenment focus on conjectural history, the idea that what is important is the identification of the drivers of progress and charting this move and definitely not getting lost in the confusion that comes from finding contemporary or past reverses that in fact only obscure the bigger picture. The Scots are quite aware that culture, education and institutions have misled people into acting in ways not in accord with their interests, but they feel that history is a story of progress and that we should do our best, in the future, to point out how it can cleave to those natural laws that we can identify from underneath the morass. This will of course require state action at points and will not ensure the right behaviour from everyone. However, only by understanding these foundations can we direct

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432 Berry, Op. Cit., p. 66
policy towards the most beneficial ends and get the most out of the progress we have achieved so far. As Coase argues, it ‘is wrong to believe, as is commonly done, that Adam Smith had as his view of man an abstraction, an “economic man”, rationally pursuing his self-interest in a single-minded way.’\textsuperscript{433} However, this is how he is usually, if not invariably, read within economics and more importantly, this approach to his work, stripped it of its metaphysical and theological underpinnings, is obviously what has gone on to underpin modern economic theory. However, we must ask ourselves: has, or even can, Smith be entirely stripped of these foundations? Or has economics unknowingly appropriated an idea of the subject as an empirical reality which is explicable only within its theological setting?

\textbf{The Smithian Basis of Economic Rationality}

To put in plainly, a major part of what we have been dealing with so far are two concepts of progress, broadly based on reason and the passions respectively, and corollaries of sorts of Isaiah Berlin’s two concepts of liberty. Insofar as the Enlightenment was about progress, and this is a great deal, the clash between the dual conceptions of freedom mirrors the clash over the two conceptions of progress. Berlin shows that in John Stuart Mill we can find the confusion of these. Mill is concerned with ensuring the freedom of ‘spontaneity, originality, genius’ for fear of society being crushed by the weight of “collective mediocrity.”\textsuperscript{434} As Berlin points out, this is not an economic freedom necessarily; it is perfectly conceivable that an economic tyrant might well permit unlimited freedom of thought in his

\textsuperscript{433} Coase, \textit{Op. Cit.}, p. 545
domain. Indeed, we can allow that a mercantilist economic system could quite easily provide just this. Ultimately, what Mill is describing here is the basis for progress on reason, and it corresponds with positive liberty, the freedom to develop the kind ‘of character of which Mill approved – critical, original, imaginative.’ Berlin goes on to argue that privileging this kind of liberty ultimately leads to coercive attempts to produce it, for instance through forced education. In any case, what is important for our argument is that it is a conception of progress which requires no economic freedom; instead it relies on reason as the motor of development. The negative kind of liberty, which we associate with the Scottish Enlightenment, insists on both economic freedom and freedom of thought as a matter of principle, but focuses on the former as the motor of progress. This is the freedom of the passions, or, as Berlin has it, ‘irrational impulse, uncontrolled desires, my “lower” nature,’ as a counterpoint to reason, the “higher nature.” Of course, both of these ideas of progress can exist at the same time, and indeed do in perhaps slightly amended forms today. However, they are always in conflict as their domains logically overlap. Just as positive progress sees its alternative as producing mediocrity, it can also take credit for scientific and manufacturing successes; indeed there has been a cult of the inventor and entrepreneur at least in the United States for some time, with tremendous credit allocated to this lone achiever. Negative progress, on the other hand, can cite in reason all those things that restrict invention and the free movement of the economy. Moreover, because it relies on an automatic mechanism, the lone genius is never more than a representative of the system which ultimately produces the good life. Hence why in the USA, simultaneously, capitalism is given credit for its creation of the standard of living enjoyed by the citizens. There is, naturally, an agency and

435 Ibid.
436 Ibid., p. 126
437 Hughes, Op. Cit., p. 163
structure clash at work here. Nevertheless, what is important for this thesis is the fact that it is the latter which totally dominates economics and leads to the production of a very particular kind of subject.

This is the *homo oeconomicus*, economic theory’s objectification of the individual, whom Foucault, amongst many others, treats as one of the most important intellectual objects of modern times. Foucault distinguishes *homo oeconomicus* from his juridical equivalent: ‘the figure of *homo oeconomicus* and the figure of what we could call *homo juridicus* or *homo legalis* are absolutely heterogeneous and cannot be superimposed on each other.’

438 He notes that the latter becomes a ‘subject of right’ – a subject with rights as opposed to a subject with mere interests, such as *homo oeconomicus* – because ‘he has agreed at least to the principle of ceding these rights’ through the social contract.

439 We can see, then, from the discussion above, from where this key difference arises. In agreeing to cede rights, *homo juridicus* is a creature of reason, a creature which observes natural law and make an institutional agreement with the state, in a Lockean sense, based on a reasoned-out idea of her own rights. This is the subject of Ockham and positive freedom and as a result, the subject of coercion, as Isaiah Berlin would have it. She is subject to juridical constraint just as *homo oeconomicus* is free of it, because they have entirely different genealogies, different natural law bases behind them and different notions of progress creating the conditions of what is acceptable. Reason is individual, it is free will, thus it cannot be systematised nor can the possessor of it be abstracted into a predictable responder. This unpredictability thus requires constraint and therefore positive progress sees institutions as potentially progressive. Conversely, negative progress sees them as inhibiting because *homo oeconomicus* is someone whose ‘conduct always answers to the single clause

439 Ibid., p. 274
that the conduct in question reacts to reality in a non-random way⁴⁴⁰ and thus can be relied upon to produce her own progress. Modern society has effectively mixed them and it is becoming clear to us now how this may have happened.

What is meant by this distinction is important to tease out, since it is universal reason that ultimately animates the idea of positive progress and it is his confusion of the latter with negative progress that will be our most significant judgement regarding Malthus’s work. The Scottish critique of universal reason relies on one major premise: that since man is not rational, only rationalising – in other words, “reason is the slave of the passions”⁴⁴¹ – it is not possible that anything thought up by an individual or group of individuals could ever make a claim to universality, since this is dependent on the notion of that idea being divorced from the specific concerns of the person making it. That is, an idea could never be universally valid because ideas never escape the particularity of their own conceptualisation. Secondly, the Scots argue that this same premise regarding man’s rationality would mean that, even if such an idea could exist, it would never have universal appeal, since people would only interpret it insofar as it affects their own wants and interests. Therefore, even seemingly good ideas – however one might judge this – will likely lead to negative outcomes, since we cannot expect the idea to be actualised in the way that it was intended. Effectively, they accept much the same original premise as Rousseau: that man’s reason is fundamentally wrapped up with his desires/passions. However they reject the idea that it could ever be otherwise; that is, they reject the notion that it is possible to effect a complete mind/body split or even that such a split could exist in principle. Reason is facilitative of the passions, nothing more. Nevertheless, as we have seen with Smith, this

⁴⁴⁰ Ibid., p. 269
should not overly concern us, as the passions of groups of people naturally interact in a harmonious way and fuel our continual progress. What should concern us, though, are ideas proposed on the basis of a belief in universal reason, since these cannot be what they claim and are likely to interfere negatively with the delicate progress being generated through the passions.

However, Foucault errs when he reduces *homo oeconomicus* to simply a utility maximiser and argues that she is ‘irreducible’ beyond this.\(^{442}\) He recognises that the most important basis for *homo oeconomicus* is in Smith and his ‘unavoidable text’ and that while Smith’s subject ‘only thinks of his own gain...in the end, the whole industry benefits.’\(^{443}\) For Smith, it was never about simply transactions, though, or even the limited idea of economic growth. He had a far larger remit: the complete progress of society. It was the belief in, and the need to show how, infinite progress could be achieved that led Smith to formulate the kind of theory and subject that he did. Unlike the followers of a reasoned progress, the Scottish thinkers did not believe it could be planned. Reason led in the wrong direction – government – but progress was a God-given fact of history, so man must simply be endowed with the ability in a non-specific sense. This gift must be set free. Hence what Smith did was to reify the market as an organic and divine totality made up of essences better understood as cells than as individuals. Every one of these cells contained a part of the whole and thus, when returned to the empirical world, became subjects endowed with the abilities needed to generate this harmonious totality when interacting. Of these, self-interest is the facility most remarked upon and forms the entirety of the creature *homo oeconomicus*, as far as Foucault, for one, is concerned. But all admit that *homo oeconomicus* exists as the basis for the harmony of the free-market. Indeed it is probably better to think of her still as a cell, and

\(^{442}\) Ibid., p. 272
\(^{443}\) Ibid., p. 279
thus it must be recognised that reducing *homo oeconomicus* to only self-interest is to fail to account fully for what generates harmony. What has been missing from this understanding of economic man, and what does a tremendously significant proportion of the work of generating the market and the entirety of the work of making it infinite, is *homo oeconomicus*’s technological creativity. This ability has been almost smuggled into the discipline of economics from Smith, seemingly unbeknownst even to economists themselves. This is why economic theory finds itself in the confusing position of serious caution when it comes to particular technologies developing and remarkable optimism when speaking of technological change in abstract. It is because the subject at the heart of the theory contains within her, unquestioned and perhaps never even noticed, a spark of the divine.

Finally, then, let us examine the effect of all the above on Smith’s explicit economic system. We should recall that – from Mandeville, Quesnay, and arguably Turgot – Smith had already inherited a static conception of the economic flow, that is, a systematic view of distribution in which the process is always the same. Foucault’s insight into what he did with this is vital though.

For what Foucault recognises is that, with Smith, we have a completely novel development in economics: ‘the possibility of a continuous historical time.”

Smith’s starting point, as we saw, was negative progress: a Baconian process underpinned by a Stoical pantheism wherein, as long as his liberty is not interfered with, man’s innate ingenuity is set free by his harmonious interaction with his fellows. The problem, of course, is that this kind of progress is unable to describe its ends concretely. It cannot, like the Physiocrats did or Marx would, draw a picture of the benevolent

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results that will supposedly follow from its adoption. This is necessarily the case, because the entire point is that there is no universally beneficial endpoint that we can, or should, simply adopt (separating Smith from Godwin and other negative progress utopians). Smith is insistent on this point: we must not prescribe the course of progress.\footnote{Smith (2005), \textit{Op. Cit.}, p. 158} Given that Smith’s interest is in material well-being, technological change was always going to be the element representing this change. However, his approach puts the theorist in something of a dilemma since, not being able to rely on the enforcement of reason, he must completely describe in the present all of the forces that will maintain this linear improvement. Most importantly, this means that the dynamic, or temporal, elements – those that represent change – have to be presented as identical at any moment in time. Anything that fluctuates randomly cannot be predicted, and the essence of Smith’s task was to create objects that would operate predictably, in order for his claims against reason to be broadly sustainable. In addition, given that this was to be a harmonious development, which would therefore preclude the intervention of the state, nothing can act in a sub-optimal way.

Smith’s solution is to utilise the theory handed down to him by Quesnay \textit{et al} in an entirely new way. He turns it from a static presentation of the flow of wealth into a cyclical representation of the dynamics of development. To put this another way, he abandons the Physiocrat presentation of economic growth as a mandated, concrete process and instead invents for us, in Foucault’s words, a picture of wealth ‘organised and accumulated in a temporal sequence.’\footnote{Foucault, \textit{Op. Cit.}, p. 255} The result of this is that the ‘mode of being of economics’ is thereafter always linked to ‘the time of successive productions.’\footnote{Ibid., p. 256} The Physiocrats had utilised a conception of distribution in which the same process is continuously reproduced. By making
technological change knowable in abstract, by dislocating it from actual technologies and concrete changes, Smith is able to add the production process to this cycle. Thus he creates for economics a mode of time where the single cycle is sufficient to account for, through its repetition, an indefinite period, since it no longer requires a supplementary, concrete end. Only a conception of progress without reason can be represented as cyclical repetition. Reason must leave its marks, show its accomplishments. Now, far from being a contingent servant of the state’s will to create progress, technological change becomes the passive result of a system of liberty. The exact procedure by which it appears is, naturally, variable, but that appearance itself corresponds exactly with the regular and predictable needs of the economic process. This is, of course, embodied in Smith’s view of man: the original homo œconomicus who, as we saw, is argued by Smith to be in essence indistinguishable from his peers, except where iniquitous institutions and artificial circumstance have limited him. This, naturally, had to be the case, as any potential irregularity would distort the harmony and predictability. In effect though, technological change is made into a static object, all aspects of which, including invention, operate identically in the past, present and future. This is all, however, only implicit in Smith. It would take, as we shall see in the next chapter, the abstracting tendencies of Ricardo to turn this into the method of economics that we know today: the simplified, static model of equilibrium growth around which the entire discipline turns.

However, though Foucault recognises the development of cyclical time in economics, he ignores entirely the presence of technological change, with two consequences. The first is that the finitude of humanity becomes central in Foucault’s reading of political economy, with homo œconomicus ‘the human being who spends, wears out, and wastes his life in evading the imminence of death.’\footnote{Ibid., p. 257} This is a reading that completely overlooks the
optimism of Smith and the vitality of the system he creates, as a result of missing the crucial role of technological change in the spread of opulence. This is not merely an important element, rather, given the way Smith’s system is set up – diminishing returns continuously offset by technological change – it has a determining effect on the entire character. The second, logically enough, is that scarcity becomes an issue of ever-increasing importance, with the steady-state that is at the end of this process taking on a much more meaningful role. Now, it is obvious to say that, absent technological change, a final state of some kind must emerge in economic theory. Baconian progress at its most basic is a picture of an unyielding nature coerced through man’s ingenuity. Without the latter, man is impotent in the face of nature’s parsimony. However, the steady-state should only be understood as a theoretical reminder of this essential Baconian element. It is the necessary binary opposite of any conception of progress in which technological change is the sole dynamic factor, becoming an immutable presence that hovers over the process, always possible and yet forever held at bay. However, an analytic necessity that is possible but cannot be charted temporally is of little innate consequence for a theoretical structure based on repetition, rather than determined linearity. And with static now made dynamic, Smith’s progress becomes one of infinite cycles; a process of change manifested in identical repetition, with all elements, including technological change, now entirely known. In reality, it becomes what is now referred to as steady-state progress though, as we shall see in the next chapter, it would take the abstracting genius of Ricardo to really make this happen.

In this chapter we have seen that Smith’s economic system is one relying to a major extent on technological change. This is not something he appropriated from earlier scholars, rather it is a point of clear

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449 Ibid., p. 262
differentiation from what came before him. It is explicable through two major influences: the materialism of Bacon and Stoic natural law. The latter is quite distinct from Newton’s conception of natural law, but Smith is still inspired by the elegant system Newton created and which all his contemporaries desired to imitate. As a result of these influences, technological change is given a natural law grounding and invention becomes a feature of man’s divine essence. When we add to this the cyclical conception of economic time which Smith created, and thus the complete knowability of technological change, it will become clear that both the conception of progress and of economic man with which the discipline implicitly and explicitly works, are profoundly influenced by this pantheistic foundation and indeed, still show the unmistakeable residue of their forebears when the optimism of economics in response to climate change is considered. It is the work of the next four chapters to show that the technological optimism we see today in economics arose directly from this particular rationality of progress within the enlightenment, one which, then as now, contained a subject imbued with a divine ingenious essence.
Chapter Five

David Ricardo and Thomas Malthus: The Birth of the Science of Progress

As Schumpeter notes, the period between 1790 and 1870 ‘was the specifically English period in the history of our science.’\textsuperscript{450} The Physiocrats and Turgot had been the leading lights of the pre-Smith era, but following the publication of \textit{Wealth of Nations}, and with the possible exception of Jean-Baptiste Say, English thinkers that would come to dominate the intellectual environment until the development of German and Austrian thought towards the end of the nineteenth century. Moreover, there is little disagreement regarding ‘the key figures of the second generation’ of economic thinkers: they are the pastor Thomas Malthus and the stockbroker David Ricardo.\textsuperscript{451} While Malthus was slightly the older, the prime of their academic lives overlapped comfortably (though Ricardo’s was cut tragically short) and the two most notable economists of the day are thus difficult to separate. They both addressed economic circumstances in their work, albeit to vastly different degrees of empirical rigour, and entered into a very substantial correspondence with each other on questions of economic theory and policy. Their opinions coloured those of the rest of the discipline and much of politics so respective reputations mattered a great deal in terms of influence. It is very much to their credit, therefore, that despite continual disagreement, they remained very close friends until Ricardo’s death. In the final analysis, they were both interpreters of Smith. As Bonar notes, the ‘two economists both start from Adam Smith, as theologians from the bible.’\textsuperscript{452} The question was: whose

\textsuperscript{450} Schumpeter, \textit{Op. Cit.}, p. 382
\textsuperscript{451} W.W. Rostow (1990), \textit{Theorists of Economic Growth from David Hume to the Present}, Oxford: Oxford University Press, p. 51
\textsuperscript{452} James Bonar (1924), \textit{Malthus and His Work}, London: George Allen and Unwin Ltd., p. 209
reading was to be generally accepted since ‘these Scriptures were of
doubtful interpretation.’ Though Malthus had the head start, for a
number of reasons discussed below, ‘this was won by Ricardo.’ We
should not think, however, that Malthus had the less valid interpretation or
lacked influence of his own.

In this chapter, though, we will look primarily at the crucial contribution of
David Ricardo to cementing technological optimism within economics. What
Ricardo invents is a means of defending negative progress through
the method of abstraction; through finding in Smith key objectifications
that, when taken into a model of analysis wherein some of the most crucial
variables are restricted or held outside, seem to show the presence of a
natural harmony underlying the flux and chaos of empirical reality. Jacob
Viner’s perceptive quote sums this up: ‘Not a trace of evidence is
discernible...that Smith in the Wealth of Nations was aware that he was
abstracting selected elements from the totality of human nature. It awaited
a later and keener mind, Ricardo, to discover the possibilities of the
 technique of deliberate abstraction in the field of economics.’ The result
of this is that technology is significantly minimised. However it appears at
strategically vital moments as a deus ex machina in the face of constraints
within the model, thereby preserving progress and discouraging
government intervention. Ultimately, I show that Ricardo’s adaption of
Smith’s discursive objects, most importantly homo economicus, put in place all
the essential elements for Robert Solow and Trevor Swan to separately
create the neoclassical growth model. This model, as we have seen, was the
 inspiration for the formal treatment of technological change within climate
change mitigation models. It also, as we shall see in chapters six, seven and
eight, led to the creation of the endogenous technological change models

453 Ibid.
454 Ibid.
that are now in the ascendancy. The next three chapters will also confirm that Solow and Swan did not really make as radical a leap as is often assumed: they merely emphasised and concretised what was already there, crying out to be utilised, for the same reasons and in much the same way as did David Ricardo. However, as will become clear, in order to understand Ricardo we must consider him in the context of Malthus, his opponent in perhaps the discipline’s most important dispute. Moreover, for our purposes, Malthus is of tremendous interest as the originator of a strange, hybrid rationality: state intervention for the safeguarding of negative progress.

I start this chapter, however, by showing Ricardo’s descent from Smith and note his acceptance of the entirety of the latter’s underlying sociology. I then discuss the same in relation to Malthus, and briefly show how his clash with Ricardo leads him to the mixed rationality mentioned above. This begins to tell us how Ricardo’s method came to be the dominant one within the discipline. Also vital though, I argue, were, first of all, the latter’s espousal of a disciplinary approach that would finally separate the economic from the political at a time when the discipline’s major audience – utilitarian radicals – was disposed towards such a move; and second of all, that his axiomatic and deductive approach was more within the general academic spirit of the times academically, being much more Newtonian than its Malthusian opponent and thus resembling a pure science in the way Malthusianism could not. In order to gain utilitarian support, the first of these was sufficient; but in order to successfully liberate the economic realm from the political, the second was indispensible. Moreover, economics could not possibly be as influential as it is today had its scientific sheen not won it mainstream acceptance. This discussion is quite general, with the real detail of Ricardian economics coming in the subsequent section, when I examine Ricardo’s system, showing that even
on the surface, invention plays a vital role. Further examination, however, seen through the lens of his clash with Malthus, demonstrates that Ricardo deployed technology in such a way as to mask its importance. In essence, he cemented the divine reliability of Smith’s ingenious subject by rendering it active but unexplained, crucial and yet deployed so as to make later scholarship seem a departure, when in fact it merely made more overt that which was already vital.

However, before I begin, it is worth reminding ourselves of the threads the development of which we need to follow to continue our genealogy. We saw how Smith embedded the power to generate technological change, and thus progress, within the individual; how this creature – *homo œconomicus* – when acting in concert with other individuals in the system of natural liberty, formed a unity, a pantheistic whole whose telos was material progress – the spread of opulence – for all of humanity. We also saw, expanding on Foucault, how it was this logic, with progress seemingly guaranteed from the system of natural liberty, that most crucially separated the economic sphere of governmentality from the political/moral/juridical and rent apart a previously overlapping subject. We can see this logic actualised in the move, uneven though it was, towards free trade in the United Kingdom, based on the arguments put forward by Smith’s followers. The promise of negative progress began to generate in actuality what Smith had been doing in theory: the disciplinisation of economics, the separation of it from other spheres, and the concomitant creation of its own subject, economic man.

The latter fulfilled the Aristotelian vision of Smith. Seeing economics as separate further strengthened modernity’s drive towards a new vision of the individual: no longer a political, moral or juridical animal, rather a working animal. There is mutual reinforcement here. From the bottom up,
the new view of man as primarily a worker challenges the traditional, unified Christian subject, and from the top down, negative progress makes the case for the good of allowing this separation. Just as Aristotle posited that the well-run state, for the good of all, would arise from letting man fulfil his natural end to be political, the good of the individual, so Smith, in accepting a Baconian near-reduction of invention to labour, posits the good of all, the progress of society, from letting the individual alone to work. The separation of the economic is necessary to allow this, because the other spheres, not disappearing, clearly impact on the individual. Disciplinisation and separation allow the individual to be free, even in only one of his guises. This ontology is plainly vital for the coherence of the pantheistic optimism of Smith. However, the economic sphere also begins to gain priority over the others, as material well-being becomes the dominant end of the state, a rationality heavily reinforced by the rise of Benthamite utilitarianism.

It is important to stress at the outset that the emphasis placed on technological change in the following pages should not be read as an attempt to argue necessarily for the absolute primacy of technological change as an economic factor in any of the works examined. In other words, I am not trying to say that it is the determining factor. What should be understood, however, and to a large extent this is not controversial, is that technological change plays a vital, necessary role in the workings of each of these theories, even where it is exogenised, or largely assumed away and thus infrequently discussed, or only implicitly so. Moreover, and most importantly, it is being argued that a particularly optimistic understanding of technological change plays a decisive role, likely a far stronger and more nuanced one than has been previously accepted by economists, in underpinning the progressive claims of the branch of economics most discussed here, a branch normally and reasonably encapsulated by the
disciplinary term ‘growth theory.’ Specifically, it is being claimed that this aspect of growth theory, far from being an empirically-derived truth about how the world works, is instead a historically created and metaphysically underpinned discursive object, without which some very optimistic and important analysis and predictions could not be made, particularly insofar as climate change mitigation is concerned.

The Great Divide: Ricardian and Malthusian Methodologies

David Ricardo seems to have been a rather nice man, liked, when not loved, by all who came into contact with him. In his gem of a biography, David Weatherall notes in particular Ricardo’s humility; a virtue regularly remarked upon by friends in letters to third parties. It seems that the young Ricardo was not the beneficiary of ‘what is called a classical education,’ instead finding himself in Amsterdam gaining a generally business-orientated vocational education, and then only for a brief period. Hence it is unsurprising that he would always be ‘conscious of what he called his “neglected education.”’ Ricardo learned what was useful to him for his early life in the City of London and after this, focused deeply on the subject that most interested him, which is to say, economics. There is little evidence from his writings, letters or library that he ever made good this lack of breadth: internally at least, his is a truly unphilosophical political economy, although externally, as we shall see, he maintained a reflexive, if superficial, utilitarianism, likely the philosophical reflection of his economic

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457 Ibid., p. 108
influence upon James Mill, more of which below. Retiring young and very wealthy from his trading days, he serendipitously encountered *Wealth of Nations*, which became ‘certainly the most important book ever read by David Ricardo. It disclosed to him his vocation.’ The practical knowledge that he had of economic matters served him well in his engagement with this book but it also assisted in forming an understandable myopia: Ricardo recognised the economics in Smith, he grasped little else; nor did he feel the need to investigate the non-economic underpinnings of the latter’s work, a trend enthusiastically followed by most economists to this day. The outcome left Ricardo perhaps even more of a strict disciple than Malthus, where Smith established ‘the basic institutional and behavioural framework’ and Ricardo ‘relied on (it).’ Indeed, ‘Ricardo owed very little to any other writer,’ except perhaps Say, himself a Smith devotee.

Importantly though, while Ricardo subjected a very significant amount of Smith’s work to sustained critique and “recoining,” much of it he simply accepted and ignored. As he says himself, ‘(the) writer, in combating received opinions, has found it necessary to advert more particularly to those passages in the writings of Adam Smith from which he sees reason to differ.’ Hence, rather than directly addressing Smith’s key question of the causes of the wealth of nations, Ricardo focuses centrally on distribution, the first paragraph of his preface talking about the three classes amongst whom the ‘produce of the earth’ is divided and setting up the book as an exercise in investigating this system. Ricardo justified this by arguing that little can be truly known about the process of wealth creation, or economic

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462 Ibid.
464 Ibid., p. 5
growth, or at least that little can be known in a sufficiently “scientific” way.\textsuperscript{465} Determining the laws that regulate distribution is therefore ‘the principal problem in Political Economy’ for Ricardo,\textsuperscript{466} a focus which allows him to hold fast those parts of economics which are more temporal and unpredictable and thereby create his abstract engine of economic analysis, a very different approach, which would be his legacy, and which we shall now begin exploring.

Ricardo’s problem was that, in his view, there had been ‘very little satisfactory information respecting the natural course of rent, profit, and wages’\textsuperscript{467} in the work of his predecessors. At the back of his mind, to whatever degree, lay the Corn Laws\textsuperscript{468} and their impact on the British economy: in order to make the case for their removal, he needed to show that rather than being vital for the financial viability of farmers and generally beneficial for the majority of people, they led to an inefficient distribution of resources that harmed the economy quite substantially and benefited no one in the end. To do this ‘Ricardo accepted the essential elements of Smith’s paradigm...the theory of economic equilibrium via the market mechanism’\textsuperscript{469} and showed how an exogenous impact, such as government intervention in this way, distorts optimum distribution and thereby hurts everyone. Ricardo thus advances on Smith in the sense of deepening and focusing his analysis. However his method of doing so in particular is crucial for this study. Advancing on the static, cyclical system created by Smith, in Ricardo we find the origin of the abstract economic modelling that so dominates the discipline of economics today.

\textsuperscript{467} Ibid.
\textsuperscript{468} Mark Blaug (1985), \textit{Economic Theory in Retrospect}, Cambridge: Cambridge University Press, p. 109
\textsuperscript{469} Hollander (1979), \textit{Op. Cit.}, p. 657
This was in stark contrast to Malthus, whose philosophical base prevented him from abstracting in the same manner. He was a firm follower of deism, a way of reconciling God with the world that became very popular during the Enlightenment.\textsuperscript{470} It arose out of the Ockham-Newton complex described in the previous chapter. Ockham told us that natural law was imposed rather than embedded and thus to discern it, we need to observe the world around us for patterns. Newton had done just that in the physical sciences, and the pattern he discovered is amongst the most famous in human history. In the social sciences, again as noted above, others were inspired to try and do likewise, hence Malthus’s statement: ‘We ought not to reason from God to nature, but from nature to God; to know how God works, let us observe how nature works.’\textsuperscript{471} Malthus’s epistemology therefore, like that of so many around him, flows directly from his theology. Bonar sums it up as the feeling that ‘economical reasoning must be a deduction from observed facts of nature and of human nature verified by general experience,’\textsuperscript{472} a much more empirical approach than Ricardo’s, but unsurprisingly identical to the pantheist Smith’s (if we allow both of them their claims to empiricism despite the troublesome presence of God in their writings).

Unlike Malthus then, Ricardo severs the link between economics and philosophical/theological speculation and as a result begins the process of forgetting that has clouded the exact nature of the objectifications Smith created. In other words, Malthus was the last of the Enlightenment political economists, someone who mixed theology with economics and openly held a divinely-inspired faith in progress. Ricardo is the first of the moderns in economic terms: no longer is religion a factor or is there, on the surface at least, any discernible metaphysics in play. Malthus and Smith of course had

\textsuperscript{470} Norman Hampson (1968), \textit{The Enlightenment}, Aylesbury: Penguin, p. 81
\textsuperscript{471} Bonar (1924), \textit{Op. Cit.}, p. 35
\textsuperscript{472} Ibid., p. 212
a significant element of this in their work, indeed most of their economics is only this, but they had one foot in eighteenth century natural law, whereas Ricardo had leaped entirely into scientific economics. As Moss observes, methodologically speaking, Ricardianism was ‘the moment economic orthodoxy came of age.’

Most of what divided Malthus and Ricardo can be traced back to this difference in their groundings. Hence, it is instructive at this point to introduce Schumpeter’s summary of Ricardo’s approach. Schumpeter is an entertainingly vitriolic writer, and he does not distribute his acid sparingly. However, the most famous – certainly the most quoted – passage from his *History of Economic Analysis* is his polemic against Ricardo, in which he outlines what he calls ‘the Ricardian Vice’ – that is, a manifest tendency towards argument through enormously simplified abstraction. Describing how Ricardo dealt with the daunting task of constructing a ‘comprehensive vision of the universal interdependence of all the elements of the economic system,’ he states that:

[in] order to get to this he cut that general system to pieces, bundled up as large parts of it as possible, and put them in cold storage – so that as many things as possible should be frozen or “given.” He then piled one simplifying assumption upon another until, having really settled everything by these assumptions, he was left with only a few aggregative variables between which, given these assumptions, he set up simple one-way relations so that, in the end, the desired results emerged almost as tautologies...it is an excellent theory that can never be refuted and lacks nothing save sense.

Malthus on the other hand strives towards empirical validation and indeed the later editions of his *Essay on Population* contain a wealth of statistical data and serious engagement with the facts of ongoing economic problems.

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Hence it is obvious that they would disagree, to a significant extent, on the character of what is known as “the automatic mechanism.” This vital idea, drawn from the harmony Smith described, supposes that the economic system has an innate correcting tendency. In other words, it sorts out imbalances, such as over-production, of its own accord and much more efficiently than any intervention might: ‘the mechanism which, if allowed to work and if conditions are not too much disturbed, may be held to guarantee in the long run an equilibrium relation between the money stocks, price levels, incomes, interest rates, et cetera of different nations.’

It is obviously, thus, a very significant idea insofar as laissez faire economics is concerned and for the most part, Malthus goes along with it. However, what is known as “Say’s law” puts him in an awkward position insofar as his major concern with population is concerned.

Say’s law holds, basically, that over-production is not really a problem because, money and goods being subject to what would later be called depreciation, there is always a strong enough incentive, in the economy taken as a whole, to immediately buy and sell any product that is made.

Given that an important argument of Malthus’s refers to “moral restraint,” how it prevents man from increasing the population in response to relative abundance, it is unsurprising that he would be in great disagreement with a principle that imagines supply to generate its own demand. To clarify this, the inherent caution that the idea of moral restraint brings to his notion of homo œconomicus cannot ring true with an idea of man as always willing to spend or invest money which, regardless of the version of Say’s law Malthus to which is responding (as Schumpeter points out, there is much confusion on this point), remains a core idea. There is certainly a tendency, he would no doubt agree, but this is checked in practice by a fear

475 Ibid., p. 365
476 Ibid., p. 615
477 Ibid., p. 615-25
of what the future will bring. Furthermore, while moral restraint would ultimately be the method of the most civilised, he argues that another check on population found more prominently in “lesser” societies was laziness, or the unwillingness of people to work hard enough to afford children. He argues, ‘the tendency to expenditure in individuals has most formidable antagonists in love of indolence, and in the desire of saving, in order to better their condition,’ summing up here his major pre-famine checks.\(^\text{478}\) Hence his battle with Ricardo about this aspect of the automatic mechanism. The important point that results from Malthus’s hesitancy, though, is that he cannot accept the perfect harmony of the market encapsulated in Say’s law; rather the market is, as a result of man’s irrationality, necessarily imperfect. However, it seems the much more empirical Malthus could not produce arguments strong enough to challenge the theoretical buttresses supplied by Ricardo,\(^\text{479}\) and though his observations cautioned him against this seeming error, in this case induction lost out to deduction in the court of academic and political opinion, much to Keynes’s later chagrin.\(^\text{480}\)

As a direct result though, with Malthus we get an important detour from Smith, one that will be scotched by Ricardo during his reign as the world’s leading economist and initially by Mill, during his: the reintroduction of positive progress into economic thinking. The negative progress argument had never made the case that, if economic man was to be left alone, from the instant the last regulation was torn up a utopia would spring forth. The Scottish Enlightenment – and Malthus followed this almost entirely – had argued that there is a logic to progress but no necessary end, beyond a vague notion of general opulence; that is, it aims towards continuously better


material well-being. As stated in the last chapter, it is a theory with a cyclical but infinite conception of time. This latter should not surprise us because the entire framework was set up in opposition to ends-based reason, which Smith vehemently attacked as the source of all the world’s problems. Smith was suspicious of the notion that we can envision the good society and how it works and thus we either can speed up our movement towards it or create it entirely ourselves (as in the Rousseau formulation). The problem with Malthus’s arguments in favour of some temporary restrictions on free trade or, especially, his advocacy of public works in times of cyclical unemployment, all of which result from his refusal to accept man’s perfect rationality, is that it implements a form of ends-based reasoning into the equation. Essentially, Malthus, one of the two foremost economists of the period and the greater of the two in popularity for a time, while still maintaining all the Smithian objectifications which support the negative progress case, argued that the state can, indeed must, motivate these objects to act in particular ways in order to generate a situation, knowable in advance, where negative progress can once more take over. In other words, negative progress, with its indomitable power to overcome constraints through technological ingenuity, can be commanded to work towards a particular end. The economy thus is not perfect, but it is perfectible.

While we cannot forget that, for Malthus, this end was the reinstatement of negative progress, from this idea it is only a small leap to the assumption that negative progress, and the technological ingenuity that facilitates it, rather than simply working generally, can be organised to work in a particular way to solve particular problems. Positive progress had always been based on an accord between reason and the human will and aimed towards creating a very particular world. Whether it was the spread of reason, in Godwin’s sense, or forcing people to be free, à la Rousseau, the
idea was that humans conceptualise a vivid picture of what a better world looks like, a picture generated through reason, and will it into existence, either through the state’s will or the will of the persuaded masses. What the end of progress looks like is thus deduced from reason and willed into being, but it is always something that the will can immediately effect: changes in law, for example. Hence, when this is confused with negative progress – hybridised effectively – the will is able to command the objectified subject with all her ingenuity, severing the link with the Providential plan but maintaining the powers with which it works. The will, then, with God-like powers at its disposal, can easily generate any reasoned end imaginable, because it does not have its recurrent barrier any more: material impediments to its actualisation. Rather than just willing a better society into existence then, we can will specific technological conditions, given, firstly, that the subjects involved react predictably and automatically in the face of whatever constraints or incentives you put in front of them; and secondly, given that the passions that are at the heart of negative progress’s objectifications will call on ingenuity to meet these challenges in order to advance self-interest. When we come to examine modern day climate change mitigation models, we will see this hybrid rationality actualised to its fullest extent.

Hence, it would be unwise to be too clear-cut about Ricardo’s influence on modern economics to the detriment of Malthus, especially because, as we will see in detail in the chapter seven, Keynesianism is heavily Malthusian. As Kats notes, ‘The Keynesian Revolution, and therefore the origins of virtually all macroeconomic theory today, can only be understood in relation to Keynes’ coming across Malthus’ economic writings in 1932.’481 Moreover, Schumpeter expresses the opinion that much more Malthusian

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analysis was on the right track (defined in relation to modern economics) than Ricardian. He sympathises that Malthus found himself in ‘the most unenviable position an economist can be in, namely, in the position of having to defend plain sense against another man’s futile but clever pirouettes.’\(^{482}\) Nevertheless, in terms of overall approach, the pirouettes triumphed. Malthus, though less gifted than his friend insofar as logical argument was concerned, maintains a far stronger tie to empirical reality, a method corresponding with the approach of much of the heterodox school of modern economics.\(^{483}\) Ricardo, on the other hand, ‘is a model builder: beginning with just a few simple axioms, he develops an ingenious system through which definite conclusions can be deduced logically.’\(^{484}\) Between them, Malthus and Ricardo represent ‘two different styles of economic argument’ the rift between which is, in the present day, ‘perhaps as deep as it has ever been.’\(^{485}\) However, despite being attacked by more empirical scholars, who question the ‘realism of the assumptions,’ it is the ‘Ricardian style, characterized by a devotion to explicitly mathematical models’\(^{486}\) that dominates today.\(^{487}\)

What advantages does this provide? Well as Hollander notes, ‘Ricardian theory is frequently envisaged as constituting a “predictive engine” par excellence.’\(^{488}\) Ricardo recognised how an abstract approach to economics would allow it to be more than broadly prescriptive: that rather than simply arguing that a particular policy would have a particular negative effect, such as Smith had done with regard to Mercantilism, one could take even very small variations in policy and show their systemic consequences. ‘Ricardo grasped better than any predecessor the conception of economic theory as

\(^{482}\) Schumpeter, Op. Cit., p. 483
\(^{483}\) Maclachan, Op. Cit., p. 564
\(^{484}\) Ibid., p. 563
\(^{485}\) Ibid., p. 564
\(^{486}\) Ibid.
\(^{487}\) Ibid., pp. 563-74; see also Geoffrey M. Hodgson (2001), How Economics Forgot History, London: Routledge, p. 5
\(^{488}\) Hollander (1979), Op. Cit., p. 637
a general purpose analytic engine. The basis of this was ‘the method of comparative static analysis that Ricardo invented.’ Comparative statics is, rather straightforwardly, the idea that one examines two equilibrium states (insofar as prices and so on are concerned), one prior to the effect of an exogenous variable, and one after it. The idea is that the cause of the variation is not at all explained by anything going on in either state nor is the period of disequilibrium caused by the variable examined; rather the new equilibrium state, once established, is used for the comparison. Typically it examines things like demand and monetary policy, while Ricardo used it to examine the effect of the Corn Laws. Of course, comparative statics analysis is not the entirety of modern economics, but Ricardo’s usage of it differentiates him from his predecessors: it is considered a scientific approach, theirs are not.

The Emergence of Ricardian Economics

Thus, as we have seen, the crux of the difference between Malthus and Ricardo revolved around ‘the nature of the new science of political economy[.] Was it a pure science, with the invariable laws of a pure science? Or was it a social science, to be adapted as social conditions changed?’ As we know, it became overwhelmingly the former; and the latter would forever more be labelled “heterodox.” As Foucault notes in The Order of Things: ‘the fundamental event that occurred in the Western episteme towards the end of the eighteenth century may be summed up as follows: negatively, the domain of the pure forms of knowledge becomes isolated, attaining both autonomy and sovereignty in relation to all

489 Ibid., p. 674
491 Weatherall, Op. Cit., p. 77
empirical knowledge, causing the endless birth and rebirth of a project to formalise the concrete and to constitute, in spite of everything, pure sciences: positively, the empirical domains become linked with reflections on subjectivity, the human being, and finitude, assuming the value and function of philosophy. What Foucault is observing is important because it indicates a pre-determination to the Malthus/Ricardo clash but also because it shows how previously overt philosophy became hardened into what would thereafter be considered scientific truth. What had been empirical and disunited came to congeal into sciences, systems in their own right with their own conceptualisations of the subject, the objects that surround her and the relationship between the two. These sciences were then able to dominate what was meant by the empirical realities they interpreted. Of course, the influence of Newton is strongly in play here, with his emphasis on a few axioms and deductive reasoning. Malthus clearly does not fit within this framework, relying as he does on demography for the validity of his economic claims and tending towards a suspicion of “laws.” His work in fact moves contrary to the ‘isolation’ of ‘pure forms of knowledge’ from ‘empirical knowledge’ and towards an anti-disciplinary empiricism. This is an important moment for the development of the rationality then, because it marks the solidification of economics as a singularity. Had Malthus’s methodology triumph, then economics could not have been the coherent system we see today, because it would have allowed non-economic knowledges control over crucial aspects of its empirical domain. We must ask, then, what conditions led the negative progress rationality to triumph.

In looking at the conditions of acceptability of Ricardo’s version of economics though, I am taking for granted the broader epistemological conditions that permitted the emergence of economics generally. Foucault,  

in *The Order of Things*, examines the latter. However, in his later, genealogy-inspired lectures, Foucault deals more with the internal content of economics, and claims, as we saw in the last chapter, that it was the very unknowability of the economic sphere that allowed the drive for its separation from the governmental, and simultaneous constitution as a science, to succeed. Non-interference was solely based on an idea of the economic as being a dark realm of which the government can get glimpses, but never enough to interfere. Foucault pins this analysis on an understanding of the invisible hand as a collection of individual interests which together form a whole that is baffling in scope and complexity and thus deflects interference from government.\(^4\) He also recognises that economics makes a strong claim for the good of untrammelled self-interest by pointing to market self-correction in instances of grain shortages, for example.\(^5\) The problem with these two arguments is that the latter, which in fact comes prior to the former in Foucault’s lecture, is of itself sufficient. Knowable or not, if the good of the economy is better served by non-interference, then non-interference must triumph. But important as this claim is, it rests on a far more fundamental one: that the determining influence of the good of the economy is only explicable by pointing to the ascendancy of a particular view of man – one I characterise above as a “working animal,” whose primary end is the fruits of his labour, as opposed to other views of man – which Foucault treats separately rather than hierarchically. In other words, man’s material self-interest must obviously trump other interests, moral and so forth, in the eyes of government in order for this good (the economic) to be the determining one. If we think back to the Lockean context of Smith, we will remember the introduction in his work of what might be called a minimum content of moral action, amounting essentially to the non-coercion of other


\(^5\) Ibid., p. 275
individuals. The economic sphere, in accepting these precepts which in any case are necessary to allow it to function, fulfils its duties to morality and is then able to claim priority over other moral claims, say, for example, the possibly corrupting influence of greed. From the point of view of man as a virtue-seeking subject or a political animal, whose good is best reached through maximising virtue or involvement in political activity, material interest would likely be trumped by fears of such corruption. From the view of the subject as a working animal, true though these fears may be, they are directed towards a now lesser part of man’s overall well-being, and are thus insufficient to disrupt economic freedom. This view of man is of course the basis for the negative conception of progress in Smith and economics generally: as we have seen, this is a form of progress the goal of which is universal opulence. Even Smith is prepared to accept that this might come at the expense of desirable goods, such as education, but finds these harms insufficient to overturn the good of wealth.

Going back to Foucault’s claims therefore – firstly, regarding the good of non-interference and secondly, that it is unknowability that really lies at the heart of the separation of the economic from the governmental – two things are striking. The first is that there is a tension between these two claims. The grain shortage Foucault sites clearly involves more than one individual. It necessarily involves large numbers of individuals, reified into at least two sets of knowable interests: those that want grain and those that want to maximise their profit in selling it. These are clearly knowable and it is the good of letting them act as they otherwise would that encourages the government not to interfere. But this points us even further: it indicates that Foucault’s overall explanation, as well as being insufficient, is also wrong. The opposite is in fact true, as should be reasonably obvious. It was the very knowability of the economic sphere that allowed the case for non-interference to be made. Much can in fact be known about this sphere and
thus, everything else being held, intervention is potentially necessary. Indeed, Smith’s immediate successor, Malthus, calls, as we have seen, for intervention in a number of areas in order to secure the good of material self-interest. Foucault’s error is to render economics much less aggregated than it actually became: there is no doubt that it rested its claims on *homo economicus* acting in his own, and everyone else’s, best interests, and these interests were manifold and true to that individual alone, but they were also able to be quickly reified into those of capitalist, labourer and so forth. Amalgamated interests were clearly knowable, and thus the interests of the individual represented by them. Foucault is certainly correct when he argues that part of the claim made by the discipline – notable, explicitly, in Bentham – for the good of non-intervention was that no one knows a man’s interests better than the man himself.\(^{495}\) However he stretches this drastically beyond its intended meaning. Sure, one must not coerce someone into taking what they do not want, but no one argued that this, in principle at least, means you cannot assist in giving them what they clearly do; for instance, providing unemployed workers with jobs. Hence, something else was clearly going on in the period Foucault identifies to explain the separation – of man’s (governable) legal and (non-governable) economic sides – that he discusses.

This something was most likely utilitarianism; it functioned as a condition of acceptability for Ricardian economics. We must remember that the forerunner of what is now referred to disparagingly as neoliberalism, was in fact considered profoundly radical. Right up until the rise of socialism, it was the Radical wing of the Whig and later Liberal party – particularly associated with Cobden and Bright – that most outspokenly fought for the good of the working classes, in parliament and out. Their positions were underpinned by Benthamite utilitarianism and the free trade argumentation

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\(^{495}\) Ibid., p. 281
supplied by Smith and Ricardo.\textsuperscript{496} Indeed, Cobden and Bright’s first political foray together was as part of the anti-Corn Law league. However, utilitarianism is in principle by no means a non-interventionist doctrine; indeed it necessitates intervention when it is seen to be for the good. There is no \textit{prima facie} reason why this would work any differently in the economic sphere. However, as Halevey notes, there has always been an interesting incongruity between Benthamite utilitarianism’s juristic theory which calls for government “to create an artificial harmony between the interests of individuals and the public interest” and its economic theory, where it “reaches laissez-faire conclusions on the basis of an implied natural or spontaneous harmony of interests.”\textsuperscript{497} This latter probably goes too far: the idea of a ‘natural harmony’ cuts a little too close to natural law theory and we are all familiar with the utilitarian view on that diverse creed. Moreover, Bentham explicitly calls for some government intervention in nominally economic domains, for example, the compensation of technologically unemployed workmen and universal free education.\textsuperscript{498} Nevertheless, we cannot escape his overriding rule of government action insofar as the economy is concerned: ‘without some special reason, the general rule is, that nothing ought to be done or attempted by government.’\textsuperscript{499}

How might this be explained? Well partly there can be little doubt that it is due to no more than the simple fact that Smithian economics was “in the air” by the time of Bentham’s intellectual maturity; if there is an implicit ‘natural harmony’ in Bentham’s economic writings, it was no doubt imbibed from Smith. More importantly, though, what we must recognise is that the economics of \textit{Wealth of Nations}, when shorn of its natural law

\textsuperscript{496} Moss, \textit{Op. Cit.}, p. 487
\textsuperscript{499} Bentham, \textit{Op. Cit.}, p. 33
footing, is very amenable to utilitarianism, though it predated Bentham’s foremost assertions of his philosophy and thus could only be conveniently, rather than deliberately, amenable. Nevertheless, in Malthus, as we saw, advances on Smith were used to support interventionist policies on utilitarian grounds, such as the Corn Laws, which Malthus, after some initial doubts, determinedly advocated. However, of himself, as we have seen, Smith was a sworn non-interventionist, arguing firstly that the economic sphere was most utile when left most to its own devices, and secondly, that government intervention was normally little more than the influence of powerful classes manifested towards their own, and few other people’s, best interests. The Corn Laws seem like a textbook example of this: the landowning classes, represented in the main part by the ubiquitous Tory-squire backbencher, who made up the bulk of that party, and the more conservative elements of the Whigs, uniting to support the wealth of their own kind against the interests of the growing urban poor (and, through the impact of high corn prices on the cost of production, the capitalist class). This should display clearly the political lay of the land insofar as utilitarianism was concerned, for industrial Manchester was almost synonymous with Benthamism and free-market radicalism.

Hence, in explaining why utilitarianism was so closely tied up with non-intervention, we only need to recognise that the government was controlled by the political enemies of Bentham, James Mill and their followers. This was far from a hidden or even implicit point of view on their part: James Mill’s famous essay of 1820, *On Government*, took to frankly embarrassing extremes Bentham’s premise that ‘legislators served only their “sinister interests.”’ An economic sphere where the sovereign ought not to meddle was the clearest way of reconciling utilitarianism with classical political economy, given the nature of the contemporary legislator.

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Essentially, Smith had shown the utility of non-intervention and Benthamism wholeheartedly accepted it. Thus when faced with a choice between two interpretations of Smith, both claiming to be utile, but one of which clearly sided with their political opponents, both in theory and in practice, it is not hard to see why the other was embraced by the utilitarians. Indeed, in this battle Ricardo was their explicit political ally;\(^{501}\) we should note again that his entire economic theory was driven by a desire to denigrate the Corn Laws. It would, of course, be their influence that would carry through the discipline for the remainder of the nineteenth century. Both political economy and utilitarianism, in their more academic forms at least, were ideas of the radical left in Britain at that time; the versions of these ideas that were likely to be accepted were those that appealed to this audience. As Bonar notes, ‘(t)he influence of Utilitarianism, and especially of Bentham’s Utilitarianism, on Political Economy has been profound and enduring. It is certainly not by accident that nearly all leading English economists, and a large proportion of Continental economists since his time have been Utilitarians when they had any philosophy at all. This applies to Ricardo.'\(^{502}\) Hence, Jeremy Bentham and James Mill embraced Ricardo, particularly the latter,\(^{503}\) which meant that his son, victim/beneficiary of perhaps the most famous education in history, became a Ricardian just as he became a utilitarian, carrying forward the latter’s method, though in disposition he would differ significantly by the end. In the final analysis, then, it was the utilitarian audience that would ultimately dominate the discipline. Thus, in convincing Bentham and James Mill, by far the principle utilitarians of the early nineteenth century, Ricardo’s economics would be the one in the ascendancy: as Dorfman notes, Ricardo’s *Principles of Political Economy and Taxation* ‘was the most

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authoritative and influential text on economics published in the 75 year span between Smith’s *Wealth of Nations* and John Stuart Mill’s *Principles of Political Economy*. However, the relationship between liberalism and economics was not one way; they came of age in partnership with each other. Free market theories could speak to all strands of liberalism and just as the scientisation of economics propelled the discipline into the political mainstream, so it assisted in raising up liberalism alongside it.

To understand this more clearly, we must begin by recognising that Gunnar Myrdal was right: the separation of the economy from the state was dependent on the promise of good outcomes. That is, the automatic mechanism, the fundament, as we saw earlier, upon which non-intervention is based, makes a claim for the public good, but ‘the moment it could be shown that the mechanism does not work, or does not work that way, general morality would reassert its claim on (the economy) and authorise political intervention.’

Embedded as it was in the utilitarian framework, of this there can be no doubt. However the automatic mechanism, in a cruder form, is a Smithian idea and indeed, the necessary conditions for separation were ‘all assembled for the first time in the *Wealth of Nations*.’ Nevertheless, the complete emancipation of which Foucault and Dumont speak could never have occurred until Ricardo took Say’s law and, welding it with Smithian premises, forged an abstract economic system and thereby, a plausible case for Malthus being wrong and intervention thus unnecessary. In other words, rather than being dependant upon potentially capricious empirical reality, the grounding both Smith and Malthus employed to significant degrees, Ricardo made the economic

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506 Ibid., p. 38
sphere deductive\textsuperscript{507} and thereby set it free. It now adhered to Newtonian premises and therefore could claim to be a science in and of itself, attaining, going back to Foucault’s words, ‘both autonomy and sovereignty in relation to all empirical knowledge’ rather than being itself defined and shaped by it. Utilitarianism and the demands of contemporary politics made this possible, but Ricardo supplied the theoretical justification: as Dumont observes, ‘the distinctness of the economic domain rests on the postulate of an inner consistency \textit{orientated to the good} of man;\textsuperscript{508} in other words, that the economy could, through its own internal and independent mechanisms, ensure the good. Only in Ricardo would this be fully and scientifically demonstrated; Malthus pointed in another direction. The question remains though: how did the Ricardian system persuade that it was to the good? Remembering Myrdal above, it could not have survived the test of utility without this and hence, the separation could not have occurred. We do not have to look very far, however, given Ricardo’s ties to Smith. The ‘system of natural liberty,’ as we have seen, led not coincidentally in the direction of progress but rather was intended to be progressive. Smith had a divine faith in progress and was simply charting its conditions of possibility. For Ricardo, then, absorbing Smith’s optimism at face value, we have a system ‘orientated to the good of man’ simply because everywhere within Smith’s creation lay progressively-operating objects, most important of all being man’s ingenuity. In accepting these assumptions and eschewing empiricism, of course the system was going to be orientated towards the good of man – it is everywhere imbued with the divine. Therefore, washed of the outward signs of this deeper essence through Ricardo’s great forgetting, negative progress is given entry to modernity.

\textsuperscript{507} Hollander (1979), Op. Cit., p. 653
\textsuperscript{508} Dumont, Op. Cit., p. 37 (emphasis in original)
Herein we have the crux of the advance made upon Smith by Ricardo: the former spent most of his time outlining the significant elements of the economic system and describing their nature, the latter put them firmly together, took this nature as read, and showed how the elements were of themselves entirely sufficient to explain the economy. For instance, Smith outlines the importance of profit for capital accumulation, Ricardo traces exactly how it fluctuates through its interaction with the other elements Smith created. As Weatherall puts it, ‘Adam Smith explained what the capitalist system was. David Ricardo explained how the capitalist system works.’\textsuperscript{509} Smith’s system only attained inner consistency by reference to theology and philosophy; Ricardo seemed to offer a system that was consistent without either of these. By simply taking for granted all of Smith’s ontological precepts – and with a Stoical turn of phrase that is likely unknowing, but nonetheless telling – economics became for Ricardo ‘eminently an organic science (no part, that is to say, but what acts on the whole, as the whole again reacts on and through each part).’\textsuperscript{510} In other words, it functions as a self-contained system without leaving the realm of the economic. Each part is knowable, as are its effect on the other parts and the system as a whole. This, as was indicated above, was vital for the creation of economics as a discipline, to cement its frontiers and discursive objects and it was quickly reflected in parliament, where David Ricardo himself played a decisive role in the process of politically actualising this theoretical split, even if it could never be a finished process. He was the discipline’s first politically influential “expert”\textsuperscript{511} and beyond his lifetime, as Blaug notes, ‘Parliament increasingly succumbed to Ricardian policy proposals.’\textsuperscript{512} Indeed, it was Ricardo’s theory of rent that ultimately convinced Peel and the Peelite wing of the Tory party to abolish the Corn

\textsuperscript{509} Weatherall, \textit{Op. Cit.}, p. 39
\textsuperscript{510} In Weatherall, \textit{Op. Cit.}, p. 123
\textsuperscript{511} Weatherall, \textit{Op. Cit.}, p. 103
\textsuperscript{512} Blaug, \textit{Op. Cit.}, p. 136
Laws.\textsuperscript{513} From then on public debate about the discipline was to be conducted in terms set by the discipline itself, with utility the arbitrating principle. Of course, Smith and Malthus began this process, but Ricardo’s break was the decisive one, wherein challenges to these assumptions – \textit{homo oeconomicus} foremost amongst which – were rendered heterodox. Overall though, it is plain that while utilitarianism and the politics to which it attached itself were the crucial factors in Ricardo’s triumph over Malthus in the battle for Smith’s legacy, by itself it was not sufficient to render Ricardianism politically significant and thus effect the emancipation of the political from the economic. Ricardo’s Newtonian method – and thus his superior claim to scientific rigour – would be necessary for this to occur in practice as well as in principle. However, even within disciplinary terms, the elegant functioning of Ricardo’s system is an illusion, achieved by ignoring or fixing not merely the theological and philosophical aspects of Smith, but also the unavoidably economic and yet inconveniently unpredictable parts of his work, most notably technological change. We remember Schumpeter’s words above: how Ricardo “froze” the problematic elements of Smith’s creation. They apply to technology perhaps more than to any other part.

**Ricardian Economics and Technological Change**

For Ricardo’s ‘direct knowledge’ of technological advance was ‘extremely limited,’ as Rostow observes.\textsuperscript{514} The point has been laboured a little, but in this regard, as in so many others, Smith’s investigations underpinned Ricardo’s abstractions: as Schumpeter notes, the ‘sociological framework he

\textsuperscript{513} Joan Robinson (1964), \textit{Economic Philosophy}, Middlesex: Penguin, p. 35
\textsuperscript{514} Rostow, \textit{Op. Cit.}, p. 89
took for granted. What Schumpeter is getting at here, and he goes on at some length about this in his *History of Economic Analysis*, is that Ricardo added nothing to the work of detailing and analysing the empirical circumstances which lead people to act economically in particular ways. There can be little doubt, given that his own name was made in this regard, that Schumpeter is thinking in particular of technical change, and Ricardo’s relative failure to engage with how the process operates. Ricardo simply assumed that Smith had the ‘basic presuppositions about human beings in society’ fashioned correctly and then worked deductively from the assumptions Smith provided: meaning, effectively, that he adopted *homo oeconomicus*. Again, it seems likely that Ricardo’s education simply lacked the historical breadth and depth necessary to allow him to think usefully about sociological matters. His abstract approach, therefore, can arguably be read as a doubtful virtue made out of a necessity. However, this would be to do Ricardo something of a disservice. He was very concerned, like any good scientist, with the ‘universality of his theory,’ for it to hold regardless of the circumstances. In essence, he was trying to find the knowable underlying tendencies – the apparently “natural” course of things – and ignoring or “holding” the supposedly unknowable or, perhaps, more erratic ones. Through this process he realises what Smith made possible and thus everything becomes predictable. The abstractions must always respond to their environment in the same way; capriciousness, unreason, lack of information and other particularities are ruled out as unhelpful and probably rare. This should not be read as a dismissive criticism as what remained was still very difficult work, but technological change – a sphere about which Ricardo knew little – was therefore made a constant, albeit in a very particular way. He might otherwise have ended up with Rae’s

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517 Ibid., p. 472
critique of Smith – which valorises at length the glorious and irregular genius of the inventor\(^{519}\) – and thereby rendered his own system contingent upon the vagaries of real-world invention. However by accepting Smithian sociology in this regard, with its reliably inventive subject, Ricardo can abstract ‘from the temporal, causal sequence of human action.’\(^{520}\) Essentially, then, it is a *homo oeconomicus* issue; Ricardo is not interested in how decisions are made under particular circumstances to produce equilibrium (assuming this latter is even possible outside of abstract modelling) but rather in how actors and objects should act, logically, under a defined and simplified set of circumstances that are universal enough to apply, in principle, to any particular set of circumstances. In other words, he “concentrates on describing the changing characteristics of his system in terms of natural behaviour of the variables in the process of capital accumulation.”\(^{521}\) Critics have long recognised how for Ricardo (and mainstream economics in general) equilibrium is automatic – that is, the market is self-correcting – because the ‘static construction’ that is the model in play involves ‘an idealized notion of how economic agents make decisions.’\(^{522}\) That said, the mainstream of the discipline would likely accept this criticism to a degree, but would counter that it amounts to our best guess, pointing, no doubt, to empirical tests which justify these simplifications. What has long been overlooked, though, is that this modelling also involves an idealized notion of agent creativity, and the empirical reality of this – once it is teased out – is dubious in the extreme.

This was important to Ricardo at least as much as it is to modern growth theorists. As he states, the ‘pursuit of individual advantage is admirably connected with the universal good of the whole. By stimulating industry, by

\(^{521}\) In Hollander (1979), *Op. Cit.*, p. 308 (emphasis in original)
regarding ingenuity, and by using most efficaciously the peculiar powers bestowed by nature, it distributes labour most effectively and most economically.\textsuperscript{523} These words could have easily been said by Smith himself, or indeed Malthus, but when Ricardo says them we must realise that they are shorn of the theological confidence that buttressed Smith and Malthus when they offered similar sentiments. This is the key difference between the first two great classical economists and the third one. It essentially completes the process of forgetting that Smith so obliged when he constructed \textit{Wealth of Nations} with little more than touches of his theological base. What is interesting here though is that, like his predecessors, Ricardo locates technological change very much within \textit{homo economicus}; it is a facet of the self-interested actor, rather than, as with Rae, a capacity of a special breed of person. This should not be surprising to us: Bacon’s influence in this regard was likely still being felt and even Charles Babbage, the famous engineer and inventor whose book \textit{On the Economy of Machinery and Manufactures} became an instant and much reprinted best-seller, took a different line from Rae, arguing, like Smith, that anyone, from the capitalist himself to the ‘operative workmen,’ could invent, the latter even being, for him, ‘perhaps, the most successful.’\textsuperscript{524} Moreover, while Babbage’s book was astonishingly widely read throughout society, Rae’s was practically unknown until Mill mentioned it favourably in his \textit{Principles}.\textsuperscript{525}

This universalisation of the capacity for invention, then, would have surprised few amongst Ricardo’s contemporaries. However, at this stage we should not ourselves be surprised to discover that this ingenious subject is never described in Ricardo as it is in Smith: when we get to the application of ingenuity, it is very much reified. For instance, ‘the wealth of a country

may be increased in two ways...by employing a greater portion of revenue in the maintenance of productive labour...(or) by making the same quantity more productive...Of these two modes of increasing wealth, the last must be preferred, since it produces the same effect without the privation and diminution of enjoyments, which can never fail to accompany the first mode. This latter, of course, is not entirely made up of technological change in the sense of machinery – improvements in morale-boosting techniques, for one, could have the same effect – but ultimately there are diminishing returns to all other options and, in the final analysis, it is technological change in the sense of machinery that keeps the economy moving.

Exploring this conception of growth further, and recognising here Ricardo’s contribution in the elaboration of the role of optimum distribution within a broadly Smithian growth-framework, we begin to see that in Ricardo, technological change is objectified in a strikingly different way, even as it is a development of Smith’s premises. This is discussed explicitly below, but Hollander points to it when arguing that despite ‘its emphasis upon the effects of new technologies on savings potential, the Ricardian argument is strikingly static. It rejects the phenomenon of general or economy-wide expansions in demand arising from opportunities created by secular growth.’ Indeed, Ricardo is convinced that ‘both the rate of return and total profit tend to fall together in a mature economy.’ This kind of analysis, which rejects, for instance, increases in demand coming from new markets abroad, of the type that Malthus envisaged has somewhat fairly led to Ricardo being labelled a pessimist by the likes of Schumpeter (more of which below). We must remember that for Ricardo as for Smith, the growth rate is entirely determined by the profit rate. That is, in order to

528 Ibid., p. 335 (emphasis in original)
have an increase in goods produced in an economy, we must firstly have sufficient capital (which is achieved through profit) and secondly the incentive to invest it, the latter being derived from the expected rate of return; in other words, the profit rate.\textsuperscript{529} As we have seen from above when discussing Say’s law, Ricardo has little interest in demand-side economics of the kind about which Malthus worried. Once something is produced, it will naturally create its own supply. Hence the idea of stimulating demand in order to increase production is both unnecessary and logically nonsensical for Ricardo: demand is stimulated, insofar as the word even applies, through production, in other words, through making products in the first place (he does accept that over-production can occur but only temporarily and then quickly corrected). Hence we come to see the importance of technology for Ricardo. Since all depends on profit – it needs to be as high as possible for both accumulating capital and spurring spending – what determines profit ultimately determines growth. Obviously the wage-rate is vital here, but that can only be reduced so much without the intervention of machinery (say to subsistence). But it is the major cost of production and thus has the greatest impact on profit.\textsuperscript{530} Therefore, reducing the wage-rate is the key to maintaining profit, accumulation, investment and thus growth. And the most obvious, and in the final analysis, only continuous means of reducing the wage-rate, is the intervention of technological change. Through the introduction of machinery, labour can be laid off, either reducing the total amount of labourers, or reducing the number of skilled labourers employed at higher wage rates. This should not, though, be thought to mean a natural progression towards a “reserve army of the unemployed,” as Marx would have it (though it is from this that he got the idea), because the saved money is almost always invested again, in expanding the business to scale

\textsuperscript{529} Ibid., p. 318
or through investment in new businesses (there is an exception to this, but it is important for other reasons and thus is discussed below in detail). Nevertheless, this analysis has seen Ricardo often criticised for being ‘an apologist for the moneyed classes’ though in fact, as Hollander puts it, “demand for labour” rises in the Ricardian world with accumulation, engendering a positive effect upon the real wage, or employment, or both, depending on labour supply conditions. Thus profit is the source of wage increases and increased employment as well because it naturally tends towards a demand for labour in order to facilitate its reinvestment. The only part that might not be reinvested (all saving for Ricardo is reinvestment, remembering Say’s law) is that part that is spent on luxuries; for example, menial labour, because this latter is classed as unproductive. We can see, therefore, that Ricardo’s theoretical support for the idea of negative progress is at least as strict as Smith’s.

In any case, what sort of conception of technological change is Ricardo employing here? For the most part it is the rather vague conception, normally referred to now as factor substitution, wherein one factor of production, always labour for Ricardo, is replaced by another, in this case machinery, which falls under the heading of capital. We shall follow this thread also since perfect substitution, as we saw in chapter one, is the key to the technological optimism exhibited in response to resource constraints. However, Ricardo also relies crucially on regular, but unexplained, interventions by technology not directly caused by internal variables; this is usually referred to as exogenous or autonomous technological change and I follow that herein. In any case, some deduction is required to tease out how this operates in Ricardo’s system. Given his frequent insistence that he was not attempting to refound the discipline,
but only to develop certain aspects of Smith’s work – in his words, to “publish only those parts of the science which have particularly engaged my attention”\textsuperscript{534} – it seems safe to assume that it is Smith’s tripartite conception of how technological change occurs that he has in mind. This lay at the heart of growth and progress for Smith, so his focus was on describing invention explicitly in order to understand the conditions of possibility for progress. Hence, while invention could be exogenised for Ricardo, for Smith it had to be endogenous; that is, caused by deliberate actions accounted for in the theory. Ricardo is interested in the distribution of resources though, so for him invention is only a means towards a different analytic end. Thus he could be content to simply have technological change as background noise in his work, steadily progressing and awaiting the need of the economy. That said, let us remember that Smith’s inventors engaged in invention because it improved their own material conditions: be they labourer, owner or “philosopher,” their ingenuity was engaged by the possibility of working with greater ease, making labour cheaper or simply the possibility of selling the invented product at some point. However, there is no reason to assume that each invention was immediately adopted. Indeed, all likelihood points to the probability that they were not. We can easily imagine an invention that is not cost-effective for its target industry until a particular wage-rate or, as was discussed in the last chapter, a particular scale is reached. In effect, then, an interpretation of Smith that sees invented technologies awaiting deployment is as likely as one that sees them immediately deployed; indeed this ambiguity very likely suggests both were in his mind. It is my argument that the former was the first step towards exogenous technological change in the modern sense. Exogenous technical change makes no attempt to discuss where and how the invention is taking place; it simply assumes a

\textsuperscript{534} Weatherall, \textit{Op. Cit.}, p. 125
sufficient or plentiful rate as an external factor and implements it separately through factor substitution and through its direct impact on growth. This leads to some rather sanguine appraisals of the potential for future growth, not least of which in Ricardo.

**Ricardo and “Pessimism”**

We must ask ourselves, then, why in the traditional interpretation Ricardo was viewed as a pessimist? For much of the past century and a half, disciplinary wisdom held that regarding technological change, Ricardo added little of note, and that little was overwhelmingly pessimistic. This latter is decidedly untrue, but even if it was not, one can in Ricardo identify a vital contribution towards how technical change is treated within the discipline. Nevertheless, engaging with this point of view serves very well in highlighting the precise nature of technological change for Ricardo and the connections it has with the neoclassical position to be seen in the next three chapters. However, the role of technological change within his work is one of many highly disputed issues within the historiography of Ricardo’s economics. To a large extent, this does not concern us, but it is important to discuss it briefly because this chapter is much more (though far from completely) in accord with proponents of the ‘New View’ than with the more traditional. Proponents of the latter have long held the idea that Ricardo’s work is pessimistic and it was only in 1979 with Samuel Hollander’s book, to which I am indebted, that a move began to demonstrate Ricardo’s links with the marginalists of the late nineteenth

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century and thus modern economics. In any case, this academic dispute is much more about his concrete analysis than about his method, which is what concerns us most, although it is vital that Ricardo’s particular placing and construction of technological change be recognised because it had a demonstrable influence on how this subject would be treated in the discipline ever after, as I have begun to show. In this respect, Hollander’s emphasis on the technological within Ricardo is much more useful: one of his principal objectives is to demonstrate ‘the significance of technical change, from the standpoint of Ricardian analysis,’ describing Ricardo’s ‘keen awareness of the potency of new technology’ to the point that even in the heat of the Corn Law debates, he still regarded long-term growth as assured. Hollander’s focus, though, is not on the precise organisation of technological change and though his exhaustive discussion assists us in putting this together, he fails to address the links that this chapter draws, through Ricardo, between Smith’s work and, ultimately, Solow and Swan’s. To his credit, though, he is most responsible for the growing acceptance of Ricardo’s progressivism and for highlighting the weaknesses in the arguments of those who see him as a pessimist of limited influence. This latter is our next concern.

Schumpeter serves as a good place to start. True to form, he provides us with the most succinct summation of this pessimistic impression of Ricardianism and second generation classical economics in general: ‘[the] most interesting thing to observe is the complete lack of imagination which [their] vision reveals. Those writers lived at the threshold of the most spectacular economic developments ever witnessed...they saw nothing but cramped economies, struggling with ever-decreasing success for their daily bread. They were convinced that technological improvement and increase

536 Ibid.
537 Hollander (1979), Op. Cit., p. 605
538 Ibid.
in capital would in the end fail to counteract the fateful law of diminishing returns...they were all stagnationists.\(^{539}\) Nevertheless, despite wrapping Ricardo and Malthus together in this regard, they were not, nor should they have been, seen as pessimistic for the same reasons. Ricardo possesses little of Malthus’s pessimism regarding population. Insofar as the latter’s theory is concerned, Ricardo states that “the chief difference between us is whether food or population proceeds.”\(^{540}\) His point is that, unlike Malthus, he does not see food production expanding until there is a need for it. Based on his arguments regarding growth, Ricardo imagines new land coming under cultivation only when the demand for labour surges and population growth thus becomes desirable. High wages are the first result of an increased demand for labour, but these wages, as Malthus would agree, usually lead to an increase in marriages (which can now be better afforded) and thus in the population. The result is that the increased demand for food leads less-easily cultivated land to be procured and the subsequent increase in the cost of food will render the real wages (wages taken in the context of the cost of necessities) less valuable, though still higher than before. The overarching difference is that Malthus sees man locked in a constant effort to increase supplies of food, with the knock-on effect of population increases, whereas Ricardo sees population increases arising only from demand for labour, and while agricultural land may be more or less easy to cultivate, he sees no bar on man’s ability to provide the food necessary to feed himself: ‘Food supplies expand *along with* growth of population to satisfy expanded demand.’\(^{541}\) There is thus no Malthusian fear of starvation within Ricardo’s work. Demand for food goes up only when wages do, and when the latter fall back down again, so does demand. There is never a situation where food and population step disastrously out

\(^{541}\) Ibid., p. 331 (emphasis in original)
of kilter. This is the automatic mechanism in action and it means that ‘Ricardo was prone to take for granted the appropriate pattern of resource allocation in any period’\textsuperscript{542} and though of course he was prepared to accept that aberrations like poor harvests could occur, they were, as aberrations, of little interest to him, given his focus on supposedly underlying laws. Nevertheless, for our purposes it is important to recognise how the reliability of man’s ingenuity is involved in this process. It is essential for the very obvious reason that if the population increases, this new cultivation must ultimately feed the extra mouths, and to do so it must be able to produce food at a price they can afford. This must obviously, at some point, involve technological change to make the land more fruitful (more on which below). Hence, whereas for Malthus, population increases are followed by a period of discord between wages and mouths, for Ricardo the required technology is immediately available. As Hollander puts it, ‘there is no emphasis whatsoever on a technical inability to vary \textit{even the food component of the [wage] basket},’\textsuperscript{543} the latter being that portion of the economy necessary to keep labour operating. This conception of inventiveness as simply a lubricant in the automatic mechanism, a part of man as reliable and predictable as his desire to procreate or act rationally, is the one that has maintained its place right up to economics of the present day.

Given this rather optimistic appraisal of the likely development of the population, where do we find the locus of Ricardo’s supposed pessimism? It comes, in fact, as a direct result of this population process and is seen as moving away from Smithian analysis. The reasoning is as follows: Ricardo and Smith agree that with increased growth comes increased population and both agree that in order to feed this population, land that is more

\textsuperscript{542} Ibid., p. 337
\textsuperscript{543} Ibid., p. 332 (emphasis in original)
expensive to cultivate must be employed. However, matters only reach this stage when there is a strong demand for labour, which only happens when total profit is increasing and further labour is required to facilitate further investment (much criticism has been levelled at this analysis for its failure to think through the time delays involved in demographic shifts). However, this also necessitates paying more to feed this labour, meaning in effect that money is transferred from the capitalist to the owners of farm land. This latter class, though, does not use this money as productively as the capitalist would, meaning that for the economy as a whole total profits are increasing, while simultaneously these profits are not being used as efficiently as were previous profits. Hollander argues that this is because landlords are not seen as a generally productive class and Ricardo in particular ‘[implicitly] placed much emphasis on social and cultural variables in his discussion of differential savings propensities between classes’ (we should remember that saving is synonymous with investment for Ricardo). The latter’s evidence for this is sparse indeed and moreover, it does not square particularly well with his general thesis regarding saving, as outlined above. In any case, it is not at all necessary to explain Ricardo’s point. For as the land going under cultivation is less fruitful and generally poorer, it requires a much higher level of labour intensity in order for profit be extracted. This indicates to us, given that wages are the major cost of production for Ricardo, that profits are likely to be low. Indeed Ricardo argues that since it only became profitable to cultivate this land upon a marginal increase in population, it has only just become marginally profitable, just enough to render the cultivation of it worthwhile, although it is of course necessary, in order to feed the population, that it be cultivated. As a result, it yields far less profit than an alternative use in

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544 Ibid., p. 324
545 Ibid., p. 328
546 Ibid., p. 324
547 Ibid., p. 325
manufacturing would yield, since in theory a new manufacturing venture is not likely to be any less profitable than an existing one, and indeed may be more so, an assumption which necessarily cannot be made in agriculture in a relatively well-cultivated country, such as Britain was at the time. In sum, this means that – again taking the economy as a whole – increases in total profits lead to a decrease in the rate of profit as increasing amounts of new revenue go to land instead of manufacturing: that is, the percentage return on investment declines. For Ricardo this had serious consequences: he felt that a declining rate of profit would eventually lead to declining overall – or aggregate – profits: “after capital has accumulated to a large amount, and profits have fallen, the further accumulation diminishes the aggregate of profits.”

In addition, wages go inexorably up, reducing the profit from what manufacturing is still ongoing and thereby rendering the incentive for investment ever more tenuous. Eventually a stationary state would be reached wherein there is no incentive to invest since this investment returns nothing more than the original sum, or worse. Naturally, unless this were to happen at some wealthy state of remove, it would have the consequence of preventing the spread of opulence that Ricardo, Smith and negative progress in general, always promised.

Hence a near-contemporary of Schumpeter’s, Gunnar Myrdal, criticised Ricardo and the Ricardians, on this basis, as being possessed by a ‘deep-seated sense of helplessness’ in the face of the challenges of poverty and recession in the nineteenth century. Equating the two, his argument imagines the triumph of Malthusianism from Ricardian premises, resulting in the expectation that poverty and misery are simply ubiquitous features of human existence. Far from this, for Ricardo, ‘satisfactory living standards in a freely operating system was the prospect envisaged, for (he) was

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548 In ibid., p. 325
confident in the long-run growth rate of labour demand and also in the possibility of an adequate control over labour supplies...\textit{provided that all institutional encouragements of population growth were eradicated from the system.}^{550} Of course, we should not be surprised by such opinions at this stage: faith in the positive tendencies of the free-market and suspicion of government intervention are the shibboleths of classical economics and negative progress. Indeed, Ricardo went a little further than Smith in this regard and even at ‘the international level, unilateral steps towards free trade were recommended and retaliation ruled out.’^{551} He did not deny that some government services, though always ‘unproductive,’ were a ‘necessary evil’ but on the occasions when he chose to spell out what exactly he envisaged, he went little further than the prevention of fraud, although he accepted the need for taxes to defray government expenses and, given his stance during the Napoleonic war, presumably saw the need for some defence spending.^{552} He put his governing principle in this regard quite clearly, maintaining that all legislation should be constructed so as to ‘interfere as little as possible with the natural equilibrium which would have prevailed if no disturbance whatever had been given.’^{553} Ultimately, as with Smith, the purpose of the economy is the spread of opulence or, as it would be phrased today, consumption: “what we are anxious about is to possess an abundance of conveniences and luxuries.”^{554} Moreover, while critics of classical economics often give the impression that he was either ambivalent or positively hostile to the well-being of the poorest, as we have consistently seen, the opposite is true, no less for Ricardo than for any of the others. Distribution issues ‘were of the very first importance’ and as a utilitarian, his concern was for the “happiness of the most numerous and

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551 Ibid., p. 542
552 Ibid., pp. 542-3
553 Ibid., p. 544
554 In ibid., p. 546

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therefore the most important part of the people.”  

His point is simply that it is in the “progressive state, while society is advancing to the further acquisition...of riches, that the condition of the labouring poor, of the great body of the people, seems to be the happiest and the most comfortable.” While critics have accused him (and the discipline in general) of a myopic focus on output (economic growth in our terms), in fact ‘the weight given by Ricardo to the desirability of increased productivity, by way of free trade or technical progress, can only be understood with an eye upon the distribution of the benefits flowing therefore between capitalists and labourers.”

This view, of course, is not necessarily at odds with a pessimistic outlook for returns to capital investment. One can be very much driven by a desire to see the well-being of the poorest increase and yet feel that the future does not hold out much hope for this prospect. However, we also have Ricardo stating confidently his conviction “that the country had not yet nearly reached the limits of its prosperity and greatness.” Insofar as the problem of diminishing returns to agriculture is concerned, Hollander records that his parliamentary speeches were notable for their ‘continual allusions to agricultural innovation; Ricardo’s qualifications to the standard doctrine (of diminishing returns) were irrepressible.” Even taking in the, as he saw it, debilitating effects of the Corn Laws, it is ‘clear enough that Ricardo’s optimism, despite protection, extended to long-term prospects. In any event, the conception of secular deceleration of accumulation is conspicuous by its absence.” In all, we can conclude from the wealth of speeches and letters which Hollander peruses that it was ‘because of the

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555 Ibid., p. 548
556 In ibid.
557 Ibid., p. 549
558 In ibid., p. 625
559 Ibid., p. 628
560 Ibid.
allowances he made for technological progress’ that ‘Ricardo did not envisage the pessimistic predictions which apparently flow from the theoretical growth model to be of great practical relevance.’\textsuperscript{561} The last thing to be answered, though, is how these conclusions are reconciled with the pessimistic ‘basic model’ we outlined above, particularly given the fact that, as Rostow makes clear, Ricardo’s ‘net conclusion flowed directly from his analysis, not from visceral optimism.’\textsuperscript{562} Investigating the differences between Malthus and Ricardo on the subject of technological change will help us to understand this.

\textsuperscript{561} Ibid., p. 600
\textsuperscript{562} Rostow, \textit{Op. Cit.}, p. 89
The Malthusian Critique of Ricardianism

The extended dialogue between Malthus and Ricardo is famous in the history of economics for a number of reasons but perhaps particularly for the lack of mutual understanding involved. Neither ever grasped what the approach of the other was really about. While ‘Ricardo was looking (in Malthus) for a “model” of the type he himself would propound and could not find one,’ Malthus seemed determined to focus the debate on specific cases where Ricardian logic would not hold. The situation is no different in the matter of technological change. Neither seemed to ever really grasp that the other was working with a very different understanding of how it occurs, perhaps due to the rather simple fact that the terminological distinctions that now clarify such differences were not available at the time. They may well have assumed that the other was working with a similar understanding to their own. In any case, there are two distinct parts to the clash, the first of which we need to construct ourselves. What Ricardo never understood is that Malthus saw technological change progressing much more endogenously. Thus they can be seen to differ over the ease with which this change takes place. However, Malthus’s failure to recognise himself the differences between them on this point means that he does not directly criticise Ricardo on the substance of their dissimilarity. The second part of the clash is much more direct, with Malthus arguing that non-wage induced technologies – which, as we shall see, are regarded by both as rare and crucial – can have particularly negative results. In general, their differences on this subject point to an ambiguity within Smith’s work, with each taking different roads out of it in line with their overall approaches.

Malthus’s understanding of technological change rests on the notion that the earth exists for the development of man. Based on his theological convictions, he argues that the “creation and formation” of the human mind is the goal, and towards this end, ‘difficulties generate talents.’ That is, humanity develops abilities in response to natural constraints. This is part of God’s design; we are intended to do so. This harks back to the old trope that “necessity is the mother of invention,” except that for Malthus, like Smith, our invention is predetermined. Progress is part of God’s plan: ‘by contriving that the earth shall produce food only in small quantities, and in reward of labour, God has provided a perpetual spur to human progress.’ Man is necessarily inventive as God planned for us to use this to overcome the constraints he placed in front of us, in order that we may develop. This logically implies that Malthus did not see any difficulties as beyond remedy: they would not serve their purpose unless humans could overcome them, though of course the abstract problem of natural constraints would go on indefinitely. This dialectic between man’s ingenuity and nature’s parsimony thus leads to the same ultimate conclusion as Smith’s efforts: a subject imbued with a constant and reliable inventive ability. This is unsurprising given Smith’s defining influence on Malthus’s understanding of the economic system. But moreover, this theology also implies a negative progress outlook, for government intervention to mitigate harms would retard man’s use of his natural reason and thus his overcoming of difficulties through technology. However, none of this implies a smooth and painless process of development.

For Malthus’s major point in regard to technological change is that ‘(inventions) to save labour seldom take place to any considerable extent,

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564 Bonar (1924), Op. Cit., p. 36
565 Ibid.
566 Ibid., p. 38
except when there is a *decided* demand for them.\textsuperscript{567} This has important implications for the economic system and goes right to the heart of Ricardo and Malthus’s dispute. That is, Ricardo’s emphasis on equilibrium against Malthus’s recognition of disharmonious fluctuations. Ricardo is assuming that the supply of technology is reasonably assured, and that the only serious problem is his identification of a declining profit incentive to use it. Malthus’s outlook is decidedly different: he is emphasising that invention rarely takes place until a rather significant difficulty arises which calls for it, and naturally, this is not a straightforward process as far as Malthus is concerned. Remembering his theological outlook regarding the earth and its problems as a proving ground for mankind, it is not at all surprising that he puts considerable emphasis on the difficulty inherent within this task, although his empiricism also no doubt had a lot to do with it. Rather than a flowing substitution, ‘in the main he laid more stress on trial and error.’\textsuperscript{568} However, an obvious time-lag enters the economy here between the demand and the invention wherein, for instance, periods of high-wages would continue while the inventors involved are struggling. This could have a number of negative consequences, for instance, worker lay-offs or a reduction in supply or demand due to high costs, leading to a period of disequilibrium that would last until the expected technology arrived. Such a scenario clashes with the idea of an automatic mechanism wherein the market immediately corrects price and demand issues. True to type, Malthus is re-emphasising his theme: that life is a ‘competitive struggle’\textsuperscript{569} between man and nature and that nothing will come easily. Moreover, as he stresses in the first paragraph of his *Principles* chapter on technology, ‘(i)nventions, which substitute machinery for manual exertions, being the result of the ingenuity of man, and called forth by his wants, will,

\textsuperscript{568} Tunzelmann, *Op. Cit.*, p. 283
\textsuperscript{569} Ibid., p. 274
as might be expected, *seldom exceed those wants*. Naturally, once invented, they can be passed on but we cannot expect a backlog to build up to any great extent, particularly in manufacturing, where competition is more significant and thus production methods much more uniform. In agriculture however, which in Malthus’s work has little trouble with issues of demand, he does recognise a significant under-use of the latest technologies but for the most part invention will have to be struggled over, potentially causing a period of economic unease. This idea, which of course clashes directly with Ricardo's approach, leads us to recognise a much broader difference between the two: while Ricardo stresses a fluid line of progress, with the worrying diminishment of profits providing the *de rigueur* pessimistic element of the supposedly “dismal” science, Malthus, as we have seen, stresses the cyclical nature of economic hardship. There is, as Tunzelmann notes, an ‘explicit nonlinearity (within) Malthus’s structural forms’ which arises directly from the sense that he has – empirical, theoretical and theological – that the regular bouts of recession he studies and predicts are intrinsic to the system, as opposed to deviations from it with an external cause.

Hence, Malthus’s direct critique of Ricardo’s position regarding technology is only to be understood as part of his more fundamental problem with Ricardianism. Whereas Ricardo was willing to sweep these particular, short-term fluctuations under the rug of his more significant “natural tendencies,” for Malthus, here was the woof and warp of political economy. This Ricardo could never understand; indeed, striving to find a model in Malthus he was occasionally driven to exasperated declarations to that effect: ‘I confess I do not very clearly perceive what Mr. Malthus's

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system is. Malthus’s response was to implore Ricardo to recognise that these short-term disruptions, these ‘serious spaces in human life,’ are ‘the grand object of all enquiries in Political Economy.’ However, this preference in Malthus for ‘messy realistic theory’ met incongruously with Ricardo’s desire ‘to formulate a few universal laws,’ all of which flow from the central plank of *homo economicus*. Hence, Malthus’s attacks on Ricardo are, for the most part, ‘grounded in claims about individual actions or choices’ and this is so in regard to technology as much as in any other area.

As stated, it is unclear the degree to which Malthus recognised the differences between their two conceptualisations of technological change but he is nonetheless driven by his sense that Ricardo’s easy linearity – diminishing returns aside – is rather too comfortable to be real. Thus it is unsurprising that the critique constructed above functions as an attack on the concept of easy factor substitution within Ricardo’s exogenous model, and is directed more towards the timing of the substitution than its actual possibility. However, while in Malthus’s work more broadly, as we have seen, ‘[l]abour-saving inventions are formally treated as *endogenous,*’ ‘innovation’ in his direct critique of Ricardo, ‘is effectively treated as if it were exogenous.’ We know this because his emphasis is on ‘absolute cost reductions,’ that is, cost-savings that do not merely restore the equilibrium price distorted through high-wages but rather produce below-equilibrium prices, a case which even he admits is irregular. To put this in more straightforward terms, what we are dealing with in Malthus’s critique of Ricardo is a situation where an invention has arisen which is cost-

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576 Ibid., p. 566
578 Ibid., p. 568
effective prior to an increase in wages and has been introduced on the whim or insight of an individual, rather than as a result of the variables within the model (say, high wages). While this is outside the core of Ricardo’s model it is in fact much less in line with Malthus’s understanding of technical change. As we will see later, for Ricardo this scenario is what dissolves his ultimate pessimism, but in any case he deliberately excludes this kind of exogenous element. For Malthus it is perhaps inconsistent, but his empiricism always led to that anyway and besides, he does qualify ‘decided demand’ with ‘seldom’ in his major statement on the matter. In any case, he notes that this kind of exogenous, absolute change does not normally have negative consequences: ‘the most usual effect is an extension of the demand for a commodity’ because people who could not previously afford it will now be able.\footnote{Ibid.} However, Malthus also discusses the possibility of absolute cost-reductions in cases of commodities where no increase in demand is likely – one may think of very basic foodstuffs – and argues that, while this frees up revenue to be used elsewhere, without an increase in demand, this revenue may well not be as gainfully employed and thus will not result in a similar amount of labour being taken on as was displaced by the innovation in the first place. This would, for Malthus, have the result of reducing demand in the economy in general, while increasing production, although he readily admits that this case, though it is feasible, is ‘contradicted by general experience.’\footnote{Ibid., p. 569} Malthus’s overarching point here is that the actions of certain individuals within the economy can, even in their own seeming self-interest, be very much out of line with the best interests of the whole, or, in the long-run, even their own. In other words, ‘[f]oresight [is] unlikely to be perfect.’\footnote{Maclachlan, Op. Cit., pp. 283-4} For Ricardo, of course, the ubiquity of demand precludes such worries. Technological change is thus

\footnote{Ibid.}
\footnote{Ibid., p. 569}
\footnote{Maclachlan, Op. Cit., pp. 283-4}
able to function as always to the good and in this case in particular it is important that it does because, as we will see later, it embodies his hopes for the defeat of diminishing returns.

Moreover, Malthus recognises a much broader understanding of the term “self-interest,” which brings him to another critique: that decision-making by economic actors is far from always utility maximising in the material sense that Smith and (later mainstream economists) imagined. ‘Indolence’ is only one of many, indeed perhaps one the lesser, reasons why people do not consume and thus why aggregate demand cannot always be taken for granted. An individual may well feel the additional work needed to afford something, even when it has all of a sudden become feasible that they might due to price reductions, is not really worth the product in question. Even on the level of the capitalist, Malthus points out that the saved revenue from these absolute cost-reductions will not be reinvested unless there is sufficient incentive to do so. He argues that the import market – providing commodities that may be desired – would need to be strong in order for this incentive to exist, because the capitalist might have had his fill of the domestic market or that the further luxuries on offer are not enough to his taste, at least in theory. Thus this lack of end-incentive means that the person may well not wish to put in the extra effort required to earn more money: ‘there must be something in the commodities to be obtained sufficiently desirable to balance this exertion, or the exertion will cease.’\footnote{Malthus (2011), \textit{Op. Cit.}, p. 241} This argument merely exasperated Ricardo, who claimed that all saving is spending, given that, for one thing, if the first capitalist does not invest it, the bank will find someone who will and this latter will do so as productively, one imagines, as the first capitalist who had no desire. However, Ricardo thinks this unlikely in any case because the outlets for
spending in an advanced economy like contemporary Britain were too
great.

It is worth noting, though it is perhaps obvious, that while it may seem by
virtue of this exchange that Ricardo is correct, he is of course not. The
subsequent history of economics has taught us that Malthus’s fears – that
people can often fail to sufficiently consume produced items and that
therefore overproduction is both possible and dangerous – were entirely
correct. In the end it comes back to Schumpeter’s pithy line: that Malthus
found himself in ‘the most unenviable position an economist can be in,
namely, in the position of having to defend plain sense against another
man’s futile but clever pirouettes.’ What Malthus is grasping at is
ultimately sociological: that invention and subsequent innovation can take
place at sub-optimal points in economic cycles is true and turns on the fact
that there are many reasons for it beyond his initial statement about
immediate wants. Evidently, Malthus never saw this clearly enough and
thus failed to give us the kind of analysis that Schumpeter would ultimately
bring, and which we shall see in the chapter seven. Importantly, though,
Ricardo’s response shows how the rest of the economic subject works,
seemingly independently, to preserve this harmony between technological
creativity and negative progress. Say’s law is at its heart the assumption that
everyone recognises absolutely their own self-interest, that interest being
entirely encompassed by the pursuit of material gain. Since the desire of
everyone to consume is so voracious, everything that is produced will be
consumed, since its very production creates an opportunity for someone
else to exchange. Hence the difficulty created by *homo economicus*’s creative
half is immediately resolved by the pursuit of opulence in his other half
while earlier we saw how factor substitution underpinned the optimal (for
everyone) distribution of revenue between the three classes through the

creation of a high real-wage, albeit with apparently negative long-term consequences. Despite this, though, Ricardo described any purported science of growth, of which technology is a central plank, as ‘vain and delusive’ and yet in his attempt to squeeze this aspect out, he only rendered it especially crucial. What is clear to us is then is that his intended separation, distribution from production, is an illusion.

Overall then, Malthus’s point is that the ‘alternative consequences of improved productivity... (if) unaccompanied by an appropriate “distribution” and demand...would be disastrous.’ It is almost as if Malthus dimly recognised that invention was playing an enormous role in the stability of Ricardo’s abstraction, a stability which accorded not at all either with the empirical reality as he saw it, nor his theological base. However he could not get to the heart of it, and instead fell back on his old standard of demand. Indeed, we must bear in mind that Malthus was torn and would, despite the critiques empiricism uncomfortably presented him with, and trying to defend his initial feeling that economic life is a struggle, always come back to the Smithian line on negative progress. For instance, he enormously minimises his above worries by stating that, in practice, ‘there was no reason to expect a collapse of foreign outlets’ and thus, “little reason to apprehend any permanent evil from the increase of machinery.” Malthus wanted to preserve the empirical facts he observed – that life is a struggle – but wished to do so within the Smithian framework of negative progress, which his own theological base was decidedly wrapped around. In any case, what we can see from Ricardo’s side is an abstract structure which allows invention to function entirely as a source of progress. Homo economicus’s readiness to act precisely as Ricardo might wish underpins this positivity. He does allow, however, in a later

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586 Ibid., p. 571
edition of his *Principles*, for a single example of technological change functioning negatively. This discussion serves to illuminate his entire framework insofar as technology is concerned so we will turn to is now.

**Negative Progress and Exogenous Technological Change**

Ricardo’s chapter on machinery is his only extended discussion of the topic. This is the site of his famous about-face, wherein he allows the possibility of technological unemployment. However, towards the end he maintains that ‘(t)o elucidate the principle, I have been supposing, that improved machinery is suddenly discovered, and extensively used; but the truth is, that these discoveries are gradual, and rather operate in determining the employment of the capital which is saved and accumulated, than in diverting capital from its actual employment.’

This is a somewhat strange sentence and its entire meaning is not altogether immediately clear. At first glance he seems to be suggesting that the introduction of technology does not involve the replacement of labour by machinery, but this makes no sense. The entire basis of thinking about technology in classical political economy was about “labour-saving devices.” Indeed, the notion of factor substitution revolves around this idea of replacement. What becomes clear from earlier in the chapter, though, is that he is not at all making such a strange claim. Indeed, he clearly notes, using the example of a manufacturer of stockings, that ‘some labourers would necessarily be discharged’ as a result of the introduction of

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a new machine. Instead he is arguing that, in all cases outside of the very unusual one he describes above, the capital being used to employ workmen will remain doing so, it is just that the workmen ‘would be employed on the production of some other commodity,’ since it is ‘in the interest of those who had it (capital) to employ it productively.’ This confusion being resolved, the rest of the meaning in the sentence can be much more easily understood. What it shows is a rare, explicit explanation of how Ricardo viewed the process of technological change, which allows us to be much more certain of what is only implicit from the abstraction within which he normally works. Two things are particularly important. The first is that Ricardo viewed technology as a predominantly gradual process, wherein existing technology is introduced by firms when it is cost-effective for them to do so: as he states in the same chapter ‘(machinery) and labour are in constant competition, and the former can frequently not be employed until labour rises.’ The rare case he describes in the bulk of the chapter is also one of exogenous change but one where the capitalist orders a part of his workforce to actually build the machine themselves, thereby utilising a portion of his circulating capital, rather than saved revenue as Ricardo feels is the norm. The important point is that this ‘sudden’ introduction of technology is very much the exception for Ricardo; the norm is invention occurring outside of the direct and immediate need of the economy and gradually being introduced as warranted by rises in the wage-rate. In this sense he is obviously pointing mostly to Smith’s third type of inventor – the philosopher who spots a potential improvement that may or may not be cost effective at a given wage-rate. Of course, it is also feasible that the first type – the worker-inventor – is in play here as well. Just like the philosopher, his improvement may also not be cost-effective. The point

590 Ibid., p. 387
591 Ibid., p. 395
with exogenous technological change is that this process is not discussed (naturally, this has always been regarded as its main weakness). As Roncaglia puts it, for Ricardo especially ‘the study of the factors modifying the structure of production is severed from the study of the analytical “core” of the system.’ However, this gradual, harmonious, but externally produced offsetting of diminishing returns is replicated, as we shall see in the next chapter, in Mill, and is a quite vital part of the story. Later, also, we will see it finally concretised in the calculus of Solow. Factor substitution, however, provides a link between the two, wherein previously invented technologies can be introduced as needed. Secondly though, the point is also very significant insofar as claims about his supposed pessimism are concerned. It was traditionally assumed, as is described above, that Ricardo foresaw the rate of profit as on a path of inevitable decline and due to this, predicted the arrival of a stationary state within a quarter of a century or so. In reality, this is a misreading of Ricardo that arises from a failure to recognise how technological change is exogenised within his work. His model fixes it outside the core of his major analytic investigations and thus appears to show an exhaustion of incentives to invest because the profit rate has dropped to such a degree. However, his discussion of agriculture, where systemic diminishing returns are ultimately rooted, tells us the full story.

Kurz has said that ‘Ricardo had a remarkably sophisticated understanding of different forms of technical change and their effects’ and this is true after a fashion: he recognises several different scenarios in which it might be adopted. However, insofar as invention is concerned, Kurz is being

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more than a little generous to Ricardo: as we shall now see, the latter placed absolutely no emphasis on the inventive process and even insofar as adoption is concerned, with the exception of the major example from his chapter on machinery which we discussed above, technology operates after the fashion of a *deus ex machina* in Ricardo’s work, allowing him to reconcile his need for a Corn Law defeating abstraction with the ultimate goal of justifying negative progress and thus the separation of economics from the state. Nevertheless, it is the closest the remarkably extensive literature on Ricardo has come to recognising the significance of factor substitution to his work, even if it misses how his organisation of technological change as a whole created a significant path dependency within the discipline ever after. Examining Ricardo’s own words on improvements in agriculture and their impact is illuminating:

The natural tendency of profits then is to fall; for, in the progress of society and wealth, the additional quantity of food required is obtained by the sacrifice of more and more labour. This tendency, this gravitation as it were of profits, is happily checked at repeated intervals by the improvements in machinery, connected with the production of necessaries, as well as by discoveries in the science of agriculture which enable us to relinquish a portion of labour before required, and therefore to lower the price of the prime necessary of the labourer. 595

The first sentence makes a clear reference to his ultimate logic of diminishing returns which we find in the core of his analytic model. It is this core that is directed at the Corn Laws most specifically and we will return to the need for it momentarily. The second sentence initially makes reference to what we have been calling factor substitution, wherein the improvements that have been made in machinery ‘check’ the diminishment of profits that results from increasing wages. This is the clearest expression

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of what is admittedly somewhat obvious from his model: that machinery is continuously substituted for labour when wages rise. Nevertheless, it sets up an important distinction with the second half of the sentence, wherein he is speaking not merely of checking an increase but indeed of lowering the price of the prime necessary, in other words, food. This allows us, for Ricardo, to avoid the situation of needing more labour, as opposed to simply addressing this additional cost once it has arisen. The effect of this latter observation would be to undermine even the minimal fears still allowable from the first part of the sentence: that at best the profit rate is doomed to remain static and that at least some time must be spent in a period of high relative wages (measured by proportion to profit as opposed to purchasing power), before machinery to meet the problem is installed. This is because rather than constantly checking diminishment, we are in fact able make inroads against it. Both labour and capital (machines) are reliably, but gradually, improving in efficiency, as they will also in Mill and eventually Solow. Thus we can see that outside of the core, Ricardo possesses a concept of technological change that is entirely unexplained but works determinedly towards the preservation of negative progress. Moreover, it is now clear why Malthus’s second challenge – regarding exogenous innovation – was of so little concern to him: it is precisely this which secures us against the stationary state for the foreseeable future.

Curiously though, Ricardo goes on to discuss the effect that factor substitution might have in agriculture in a way that he never does with manufacturing. He argues that it will not have a short-term effect because, and he tries to demonstrate this mathematically, it will lead to reduced rents and thus will not be introduced by the self-interested landlord. Hence agriculture should not be seen as synonymous with manufacturing in this regard. The best that can be said for this is that he is mistaken; Mark Blaug, a well-known modern economic historian, shows with little difficulty that
the actual effect, following Ricardian premises, would be to increase rents.\textsuperscript{596} Blaug is confused by the fact that Ricardo only pursues this kind of short-term analysis insofar as improvements in agriculture are concerned, whereas in manufacturing his emphasis is on long-term change. He tries to explain this strange part of Ricardo’s work as perhaps having ‘something to do with his ideological bias against landlords.’\textsuperscript{597} One possible explanation of this is to point out that easy factor substitution in farming, comparable with that in manufacturing, would have hampered what Ricardo’s entire purpose insofar as the Corn Laws were concerned. That is, if farmers substituted labour for machinery with the same ease as their industrialist counterparts, it would be hard to maintain the idea that the Corn Laws were raising the cost of manufacturing, since the available technologies could mitigate this continuously. This casts a new light on Blaug’s charge of bias: it seems possible that Ricardo recognised this flaw and acted to nullify it. Indeed, this is an interesting example of the difficulty of working with the seemingly omnipotent conception of \textit{homo œconomicus} that Smith provides; although it is precisely this idea, that ingenuity has no cause to distinguish between “natural” and “man-made” constraints, which motors a substantial portion of the climate change policies we see today. In any case, how Ricardo made this error is probably impossible to be sure of and perhaps we ought to give him the benefit of the doubt given his, by all accounts, unimpeachable character. Overall though, we can now see that two related conceptions of technological change are operating in Ricardo: the external and autonomous flow of inventions is primary, but it feeds continuously into factor substitution in order to check wage increases. Just as importantly though, this same flow also throws out a different kind of invention; one capable of more than merely checking the constraint of high labour costs but indeed of reversing the diminishment of returns.
absolutely. Progress, for Ricardo, is thereby sustained because the spread of opulence (manifested in real wage increases), can be maintained even as it leads to a reduction in profits.

With this last point, though, we are getting closer to why Ricardo employs this core/periphery separation which necessitates exogenisation. Hollander’s explanation of it is persuasive; he argues that the ‘model was applied largely in a comparative statics analysis of the consequences of protection...In undertaking any investigation of these issues, it was the obvious way to proceed by assuming for analytic purposes unchanged technology, whatever may have been the prospects for new technology on a historical view.’\(^{598}\) We will remember that comparative statics is concerned with the effects of major exogenous variables, in Ricardo’s case, the Corn Laws. More than one variable would skew the findings. Hence, for the purposes of examining distribution, this suggests that Ricardo fixed technology, keeping it on the outside of his model. However, as O’Brien points out, this is only true to a degree; Ricardo uses comparative statics in an embryonic form that is far from absolute and hence not fully comparable with modern usage.\(^{599}\) Hence we can clarify what Hollander means by ‘unchanged technology’ in this quote. Obviously he does not mean this insofar as factor substitution is concerned; rather the point refers to an important distinction within economic theory – which Blaug identifies in Ricardo though he does not recognise its full significance – between ‘technical progress, which shifts the production function’\(^{600}\) and ‘the substitution of capital for labour along given production functions.’\(^{601}\)

The former (which Ricardo is employing in his treatment of diminishing returns), as explained in previous sections, is referring to a brand new

\(^{601}\) Ibid., p. 133
technological environment, whereas the latter merely allows for the substitution of labour for capital up until the technological capacity of the existing environment is exhausted. Upon formal mathematical models being introduced, these distinctions would become much clearer, but with Ricardo one has to be careful to note when he is dealing with static distribution and when he is discussing issues relevant to growth. Hence Hollander’s point is that Ricardo chooses to ignore all but factor substitution in the core of his analysis because including substantial technological change could potentially gloss over the negative impact the Corn Laws were having on the British economy. Ricardo wanted to demonstrate their harm outside of the lustre of pure technological change, which might only confuse and lessen the impact of his work. He was adamant, quite logically, that even though he recognised that Britain would continue to prosper even with the Corn Laws, he would prefer to live in the best possible world as opposed to a good but inferior one. Of course, one could ask why Ricardo did not simply go one step further and exogenise technology entirely, including factor substitution. The answer is most likely no more than the realisation that this would render any theory of his ridiculous, since substitution is such an intrinsic part of the response to high wages. Ricardo wanted to show the “natural” movement of forces and machinery is clearly too important to be entirely left out. On first glance, this seems more like an honest desire to have exact clarity and avoid misinterpretation, deliberate or otherwise, as opposed to any kind of desire to propagandise.

But the Corn Laws are really only one example of a wider trend which motivated Ricardo. We must remember that Malthus’s empirical work ended up justifying the Corn Laws and much other government intervention as well. Effectively, for Ricardo, shorn of Malthus’s theological

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base, this defeated negative progress and the ‘system of natural liberty’ that was Smith’s legacy. Moreover, it appeared to him to do so on the basis of messy empirics from which the real ‘natural tendencies’ – from which negative progress derives – could not be sifted. Problems of causation would therefore abound. It would be hard to see what was causing what and thus easy to be led to the conclusion that the automatic mechanism of Smith was not working and therefore intervention justified. Abstraction saved Smith’s legacy from this. Ricardo’s model was a direct response to this problem, functioning effectively as a rebuttal to Malthus’s use of the great man’s work: ‘(i)t was out of their controversy around this problem (the Corn Laws) that the new Ricardian system eventually emerged.’

Once cleansed of messy empiricism, Smith’s objects, united with powerful deductive logic, could show that negative progress was in fact possible. This was very important to Ricardo: as we have seen, his theory was always about organising the economy to effect the best possible distribution, over as long a time-period as possible, in order to ensure the spread of opulence. And indeed, with the impact of technological change, he could be very optimistic about the prospects for this, as we saw above. Hence Blaug’s explanation is insufficient: that ‘the core of the argument abstracts from technical change’ is only a part of his wider abstraction from messy empirically-driven analysis. It was all, at heart, designed to set out the Smithian idea that material progress is natural and is only hindered by government intervention. Technological change is obviously crucial to this and has to be maintained but its exogenisation can be understood as a reliance by Ricardo on Smith’s optimistic appraisal of its likelihood and effects and as opposed to engaging in the sort of empirical investigations that lead Malthus to his, significantly different, conclusions.

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Smith’s two sides are thus at the heart of the problem: on the one hand, he develops some still influential and insightful analysis of how the inventive process in fact takes place and the constraints to which it responds, and the likelihood of an additional exogenous invention by philosophers. There is truth to all of this, indeed it probably covers the most part of the climate in which he worked. In more recent years, and dealing with contemporary circumstances, others have elaborated on the relationships between types and modes of invention and economic circumstances, talking about research and development and its relationship with incentives and so forth.\footnote{As we saw in chapter two} However the other side of Smith’s theory was of negative progress, always directed towards universal opulence and crucially facilitated by technological change. The problem is that the direction of technological change in abstract does not square with the empirical reality of how it actually works, either in Smith’s time or elsewhere. In fact, the negative progress theory, the idea that a natural, harmonious progress will occur once intervention by government is minimised, only works with the abstraction Smith created to explain this empirical reality: *homo oeconomicus*. If one attempts to bridge the gap between this abstraction and introduce these real actors and their motivations into the equation, it immediately breaks down, as Malthus tried to show. In fact, at the level of empirical reality, technological change is the cause of discontinuities within equilibrium progress as well as the solution to them; occurs very irregularly; and possesses only a loose correlation with the spread of opulence. We saw some of this in chapter two and will see more when we discuss Schumpeter in the chapter seven. All of this points to a distinct need for intervention given the failure of the automatic mechanism it illustrates. The reason for this unbridgeable gap, of course, is that God underpins the assumption at the abstract level that Smith works with. He could construct it as
harmonious, regular and predictable because of his faith in a Stoic, pantheistic God – a faith in negative progress. And as a result economics has always been driven by the legacy of Smith’s conception of progress: it was this that in Ricardo really permitted the breach with the state and facilitated disciplinisation – the fact that the move could be shown as progressive. This is still the conception that people like Solow are attempting to get to work at the level of formal theory and they thus abstract like Ricardo did, which is the only way of making a Smithian optimism with regard to technological change fit with the variables involved, such as prices, demand, population and so forth. Ricardo’s device – exogenous technological change at a formal level – was a powerful way of working with \textit{homo economicus} through the distribution process and its logical results from Smithian premises without ending up with Malthusian disequilibrium. Attempt to do it as Malthus does and introduce the very differing realities of different kinds of technological change – even only in his limited fashion – and one ends up with a scenario perhaps far closer to reality, as Schumpeter opined, but much further from negative progress, the gold standard of the discipline. In other words, it only works in Smith’s world of divine essences, but with Ricardian scientific economics and deductive logic, and especially with the advent of mathematical modelling, this problem got lost and this part of Smith, forgotten. And yet to this day, the negative progress line – the basis of the discipline – is always what is aimed at, even when Keynesian style intervention is called for: hence the mixing of rationalities that we encountered at the beginning of this chapter.

In the end, what Ricardo does in exogenising technological change is to appear to detach from \textit{homo economicus} the task of inventing. In order to keep the same level of equilibrium while endogenising technological change, Ricardo would have had to propose an analysis of man inventing which utilises identical foresight, judgement and predictability to that which
is embedded within the utility-maximising economic subject that has always been to the foreground in mainstream economic theory. Through this separation, the intrinsic creativity that underpins *homo economicus* and thus negative progress, never gets addressed by critics such as Malthus. Its role in the harmony is missed, while the decision-making abstraction gets the whole of the attack. Malthus, who emphasised the difficulties and potential for misjudgements – “learning-by-failing” – in invention, as in everything else, would likely have lambasted such a casual display of overt technological optimism as he did the simple rationality that is *homo economicus*’s most recognisable characteristic. However, we have no reason to suspect that an attempt to deceive is involved here: Ricardo, we will recall, took the sociological aspects of Smith for granted. Moreover, his explicit recognition, discussed above, of a case of technical change not in keeping with his system’s norm smacks very much of intellectual honesty. Nonetheless, by separating invention from the subject, Ricardo is detaching the face of the theory from the power behind it; in other words, splitting Smith’s *homo economicus* and leaving himself only with the residue of this subject which much of mainstream economics has had to defend since – the predictable, utility-maximising, rationaliser. He thereby avoids having to defend the extra burden of perfect creativity, which in fact does most of the work of rendering Malthus’s disharmonious situations impossible within Ricardo’s own framework. He also performs the trick of empirically accepting these scenarios and arguing against their potential negativity with Say’s law and so forth, while in fact maintaining a theory wherein invention never operates in this way. Indeed, behind the scenes, through the curtain of exogenisation, Smith’s creation continues to operate, responding perfectly to constraints and facilitating negative progress. A lesser *homo*

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is to the foreground, but the apparent detachment is nothing more than illusion.

Lastly, then, let us sum up Ricardo’s contribution to technological change within economics and begin to chart what it made possible insofar as modern growth theory is concerned. We must remember that, as noted at the beginning of this chapter, whatever about his explicit insights into how an economy works, Ricardo’s major contribution to economics was an approach: as Blaug observes, ‘if economics is essentially an engine of analysis, a method of thinking rather than a body of substantive results, Ricardo literally invented the technique of economics.’ It is also vital to remember, as noted, that in his work economics is finally severed not only from its theological base, but also from its particularity. In truth, whereas Malthus had been a genuine empiricist, Smith’s empiricism amounted to little more than an examination of the process by which technological change, and hence growth, takes place. Using the pin factory as an example, Smith gives us three differing scenarios by which invention can occur. Nevertheless, this kind of endogenous analysis was never more than elaboration on a theme: Smith, as we have seen, was certain that people responded to constraints through ingenuity and that this propelled the course of civilisation. He then set out to document how this occurs and why it is sometimes retarded; in other words, to provide its conditions of possibility. However, whereas Malthus pursued the empirical elements of Smith, Ricardo, aided by Say, followed the more distinctly Newtonian path, building up an interlocking system wherein progress was rendered axiomatic. Of course, Ricardo is not a dishonest scholar and both reality and the ultimate logic of his own beliefs often pointed to the breakdown of this system: wages must necessarily rise and profits diminish as a result. The natural course of distribution is not, in and of itself, amenable to the

\[\text{Blaug, Op. Cit., pp. 135-6}\]
continued progress of universal opulence. This is where ingenuity steps in, clearing up the residue in every instance and functioning as a literal *deus ex machina* with no disharmonious results. Without invention the laws of Ricardian science do not stand and without these, and shorn of an unscientific Providential faith in progress, everything is particular; it all becomes messy sociology.

Reliable invention at the heart of Smith’s *homo economicus* makes the ontology work; it is the spring at the heart of the Newtonian clock. For invention does not merely occur and often find a useful outlet: instead it reacts directly and with precise timing to every ‘natural’ constraint, stretching economic growth over a distant horizon and ensuring that wealth is spread with the greatest possible utility. However, in its Ricardian form this is entirely unexplained. For Malthus, it was clearly a part of man, inscribed on his being by God. For Ricardo the scientist, Smith’s subject seemingly has his self-interest severed from his creativity, rending the ontological unity that made freedom for each one progressive for all. This split, however, is an illusion. Technological change, despite being unexplained, unaccountable and thus potentially disorderly, is still precisely aimed at the constraints produced from within the model. Collective necessity still drives the actions of this off-camera creative subject, the interests of one and all remain its guiding hand. God, it seems, is removed but His powers have in fact been secularised. Divinity is hidden behind inexplicability. Insofar as modern exogenous technical change is concerned, this move was a necessary precursor: Ricardo gave us an exogenous invention which renders factor substitution plausible and provides irregular bursts of inventive energy to reverse diminishing returns in a gradual and harmonious way. Swan and Solow, as we shall see, simply subtracted the irregular bursts and replaced them with a continuous rate of change which also acts to prevent diminishing returns. The leap between the two is a
small one and Ricardo’s significance to modern climate change policy becomes immediately apparent. Smith made technological change a knowable and harmonious object, but through exogenisation, Ricardo allowed economics to scientifically preserve this as truth. And at its heart is the man that Smith built: *homo economicus* and his pantheistic ingenuity. The God that was removed long ago is still acting through men, when left alone, to make progress happen.

In conclusion we are brought back to the words of Viner: ‘It awaited a later and keener mind, Ricardo, to discover the possibilities of the technique of deliberate abstraction in the field of economics.’[^608] We have seen how this technique came to dominate the discipline, while also lending economics its crucial scientific air: it would forever after be seen as a reliable speaker of truths. We then examined the traditional argument that Ricardo was a pessimist, bereft of a meaningful contribution to the study of technological change, and found this sorely wanting. It was his desire to rescue Smith’s ‘system of natural liberty’ from the mire of Malthusian interventionism – minimal though this was – that led Ricardo to abstract. He relied, as he always did, on Smith’s sociological base, most significantly in regard to the reliability of invention, and was thereby able to construct a system wherein ingenuity would act as a saviour of last resort, resolving all the constraints the model produced while being spared the vagaries of the empirical inventive process that Malthus had noted and Schumpeter would later emphasise. I also showed that within Malthus’s work we can find an ancestor of the confusion of two formerly distinct rationalities of progress. This mixing is what ultimately allows climate change mitigation policies to make such optimistic claims regarding endogenous technological change, though this approach would be sidelined for some time in favour of Ricardo’s more appealing alternative. David Ricardo, therefore, left behind

him a discipline that eschewed messy empiricism for the equilibrium that could be found in abstract models, obscured Smith’s divinely ingenious subject behind a veil of inexplicability and ultimately maintained a theologically-derived conception of innate progress while forging the economic domain as its own scientific fiefdom. Overall, technological change, while superficially minimised, was in fact set up as an autonomous external force that constantly battled the threat of diminishing returns and was really almost waiting for Solow and Swan to adapt it into a continuous rate of change.
Chapter Six

Mill to the Marginalists: Continuity and Formalism

In chapter two we saw how the various approaches to modelling technological change all took for granted the idea that invention would operate in a desirable way. That is, they premised their findings on the assumption that the rate and direction of invention and innovation in the past could be extrapolated forward and thus used as a basis for predicting the future rate and direction of technological change, with the result that remarkably optimistic findings regarding spontaneous climate change mitigation were produced. Indeed, in spite of the admitted uncertainty in relation to invention, this method and its results were strongly defended as robust by the modellers themselves and the IPCC authors. Let us leave this problem for a moment, in order to draw the connections between it and the genealogy we have been pursuing.

In chapters four and five we saw how Smith’s Stoic faith led to a discipline that, as a result of this rationality, was founded upon eternal objects operating in an infinitely repeating, divinely ordered, harmoniously progressive cycle. We also saw how this essentially static construction was formally abstracted and scientised in Ricardo’s work, in spite of the notable, empirically-driven misgivings of Malthus. Finally, we saw how this development led technological change to be exogenised, and yet with its divinely optimal effect preserved in the form of a deus ex machina, permitting infinite substitution and offsetting diminishing returns, without being formally included within the model, and therefore allowing its innately unpredictable nature to be circumscribed. The status of, and approach to, technological change was thus set, in an informal, obscured way, but one
that happened to fulfil the role set for it by Smith: preserving both harmony and progress.

In these final three chapters we see how it is finally, though only partly, formalised (in a recognisably Ricardian way) in the work of Robert Solow: as an external force that consistently and repeatedly offsets diminishing returns, but only in a positive manner. In addition, it once more finds a secondary role in preserving this harmony through perfect substitution. Hence with this move, Solow returns to the static progress of Ricardo, ignored since Marshall, but creates from it a concrete, fully objectified technological change, which embodies all varieties, including invention, and yet is still entirely predictable. The future of technological change can therefore now be gauged formally, because the past, present and future workings of it are, in line with the rationality, identical. It is this object that is subsequently applied to early climate change models, with the result that part of our problem finally becomes clear: the rationality of the discipline itself requires its objects to be eternal and knowable, with the result that the past must necessarily be identical to the present. This past is duly parsed, and the resultant numbers inserted and extrapolated to produce a “scientifically” determined future. Immediately beside this result, though, is the recognition of its empirical uncertainty, though the guiding premise cannot be abandoned lest reason, change and heterodoxy generally, be readmitted, and the discipline collapse as a unity and a science. We therefore find ourselves in a strange world where reliability and doubt are simultaneously and forcefully asserted in relation to exactly the same proposition.

The above narrative, though, implies far more cohesiveness than was in fact ever present in the discipline. The necessities of negative progress have normally been the determining force in the discipline, but underneath the surface difference and change – empirical nonconformity in other words –
have been impossible to suppress. This has formed an irregular and occasionally triumphant challenge to the governing rationality, but never in an absolute, dichotomous way. As we saw in Malthus, so it is with Keynes: rather than abandoning the harmony of negative progress, it has instead been qualified. Why the extent of this, shall we say, mainstream challenge is so limited is easy to explain: the objects created by Smith – transparent and eternal – push naturally in the direction of negative progress (unsurprisingly, since this is what they were designed to do). Moreover, though the discipline is no longer as philosophically and politically opposed to intervention (though very powerful pockets of this orthodoxy remain, most notably through the Austrian-Chicago School tradition) the acceptance of historical change and difference still has the potential to descientise – to render sociological – and hence has always needed the power of events in order to give it credence, most notably with Keynes and the depression. Nevertheless, with the exception of Schumpeter’s unique and radical evolutionary approach, challenges to negative progress have always been made within the circle of complete knowability and predictability, caring for and preserving Smith’s objects rather than abandoning them, even as they seemingly assaulted the most cherished principle of economics: non-intervention.

Recognising that the status of the (mainstream) knowledge of economics operates to produce a response to climate change that makes possible the notion that economic growth and environmental sustainability can be reconciled, these final three chapters show how this knowledge came to be as it is. Broadly speaking, they follow the same lines as would a standard history of economic growth theory. This is because the treatment of technological change, and changes therein, are directly linked to the waxing and waning of concern with economic growth which, despite being the original interest upon which the discipline was founded, has been more or
less ignored far more often that it has been at the centre of attention. Indeed, it would not be wholly unfair to say that economic growth has been ignored whenever possible, and with it technological change. That said, the latter has not been unaffected, even when not under explicit consideration, by changes in disciplinary approaches and tools: the marginal revolution marks a high point of negative progress that necessitated a change in how technological change would be described, even if that change did not in fact take place for another eighty-something years. Indeed, it is precisely at the times when this negative progress dominance has either been most challenged or most strongly asserted that, not at all surprisingly, technological change as an object has been most affected. These changes have not been insignificant, but, in the final analysis, we can say with confidence that the objectification of technological change undertaken by Smith, lodged in his ingenious subject \textit{homo economicus}, remains at the heart of the variety of forms it takes today.

I begin with Ricardo’s immediate successor in the role of premier economist, John Stuart Mill, showing that his contribution, though different from Ricardo’s in certain significant respects, essentially maintained both the place and shape of technological change that his inspiration had constructed. At this stage the forefront of political economy was still an overwhelmingly British affair. However, I then discuss the marginal revolution, which was more generally European, arguing that it cannot be seen as a radical departure in outlook – and certainly not the Khunian paradigm shift it has often been portrayed as – but rather a very significant development in terms of method and emphasis. It ought to be understood as formalising a previously literary discipline, although in direct response to the radicalisation of Ricardo that took place some years before his death. In short, it was a return, through calculus, to the latter’s actual intent. Of the marginalists, however, only
Marshall really discusses growth, and indeed his work can be seen as involving a reappraisal of the impact of technological change, one that is, however, not carried forward by the discipline. Still, Marshall’s textbook was the dominant influence on the discipline until Keynesianism which, though it makes no mention of technological change, effectively redisCOVERs the macroeconomics, albeit in a more formal manner, that will go on to form, fused with the marginalism of Walras, the basis of Solow’s theoretical framework. It is the latter that will dominate how technological change is modelled until Paul Romer’s endogenous work, in the mid-1980s, redisCOVERs Marshall and, more importantly, place *homo economicus* back into the foreground from where he had been banished under the chain from Ricardo to Solow. Parenthetically, the contribution of Joseph Schumpeter is discussed, and is adjudged a truly radical performance that, alone of mainstream work, cannot be placed within the disciplinary unity/tension described above. It is contrasted with Keynes’s work – which is a clear return to Malthus’s objections – in order to show what a true threat to the governing rationality looks like. The nature and extent of this challenge does not appear to be roundly understood in the discipline at large, but in any case, unsurprisingly, it cannot be appropriated by economics except in one sense: it makes plain that which the rationality is constantly repressing; difference and change. Schumpeter’s treatment of technological change comes to be the “Schumpeter problem” in the discipline, and as such motivates responses, such as Solow’s and Romer’s, that work to preserve disciplinary unity in light of it. These are the two major approaches to technological change and they represent the two major threads that have occupied the evolution of the mainstream of the discipline: the negative progress approach with exogenous technological change is formalised and made plain in Solow, while positive progress returns to impact on Smith’s harmonious objects in Romer, with the result that, as described in relation
to Malthus, the economic subject is suddenly possessed with an infinite
power to solve all problems on the road to progress, since reason is given a
place from which to direct *homo economicus* in his divinely ingenious course.

**John Stuart Mill: Ricardianism Refined**

One of the central arguments of the last chapter, and the thesis more
generally, is well summed up by Lord Robbins, one of the foremost
economic minds of the twentieth century, at the commencement of his
*Evolution of Modern Economic Theory*: ‘I begin with Ricardo and show how the
development of economic theory in the West has proceeded by way of
reaction from, or extension to, his system.’\(^609\) If marginalism, as we shall
see, is the great example of the former, then John Stuart Mill’s extensive
economic work is by far the most notable of the latter. However, though
some significant Millian extensions lie outside of our sphere of interest, on
the whole, as we shall see, Mill’s work ‘is not that of a great constructor.’\(^610\)
Rather he is known as ‘primarily the economist who summarized the
cumulative technical achievement of the previous century.’\(^611\) In this role he
was extremely influential, his *Principles of Political Economy* functioning as ‘the
undisputed bible of economists’ during the second half of the 19th century;
indeed, it was still the major textbook as late as 1900, when Marshall’s
version began to surpass it.\(^612\) In this way, the Ricardian approach was kept,
 overtly, in the ascendancy (as the new marginalist approach begins to take
hold, as we shall see, the matter becomes somewhat more complicated), for
Mill is almost universally considered a thoroughgoing Ricardian,\(^613\) although

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perhaps not quite as much Laughlin makes out when he asserts that ‘in truth, he only put Ricardo's principles in better and more attractive form.’

Perhaps Mill’s greatest departure, or at any rate his most well-known, is in relation to government intervention. It will be recalled that the discipline of economics was, by this stage, suffused with utilitarian philosophy, of which Mill is perhaps the greatest exponent. It should come as no surprise to us, therefore, that he argued strongly and often that there was no reason *in principle* for the government not to intervene in the economy. However, as we saw in the last chapter, this had always been the case: as long as the automatic mechanism seemed to hold, reason could be sidelined, but the case for its exclusion needed to be ceaselessly made. However, as Rostow also notes, by the 1840s, following a number of recessions, regular bouts of civil unrest and the beginnings of working-class politicisation (the *People’s Charter* was published in 1838), the arguments of Smith and Ricardo were beginning to wear a little thin. Opulence did not appear to be spreading and this failure led later thinkers to recognise the possibility of a clash between market efficiency and ‘the imperatives of human welfare.

It can reasonably claimed, however, that ‘what Mill and Marx had to say in 1848 marks the beginning’ of this.

There is, though, an important nuance here, which distinguishes Mill’s interventionism from that of Malthus and Keynes. Whereas the latter describe an economic system with inbuilt efficiency-distorting problems – namely, irrationality – Mill, while accepting this as a fact, does not give it analytic credence. This is an important point when it comes to

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617 Ibid.
618 Ibid.
understanding Keynes: Keynes and Malthus argue that irrationality, rather than being something that just happens, as everyone would accept, is something that can be analytically depended upon. It is endogenous, or a necessary part of the production cycle. In the proper sense, it is not irrationality at all in fact, as we shall see, but rather a very serious tragedy of the commons. Mill, on the other hand, sees it as exogenous; an issue of values and institutions, not a logical constant. This is how we should understand his objection to socialism: he is not prepared to justify the kind of socialist policies that were being developed at that time, not because he is not in sympathy with them, because he certainly is, but rather because he does not accept that a deliberate shaping of the economy, as opposed to a slight softening of its consequences, might lead to a better state of affairs as things stand politically and psychologically. To make this clearer: he rewrote his chapter on Property because it had been interpreted as a condemnation of socialism: ‘far from intending’ this, he states, the ‘only objection to which any great importance will be found to be attached in the present addition, is the unprepared state of mankind in general, and of the labouring classes in particular; their extreme unfitness at present for any order of things, which would make any considerable demand on either their intellect or their virtue.’

At this point, though, Mill’s well-known tendency towards inconsistency comes into play. He is prepared to go further than Smith, who favoured state-subsidised education, in arguing not merely for this, but for poor-laws and perhaps even government regulation of working hours. However, he does so only in a rather ad hoc way; as Bonar states: ‘he too often leaves us with the impression that of two opposing theories both are true, though the principle that reconciles them is not clearly discoverable.’ The fairest judgement, therefore, is probably that in more

621 Ibid., p. 264
substantive terms, his economic theory gave him little justification for the kinds of intervention the realities of early Victorian society seemed to be crying out for.

Given this, we should be not at all surprised that his Principles lacks the optimistic tone of its canonical predecessors. Indeed, he seems on the whole to be rather disenchanted with the economic theory he does so much to espouse. This is not at all contradictory, however, for Mill was a keen student of methodology (indeed, clarifying the principles of this may be his greatest long-term contribution to the discipline). To elaborate: while Mill was strictly orthodox theoretically – insisting, for instance, that without the assumption of perfect competition, economics could not be a discipline\(^\text{622}\) – he was not at all convinced that society, even when left to its own devices, would follow along the lines seemingly furrowed by abstract economic logic. In other words, as we saw above in relation to socialism, Mill is prepared to draw a rather straightforward dichotomy between the abstract, innate tendencies towards material well-being, from which the all-things-being-equal best policy can be determined, and the values and traditions of society itself, which might prevent this from ever being realisable: ‘no one who attempts to lay down propositions for the guidance of mankind, however perfect his scientific acquirements, can dispense with a practical knowledge of the actual modes in which the affairs of the world are carried on.’\(^\text{623}\) There is an important separation, then, to be made between Smith and Mill, the two most philosophically sophisticated political economists, perhaps of all time. Smith, with his conjectural history, sees institutions and the products of a supposedly universal reason as the source of man’s problems, and the innate economic harmony as something struggling over time, more or less successfully, to get out. Mill, on the other

\(^{622}\) Ibid., p. 258
hand, is not a historical determinist: he does not really see a logic to history comparable with that described by Smith. Rather the status quo obstacles to economic progress – the realisation of the harmony – are perhaps insurmountable, given the entrenched nature of the values, beliefs and institutions underpinning them. In short, Mill will only meet Smith halfway; there is a single universally progressive way of organising the economy, much of which is apparent in everyday reality, but it is not a certain future to which we will move if people are simply left to their own devices. There are no essences in men for Mill (as is well known, for he is a famous exponent of the experiential mode of epistemology), rather a Lockean creature of no fixed inclinations (tabula rasa). Smith’s world will work, for Mill, if people move towards it, and they should be encouraged to do so. But we must accept, he feels, that progress in this direction may not be our lot, the superstition preventing it being at least as strong as the logic in its favour. This opinion comes across explicitly in many passages of his autobiography, one selection from which will suffice: ‘I am now convinced, that no great improvements in the lot of mankind are possible, until a great change takes place in the fundamental constitution of their modes of thought.’

This is an important methodological shift, albeit one implicit in Ricardo, for it moves the “natural course” of the economy from the innate to the abstract, but in so doing it merely facilitates the scientific claims of the discipline, rather than abandoning its metaphysical basis: in the final analysis, as we have seen and shall see further, negative progress in the abstract is still only plausible under very particular assumptions regarding technological change. In any case, although Mill has perfectly sensible epistemological reasons for this position, it is hard, again, not to see a note of the times having a role in it. Moreover, this is perhaps why the notion of the stationary state, which hovered like a grim spectre over

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the work of his predecessors, troubles him so little: he does not see it as the fearful end to a buoyant trajectory.

Much is made of Mill’s rather utopian conception of the stationary state, but for our purposes it is important to note that it does not play a significant role analytically. That is, it is not an element of what might be called the Millian “model” – though of course this is an anachronism – but rather the sort of general speculation justified by the subtitle to his economic textbook: ‘with Some of Their Applications to Social Philosophy.’ It is this latter element that makes Mill’s work archetypal “political economy.” He not only has the Ricardian abstraction, which is the analytic core of his work, but also, as should be plain from the methodological separation described above, an examination of the general character of the society in which it might be enacted, with analysis of the potential for accord between the two. Nevertheless, in relation to the stationary state, he does make some substantive comments about technology that ought to be considered. More generally, though, Mill’s comments about the possibility of a stationary state reflect his dissatisfaction with the status quo, and perhaps even with how the world might be if the abstractions he describes in his “model” were closer to the reality. It is certainly nothing to be feared, and in a polemical end to his chapter on the subject, he argues that when ‘minds ceased to be engrossed by the art of getting on,’ the human race might well develop technologies that serve the entirety of the race better, increasing the lot of those they have up to now merely enabled ‘to live the same life of drudgery and imprisonment,’ while allowing ‘an increased number of manufacturers and others to make a fortune.’

Indeed, he professes his belief that technology ‘has not yet begun to effect those great changes in human destiny, which it

625 Ibid., pp. 756-7
is in their nature and in their futurity to accomplish.\textsuperscript{626} For this to occur, birth-rates as well as institutions will need to progress under the guidance of ‘judicious foresight.’\textsuperscript{627} This is an interesting passage because it contrasts with much of what goes before and after it: the more positive economics. In the final analysis, it is not particularly relevant for our discussion of Mill’s thought. Lacking any details about how this stage of human progress might be attained, but rather trusting, in utopian fashion, that it can and probably will, we can deem it only an expression of hope, and not one of economic analysis. One disappointing aspect is Mill’s failure to address an obvious implication: if this steady-state is of such benevolence, why do we not try to attain it now? We can, with reasonable certainty, adjudge the answer to be: because humanity is still too mired in the ‘art of getting on’ to develop the requisite mentality for such a heaven-on-earth. We can therefore see Mill’s Rousseauian conclusion to be the normative addition to his analysis of what the world is like now and likely to be for some time. Presumably the government intervention he lauds as necessary for the fulfilment of the promise of the steady-state does not apply to, or will not work under, the status quo. Again we have an example of Mill being decidedly drawn to positive progress, the power of enlightened government, but analytically drawn back to the normative implications of his abstract, non-interventionist, economic theory. And once more, then, Bonar’s judgement seems astute: ‘[Mill] prepared the mind of English economists for new ideas, but he did little to introduce them himself.’\textsuperscript{628}

More importantly though, it is clear that Mill is only a qualified technological optimist. This needs a little elaboration insofar as our analysis is concerned, the point being that he retains the structure of technological optimism received from Ricardo, if not the outlook. For a start, regardless

\textsuperscript{626} Ibid., p. 757  
\textsuperscript{627} Ibid., p. 757  
\textsuperscript{628} Bonar (1909), Op. Cit., p. 265
of some rather elaborate stationary state discussions, when talking about the fall in prices of manufactured goods which, it must be recalled, is at the heart of the classical belief in the progress of human welfare, he argues that this trend has been ‘accelerated by the mechanical inventions of the last seventy or eighty years, and susceptible of being prolonged beyond any limit which it would be safe to specify.’ This latter is a rather important point: given that the ability of technology to provide free lunches is the ultimate guarantor of continued growth, what Mill is telling us here is that, while the stationary state is possible, perhaps even probable, its appearance cannot be determined. Hence, it is of no analytic import; that is, the thought of it does not affect economic actors. It has no, if you like, “presence” in the analytic core. The same was true, as we saw, for Smith and Ricardo and perhaps merits restating, in order to avoid confusion between analytic technological optimism – the structure of the objectification and its power – and a more general kind, regarding an ultimately unknowable likelihood of inventions continuing to occur. Insofar as that analytic variety is concerned, Warsh credits Mill with being the originator of exogenous technological change, though this really only results from a failure to grasp, understandably since it is left so implicit, Ricardo’s methodology. Hence Warsh takes from Mill’s discussion of the matter, as part of his elaboration on method, that Mill’s approach is novel. The latter tells us, ‘(in) so far as the economical condition of nations turns on the state of physical knowledge, it is a subject for the physical sciences and the arts founded upon them. But in so far as the causes are moral or psychological, dependent on institutions and social relations, or on the principles of human nature, their investigation belongs not to physical, but to moral and social science, and is the object of what is called Political

Economy. Warsh interprets this as Mill abdicating any responsibility to account for technological change, however, it can hardly be disputed that ‘the state of physical knowledge’ results itself from societal factors, so it is probable that by this Mill did not mean what Warsh takes him to mean. It seems rather more likely he is simply arguing that the content of ‘physical knowledge’ is a subject for science and its applications. The latter tells us what is possible insofar as the ‘production of wealth’ is concerned, it is not expected to account for its own existence or the existence of a certain level of technological capability; or at least, this quote does not justify assuming Mill thought that it ought to. Hence we need to do a little more investigation to fully grasp Mill’s position on technological change.

Rostow argues that Mill ‘did not quite conceive’ of invention as a flow, since, as Mill has it, ‘(agricultural) skill and knowledge are of slow growth, and still slower diffusion. Inventions and discoveries, too, occur only occasionally.’ Rostow’s is certainly a reasonable interpretation, but in the phrase ‘not quite’ there is a very fine line being tread, more by Mill than by Rostow. This should be familiar to us from Ricardo, who matches it exactly, if implicitly, but Mill is not prepared to say that invention occurs regularly, while maintaining that it certainly does so gradually. Talking about agricultural improvement – for Mill, as for the Ricardo, the most important variety – Mill states: ‘taking place, as such improvement always does, very gradually, it causes no retrograde movement of either rent or cultivation; it merely enables the one to go on rising, and the other extending, long after they must otherwise have stopped.’ The effect of this on the model can be summed up as follows: invention happens irregularly, but diffusion happens much less so. Indeed, diffusion happens

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631 Mill (1965A), Op. Cit., p. 21
632 This is reasonably clear from the rest of the chapter. See Ibid., pp. 20-21
in such a way as to finely balance the problem of diminishing returns with that of drastically increased food production, with all the Malthusian consequences that may bring about. Hence the impact of invention upon the economy, even if not quite a regular flow, is as near to as makes no difference. However, it is important to note that Mill includes both invention and diffusion in this discussion. This is because he could hardly argue for a state of affairs where invention is proceeding apace and yet its diffusion still happens in such a way as to preserve his balance, given the profit-incentive on the part of landlords (which Mill clearly states). The timing of invention is as important to the stability of the model as is that of diffusion. Just as in Ricardo, it happens more or less precisely in accord with human need, or at least, what the logic of the model makes those needs appear to be; that is, harmoniously

Hence Rostow describes Mill as being ‘candidly’ derivative in this regard, overwhelmingly of Charles Babbage, who we encountered briefly in the last chapter. Rostow is critical of Mill’s failure to exploit the reflections of Babbage and, indeed, John Rae (the perennial outside-man of technology economics) in regard to the generation of inventions, and argues that instead ‘Mill’s treatment of investment and machinery can be seen as an orderly elaboration of the structure of thought inherited from his great predecessors, most notably Ricardo.’ We can, however, perhaps allow that Rostow is short an element of perspicacity in making this division. As we saw, Babbage’s view was very much in accord with that of Smith and, implicitly, Ricardo, insofar as the generation of invention is concerned. Babbage argued that it is derived from many sources, including frequently the machine-operators themselves, in the manner of Smith, and ought not to be explained in the “genius-of-the-inventor” style of Rae, which

636 Ibid., p. 731
obviously requires more elaboration. That is, if technological change is something routine, if irregular, something that proceeds alongside the economic process harmoniously, then it scarcely requires any furtherer explanation in an economic model beyond the elaboration of the model itself. It is related to the economic process, but not something that arises predominantly from a monetary incentive or, more accurately, profit is a necessary but neither sufficient nor proximate cause. This is important to Mill since, as we have seen, he also argues that invention after the onset of the steady-state could be more beneficial to humanity than that arising under the status quo. If invention was simply something that came about due to a profit motive, we cannot easily imagine how it might proceed once this is no longer present. For Mill then, as long as there is money to invest, there will be technologies to be utilised, so why worry about the latter? Hence, we can see that Mill decidedly does produce a description of technological change taking in Babbage (but not Rae’s) insights, it is merely that these insights require little from the economic system other than its existence. Schumpeter, true to his own vision, is therefore undoubtedly correct in saying that Mill, like his predecessors (again, excepting Rae), ‘greatly underrated the importance in economic development of the element of personal initiative...he took it for granted that the important thing was to have something to invest: the investment itself did not present additional problems,’638 something that we have also explicitly delineated in Smith.

It is probably worth stressing again that, in this discussion, I am not claiming comprehensiveness insofar as the Ricardo-Mill transition is concerned. In the matter of, say, value and price, Mill makes an arguably significant advance on Ricardo’s work. However this is not an important fact for our purposes, so I make no claims on it. In any case, the last matter

of significance insofar as Mill’s contribution is concerned relates to *homo economicus*. Mill is often credited as the inventor of this abstraction and indeed a passage in his essay ‘On the definition of Political Economy’ examined the notion in a far more explicit form than had any preceding text:

“Political Economy”...does not treat of the whole conduct of man in society. It is concerned with him solely as a being who desires to possess wealth, and who is capable of judging of the comparative efficacy of means for obtaining that end. It predicts only such of the phenomena of the social state as take place in consequence of the pursuit of wealth. It makes entire abstraction of every other passion or motive; except those which may be regarded as perpetually antagonizing principles to the desire of wealth, namely, aversion to labour, and the desire of the present enjoyment of costly indulgences... (not) that any political economist was ever so absurd as to suppose that mankind are really thus constituted, but because this is the mode in which science must necessarily proceed.

However we must bear in mind two things before we give Mill such a weight of credit. The first is the same as that noted above: that Mill’s work, as Bonar put it, ‘is not that of a great constructor,’ but it does elucidate, and perhaps iron out, the often hidden methodologies of his predecessors. Given his extraordinary powers of logic, this was a task he was perhaps better suited to than anyone else. The second, and obviously related, point is that all elements of the above quote are to be found without effort in the work of Adam Smith. The desire to improve one’s own material condition; the valorisation of the individual’s capacity to judge this best himself; the desire to abridge one’s labour even. To the extent that Smith had additional characteristics in mind, these were safely disposed of by Ricardo. Hence, while we can give Mill credit for his exposition and a certain amount of influence insofar as the clarity of the work of later economists is

concerned, we have no reason to believe that, in this respect at least, much would have been different in the discipline had Mill decided against holding forth on the matter.

It is fair to say then, overall, that despite his many accomplishments, Mill, for our purposes, left the discipline of Political Economy more or less exactly where it had been at Ricardo’s death, albeit on much clearer methodological foundations. This is important, because although Marx would be the first major thinker since Smith to take technological change seriously (as we shall see below, when discussing evolutionary approaches), it is the Ricardo-Mill tradition that, as Robbins indicates in the quote at the start of this chapter, would be the target reacted against in the marginal “revolution,” which we shall now examine. That said, to the extent that marginalism can claim to be the start of “economics,” as opposed to political economy, it must accord much of the preparation for this move to the rigid distinctions Mill was the first to really clarify.

**Marginalism: The Triumph of Mathematics**

The marginal revolution is recognised as doing a number of things: first, and most famously, overthrowing ‘the labour or cost-of-production theory of value by the marginal utility theory,’ something not of overwhelming import for the problems addressed here, but still a matter that needs to be reviewed; second, being ‘the commencement of model building on a grandiose scale;’ third, being the point at which a mainly literary discipline became predominantly mathematical; and finally, generating a concept of equilibrium defined as ‘a set of marginal equalities pervading the entire system of exchange, production, capital formation, and money under ideal
competitive conditions.\textsuperscript{641} This latter we shall get to later, as its rather intricate, exact meaning is not of interest to the general discussion we need to have first. We should allow ourselves, though, a brief digression to consider the second of these, since as we saw in chapter two it is an incredibly significant development. With marginalism, on balance, begins the process of formal economic modelling of the type ubiquitous today. What is a model in this sense? Following Schumpeter, it is perhaps easiest understood as a generalised picture of the essential features of capitalist reality.\textsuperscript{642} These features are distilled from a body of facts which, by themselves, are too many to have each given its causal due; so instead what are considered to be the most salient ones are selected, with the hope (and it is initially little more than this plus intuition) that they will, when put into mathematical motion, produce results that broadly agree with what most people, and the statistics, believe economic reality to be or have been. That is, they should be able to broadly replicate the past. For instance, if high levels of unemployment have typically been associated with low interest rates, then one’s model, adjusted for unemployment, should automatically produce high interest rates. If the model roughly matches the past blow for blow, then one can consider it robust and begin to play with it, in order to see how changes in one or more variables might affect the rest of the economy. That is, once it is shown to fit the past, it is assumed to be able to predict possible futures: it is then, in essence, and as we saw with Ricardo, an analytic engine. This is a crucial point and one we shall return to later.

Of course, it might be objected: why discuss marginalism at all; very little in the neoclassical “revolution” (aside from Marshall, as we shall see) referred to growth or technology; certainly nothing fundamental was contributed?

\textsuperscript{641} All William Jaffe (1972), ‘Léon Walras’s role in the “Marginal Revolution” of the 1870s’ in HOPE, Vol. 4, pp. 379-405, p. 380
\textsuperscript{642} Schumpeter (1976), Capitalism, Socialism, Democracy, London: Routledge, p. 73
There are two reasons. The first is that marginalism supplied a new way of doing economics, one that, though not much more abstract, was certainly far more mathematical or “formal” than Ricardo’s. It is a simple truism that we cannot understand the development of modern economics without it. Secondly, marginalism is often claimed as a revolution, a “paradigm shift” in how the discipline operated.\textsuperscript{643} If this is the case, it could naturally be claimed that the continuity I discern between Smith and, ultimately, Romer, cannot be sustained. Overall then, the extent of the marginalist contribution needs to be assessed. In this discussion I shall be mainly focusing on Leon Walras, since it is his system that forms ‘the basis of practically all the best work of our own time.’\textsuperscript{644}

In beginning we should perhaps remind ourselves that, for the most part, ‘(the) term “marginal revolution” is usually taken to refer to the nearly simultaneous but completely independent discovery in the early 1870’s by Jevons, Menger, and Walras of the principle of diminishing marginal utility as the fundamental building block of a new kind of static microeconomics.’\textsuperscript{645} Why this came about, and its significance, is heavily disputed. Certain facts are indisputable though: first of all, that Ricardian value-theory in particular, and his economics more generally, was being utilised by socialist thinkers – most notably, of course, Marx – to discredit the status quo system of wealth distribution;\textsuperscript{646} secondly, that the discipline began to turn its back on, and certain powerful people began to fund opposition to, the offending Ricardian arguments;\textsuperscript{647} thirdly, that by about 1900 the marginalist victory was complete, with their doctrines essentially ubiquitous, in a basic form, amongst those concerned with economic

\textsuperscript{644} Schumpeter (1954), Op. Cit., p. 1026; See also Jaffe, Op. Cit., p. 381
\textsuperscript{645} Mark Blaug (1972), ‘Was There a Marginal Revolution?’ in HOPE, Vol. 4, p. 267
\textsuperscript{646} Ronald L. Meek (1972), ‘Marginalism and Marxism’ in HOPE, Vol. 4, p. 57
\textsuperscript{647} Ibid., p. 59
theory, and finally, that the new marginalist doctrines, wherein the price of goods and services are determined by their desirability in the marketplace, directly contradicted the labour-theories of the classics (differing though they were), as well as, particularly in Walras’s work, the disharmonious implications of Marxian thought. In their new principle of value, the marginalists found an abstraction ideally suited to the simultaneous equations of calculus, and resultantly, to mathematically verifying the notion of economic equilibrium: this is the essence of what is ubiquitously referred to as the marginal “revolution.” What these facts mean for marginalism, however, is disputed. Joan Robinson, for instance, has argued that ‘the whole point of utility was to justify laissez-faire,’ calling it ‘an ideology to end ideology, for it has abolished the moral problem’ of inequality. Routh agrees, claiming that marginalism was little more than a tool designed to defeat the misuse (for Ricardo certainly would have balked at the Marxian interpretation) of Ricardian labour analysis. In line with these points, there is a noticeable tendency amongst adherents of the Marxist school to dismiss marginalism as bourgeois economics or an “ideological illusion,” the corollary of which is that its findings are tainted and of little worth.

I find the overt ideological explanation unconvincing, and not merely because it is hardly more than asserted. For a start, marginalism began to emerge in the 1870s, well after the often bleak and revolutionary period that prevailed between Waterloo and the Crimean War, when the socialist adoption of Ricardo was at its most significant. Had it emerged in the dark days of the British “General Strike” or the Bonaparte restoration, a proximate cause could perhaps be claimed (though only a very arguable

648 Schumpeter (1954), p. 952
651 Guy Routh (1975), The Origin of Economic Ideas, London: Macmillan p. 260
one), but several decades later is a rather long time-lag. Moreover, by the
time of the Paris Commune, Mill’s work on value had long-since replaced
it, and this had not the same disharmonious flavour. Lastly, it took decades
for marginalism to replace Mill, so there clearly was considerable resistance
to it in the discipline, and hence it is unlikely that it would have been of
much use politically for a long while after its arrival. It seems, at best, that
the powerful supporters of “hired-gun” theorists had succeeded, and
Ricardo’s work on value was now far from the orthodoxy: as Meek argues,
by the 1840s Ricardo’s system ‘was purged of most of its more obviously
disharmonious elements, particularly those which might have been used to
suggest that there was a real conflict of economic interest between social
classes under capitalism or that progress under capitalism might be limited
for some other reason.’ In short, there seems to have been neither a
political nor disciplinary outcry for a successor by the time utility came into
the picture.

It could be argued, though, that marginal utility is the product of a more
general desire to support the status quo, though an alternative explanation
is much more convincing. Nevertheless, Meek describes how the
disciplinary attitude to Ricardianism changed quite quickly upon its
adoption by the socialists, since his analysis now seemed to set ‘limits to the
prospects of human progress under capitalism, and therefore could not
possibly be true.’ This is interesting, and very much in line with the tenor
of the discipline as created by Smith and carried forward by Ricardo. As we
saw in our analysis of Ricardo’s rise, negative progress was certainly the
disciplinary shibboleth. However, “progress under capitalism” is not laissez
faire; one could certainly argue for a Malthusian or Keynesian regime as
ensuring both progress and capitalism. The crucial point is that static,

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654 Ibid., p. 57
abstract, theory does not at all justify non-intervention, as Mill made clear. Quesnay, for instance, described a static system which needed to be brought into being by the state, something for which Adam Smith took him to task.\textsuperscript{655} Walras seems to have considered his work, the most advanced of all the general equilibrium theories of the period, to require a lesser but still significant amount of state involvement (he advocated the nationalisation of farmland).\textsuperscript{656} Meek goes as far as to argue, in response to Robinson, that there is nothing inherently supportive of the status quo in marginalism and that it is more that such a use was frequently found for it.\textsuperscript{657} In a sense this is true, for if we take what Ricardo thought he was arguing and what, say, Menger thought he was arguing, their support for the status quo is roughly equal: that is, they both ended up propounding non-interventionist schema.

Meek’s point becomes clearer when we ask ourselves why such a use was frequently, or easily, found for marginalism. The answer is that the terminology used in, and the logical process of, marginalist analysis, were something of a rhetorical windfall for those who wished to prevent government intervention. For instance, in the classical system, wages were paid out of saved capital at the beginning of the productive process. A choice was made by the capitalist at that stage between investment (including wages) and consumption. It thus seemed very much like the amount paid to labour was the capitalist’s decision, and one framed in terms of paying him as little as possible. In Walrasian system, perhaps the most advanced of the marginalist analyses, labour is paid its marginal product; that is, a price determined by exactly how much each labourer adds to the process of production. Hence it appears as if labour is being


\textsuperscript{657} Meek (1967), \textit{Op. Cit.}, p. 57
paid what it deserves under the latter system, and what can be gotten away with under the former. In reality, the rational capitalist pays as little as he can get away with under both systems: regardless of the analysis, he pays only up the point at which paying more confers upon the capitalist no further benefits. Both are ultimately determined by the supply of labour and market demand for goods. Rhetorically, however, the marginalist analysis pays labour, if you like, as part of the process of determining all prices; it appears to take the decision out of the capitalist’s hands, placing it not at the beginning of an investment decision by an entrepreneur, but rather in the middle of a disinterested, objective market process. This is what Eagly means when he says that “labor is paid out of current, not past, output.” In the final analysis, though, the capitalist can be seen as just as exploitative under either, but it is no longer framed in terms that can be easily read as the exploitation of the workers. It appears to be far more egalitarian, when in fact it involves precisely the same mentality.

Dobb describes this well: “the statement that individuals choose, as soon as it is made concrete in the form that individuals choose in a particular way, becomes the false statement that individuals choose freely and that the events which are the outcome of these individual actions are unaffected by those basic productive relations-class relations.” Of course, and again, the point is that this is not necessarily a fair reading of the theorist’s intent: an abstract, harmonious system lends no more support to the idea that the world is, in reality, a harmonious, optimal system, than it does to the idea that this optimal system is realisable if it is willed into being. Menger meant the first, Walras the latter. In its essence, this is Stoic ontology put against nominalist ontology. Recognising this, we can better understand the simplifying and, it is often argued, ideological element to marginalism: it

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658 In De Vroey, Op. Cit., p. 428
659 In Ibid., p. 435
“implies that economic phenomena are ruled by a series of contractual relations freely entered into by a community of independent individuals, each of whom knows well what he wants and has access to and knowledge of all the available alternatives.”

Again, though, the differences between this and classical scholarship are more in terms of emphasis than substantive justification. For Smith et al the same premises were held: the desire to advance one’s own best interests in a sphere without government intervention; the belief that individual is best suited to know what these are, all with hardly a shred of emphasis upon information asymmetries, and with a final belief that, left to freely operate, equilibrium would result from this reality. Walras had no such predilections and yet his abstract system is read as supporting them as a result of its objectifications and the process by which it reaches equilibrium. Paradoxically, it was easier to ignore Walras’s deliberate, but non-essential socialist implications, than Ricardo’s unintended, but intrinsic ones. Thus it seems safe to conclude that marginalism was neither an explicit and political attempt to defeat Ricardian value theory, nor designed with the overriding goal of supporting the status quo. At best, it made possible its disingenuous use in support of laissez faire by the nature of its composition.

It could, however, still be argued that, regardless of intent, a sort of false consciousness was in play in the 1870s amongst the neoclassicals, meaning that whatever Walras intended, in actuality he was impelled to produce a status quo-supporting system. This is not my reading of those like Robinson, Routh and possibly Myrdal, who certainly seem to be arguing that some sort of knowing-bias is in play, but it is a reasonable interpretation. However, another reading, associated with De Vroey and to a lesser extent Spengler, argues that, far from being, in Robinson’s words,

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660 Ibid., p. 427
661 Talking about economic liberalism and abstract theory more generally, he argues ‘(its) only significance is that it gives a scientific appearance to an individualist, anti-interventionist prejudice.’ Myrdal, Op. Cit., p. 137
merely ‘a rigorous proof of the vague doctrines of the classics,’\textsuperscript{662} or Routh’s, ‘simply more closely argued prescriptions for laissez-faire,’\textsuperscript{663} marginalism in fact constitutes a Kuhnian paradigm shift. My opinion lies somewhere between these two: I accept the idea that, broadly speaking, the neoclassicals relayed formally only what the classics had already argued, while rejecting the idea that they did so for vague ideological purposes. Instead it seems apparent from the logic of marginal utility that they would end up at the same destination; however, we ought not to go so far as to pretend that a major change took place in how the economy was conceptualised, as De Vroey would have it.

De Vroey’s starting point is similar to that of Meek, except for the vital fact that De Vroey believes the changes in emphasis to be genuinely substantive differences. Beginning, he maintains that ‘(profit) no longer is equated with an exploitation made possible because of the unequal distribution of wealth between classes... Profit becomes the reward for the capitalists’ abstinence and thus receives an explanation in purely subjective terms.’\textsuperscript{664} It is difficult to see how this is at all different from the classical analysis, which repeatedly and explicitly described the investment process, and thus profit, in terms of abstinence. This was one of the main pillars of Adam Smith’s analysis, and as we saw in the last chapter, formed a major part of the dispute between Malthus and Ricardo. In a superficial sense, profit is determined in the same “objective” way as we saw above with wages. This frames the process differently, but an identical reality is offered by both analyses.

His flagship claim, however, is that the marginal “revolution” marks the ‘rise of subjectivism’ in the discipline.\textsuperscript{665} Spengler agrees, arguing that it

\textsuperscript{662} Robinson (1964), \textit{Op. Cit.}, p. 54
\textsuperscript{663} Routh, \textit{Op. Cit.}, p. 257
\textsuperscript{664} De Vroey, \textit{Op. Cit.}, p. 429
\textsuperscript{665} Ibid., p. 432
represents economics becoming ‘a subjective science,’ one in which economic growth ‘was viewed more explicitly as the product of conscious individual decision and choices and less as an automatic outcome of the surplus-producing propensity of the economic mechanism.’ 666 The first of these claims we shall come to, but as for the second, Spengler’s reading is hard to credit, given two obvious points. The first is that, far from being the study of uncertain choices that Spengler seems to be describing, the assumption in marginalism is that each actor will maximise his utility, providing in effect, along with perfect competition, an identical automatic mechanism to that found in the abstract work of Ricardo. Indeed, it was exactly this principle, albeit with different theoretical objects in play, that led Smith et al to the same conclusion as the marginalists; i.e., equilibrium, and it can hardly be disputed that automatic equilibrium (at least in abstract) is asserted with greater concurrence in the marginalists’ work (with the exception, to a degree, of Marshall) than it ever was in that of the classical theorists (remembering Malthus). Moreover, and secondly, it is hard to see how the nominally “subjective” mechanism Spengler is describing differs from the savings decisions of the capitalists which, for instance, formed part of the dispute between Malthus and Ricardo. Indeed, the Ricardian logic seems identical, in its reading of human propensities and the subsequent overall outcome, to that of Walras, Jevons et al. It is difficult, therefore, to accept, for Spengler’s reasons, that marginalism was something new under the sun.

On a similar tack, De Vroey observes that individuals ‘were the only units of analysis’ for the marginalists. 667 This is a strange assertion, since all of the marginalists make reference to households and firms, as well as

individuals. Nevertheless, there is clearly a major change in analytic tools going on, so it is reasonable to ask whether this amounts to a ‘new social vision,’ as De Vroey proclaims. It is this latter that we ought to focus upon, according to him, ‘rather than the particular form in which this subjectivist approach became embodied, that is, the theory of marginal utility.’ In fact, the opposite is true. For a start, and as noted above repeatedly, Smith founded the discipline on the postulate that man’s desire to improve his own material condition could be taken for granted. Everything else is premised on this one simple axiom. It is therefore hard to see how marginalism constitutes a new ‘vision’ of any kind. However, the change in emphasis is significant, away from aggregates in the form of classes and towards smaller units, such as firms, households and individuals. Now, having disposed of the idea of these units constituting a philosophical paradigm shift of themselves, we can once again entertain the notion that they are the malign product of ideological influence. Here I think we can finally satisfy ourselves that all versions of this theory are false. In fact, and contrary to De Vroey also, far from marginal utility coming to embody some kind of *a priori* ontological change, it is the consequences of marginal utility analysis that explains the essence of the change in emphasis: the exclusive focus on what is now known as microeconomics.

For a start though, it is important to remember that general equilibrium analysis of the neoclassical type does not focus on any less of the economy than did the macroeconomic, or aggregated, analysis of the classics. When working at this scale, there is every reason to aggregate if by doing so one loses nothing of import. With a labour theory of value, this was

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670 Ibid.
certainly the case, since, taking all the variations broadly, labour-time is a universal currency. It is easily aggregated. This is not so with the concept of marginal utility. When the value of an object is directly related to extent of its desirability, but it is limited in quantity, the process of pricing becomes one of negotiation, as the differing levels of desire amongst the different actors mingle with variations in the resources at their disposal. Schumpeter describes this as ‘a game of trial and error (tâtonnement)—prices being adjusted and quantities being readjusted in response,’ with the result being that we can determine ‘the prices of all products and factors and the quantities of these products and factors that would be bought, in perfect equilibrium and pure competition, by all the households and firms.’ To put this another way, while labour-value is just as attached to the individual who put in the labour, it is possible to equate this with the efforts of other individuals, and thus to aggregate. On the other hand, an individual’s desire is no less or more linked to herself than is her labour, but the ratio of the extent of her desire (her level of preference) to the resources at her disposal, is, if not unique, as close to being so as to make it impossible to aggregate. It must be worked out at the individual level, with the result being a general equilibrium analysis focused on functionally indivisible units (even if some of these units, firms and households, are in fact divisible). The resulting formal models, as Blaug has it, converted “the whole of economics into a branch of applied mathematics.”

To explain: once one arrives at marginal utility analysis, differential calculus is, if not easy, at least clearly applicable. This is mostly because, as Schumpeter notes, the actors are, for the first time, all united under one governing principle: ‘in the ‘new’ theory of exchange, marginal utility analysis created an analytic tool of general applicability to economic problems...(the) whole of

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673 Ibid., p. 1009
674 Ibid., pp. 998-9
the organon of pure economics thus finds itself unified in the light of a single principle—in a sense in which it never had been before. Without going into mathematical details, the process is much more difficult, and seemingly beyond the capacities of those economists of the time who were acquainted with calculus, if, for instance, rent and labour-costs are to be discerned under a different principle. General equilibrium assumes that each individual matter plays a part in the whole, so ease of reconcilability—displaying as a mathematical proof how each connects—is made far more straightforward if there is a single uniting principle. As Myrdal says, equilibrium theory ‘could not be developed properly until the discovery of marginal analysis.’ Indeed, given the existence of equilibrium assumptions and ends, calculus, which is applied to this concept in physics, is a rather obvious tool to employ. Once this was in place, the mathematical approach was never likely to lose out to its more literary competitors. The authority that goes with the claim to being a science is too strong a current to swim against. This is why Ricardo, as we saw, organised his work on deductive lines. Empiricism alone is only scientific if it can conduct experiments, which economics naturally cannot do. Hence Jevons’s point, which tells us all we need to know: ‘(it) seems perfectly clear that Economy, if it is to be a science at all, must be a mathematical science.’

So the final question becomes: from where did the notion of marginal utility arise? This is a vexing question and there is no persuasive answer to it. As Blaug details, the three “inventors” all came from very different backgrounds and, while the notion that the maximisation of utility plays a role in price formation was well established everywhere, there was significant work to be done on it, since the classics could not see how this

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677 Myrdal, Op. Cit., p. 33
“use-value” might be able to explain the entirety of “exchange-value.”

Mirowski has an interesting hypothesis regarding the adoption of the essential features from physics, however this never relied on the strongest of textual evidence and Samuel Hollander has dealt what to my mind are fatal blows to its historical credibility. In any case, the answer to this question is not really important for our purposes. It explains the advent and development of microeconomics when it is the macro variety that concerns us. Two things are worth noting though: the first is that in marginalism *homo œconomicus* is tailored to provide a far more thorough mathematical proof of the static equilibrium assumptions upon which the discipline already operated: as Amariglio puts it, ‘(the) neoclassical view of subjectivity attributes to agents just those forms of consciousness and action that, under specific circumstances, tend to bring about equilibrium solutions.’ Of course, to the extent of their knowledge and ability, this is as true of the classics and in any case, as we have seen, this does not impact on the argument presented here. The second thing to note is that the Walrasian adaption, a static, general equilibrium, triumphed over Menger’s non-mathematical, less-static alternative, which would form the basis of the heterodox Austrian School. This is indicative of the hollowness of general ideology as an explanation: though Menger was philosophically as non-interventionist as one could be, and his work certainly supports this policy approach, Walras’s, at least intentionally, interventionist efforts came to be the basis of the entire discipline. In other words, while Menger’s work could never be used to justify intervention, Walras’s certainly could, and yet it was the latter that prevailed. Ideology offers us no clues as to why this

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680 Schumpeter (1954), p. 911
might be, other than the greater authority of mathematical models, which is of itself a sufficient explanation without need for political additions.

As we saw with Ricardo, the tendency in economics has always been for the more mathematically-driven theory to triumph, regardless of how much realism needs to be sacrificed. Nevertheless, given the tendency for ideology-based explanations to be at variance with this fairly indisputable fact, there is potentially some very important work to be done advancing on Foucault’s efforts in *The Order of Things* in explaining the conditions of acceptability and *general* disciplinary rationality, and its development, that potentially underlie these movements. For instance, Foucault ‘points out that in the modern era, the mathematisation and formalism of social scientific discourse is possible only on the premise that Man and his body are quantifiable.’\(^{684}\) This indicates to us that it ‘is only the scientistic prejudice of the modern age that denies the possibility of nonmethodological principles of unity and regularity in economic discourse.’\(^{685}\) In other words, between the methodological tenets and the reality that is ultimately produced, disciplines such as economics unknowingly maintain shared assumptions that permit and shape, in a very crucial way, what this reality looks like. For my part, as said, I can only contribute to this the pre-eminence of what I have been calling negative progress: the rationality of economic growth, which leads to the idea that technological change will follow directly, and without disturbance, from harmony. To be clear, the extent of my contribution to understanding the conditions of acceptability of the discipline as a whole is no more than showing how Smith’s treatment of technological change, as developed by Ricardo, permitted a discipline which, in the first instance, could take technological change, and thus harmony, for granted and, in the second,

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\(^{685}\) Ibid., p. 610
allowed for the certainty regarding invention that manifests itself in current climate change policies. As Foucault’s work makes clear, this contribution cannot, though significant, be considered a sufficient explanation of all aspects of how the discipline is. It merely fits within a broader, yet still local, rationality. I shall now discuss how the development of Walrasian general equilibrium analysis impacted on the particular rationality that concerns us.

To get to that point, let us first ask: what is equilibrium? Schumpeter tells us: that if ‘the relations which are derived from our survey of the “meaning” of a phenomenon are such as to determine a set of values of the variables that will display no tendency to vary under the sole influence of the facts included in those relations per se, we speak of equilibrium: we say that those relations define equilibrium conditions or an equilibrium position of the system.’\(^686\) This is a complicated definition, but it need not be so difficult. What Schumpeter is saying is that firstly we must examine the economy – the ‘phenomenon’ – and how it operates. From this we are able to determine the particular relationships between the variables involved. Then we ask: are there a particular set of values for these variables which, when put into the system, will not cause any of the variables to impact on any other? For instance, in the steady, Walrasian case, were we to alter just one of the values, the rest of the system would begin to alter at least to some extent also but it would adjust itself until it returned to equilibrium values, thereby validating the automatic mechanism principle we encountered in the last chapter. In this case, we have found equilibrium values, ‘namely prices such that no demand willing to pay them and no supply willing to accept them remain unsatisfied.’\(^687\) There need not be only one set of values of course but the important point, from the perspective of

\(^{687}\) Ibid., p. 1002
economics as a science, is that without this being the case, they would never be able to determine with mathematical precision the relationships between the individual variables. That is, starting from a point of rest and altering one variable allows one to see the impact of the change. If the system was constantly in flux, then one could never tell with any hope of accuracy the impact of the change. It could not be brought ‘under analytic control,’ as Schumpeter has it, something that ‘from the standpoint of any exact science...is, of course, of the utmost importance.’

This is why Walras, and later Arrow and Debreu, went to such lengths to show that the existence of a unique, optimal set of values is possible, even if this must be done ‘at however high a level of abstraction’ is required to make it work.

Of course, this static approach is, at first glance, not at all well suited to analysing processes of change. This is why the many empirical and historical economists of the time felt that theirs was the only ‘truly scientific and realistic research.’ The Physiocrats who, as we saw, relied upon a static conception of the economic flow, abandoned this when describing progress. Moreover, the nineteenth century was a time of perhaps more economic change than any before or since. It seems fantastical to imagine that technological change – recognised since Smith at least as ‘the most important source of dynamism in capitalist economies’ – and indeed growth itself, could be ignored. It is not as if the period was one of unbridled development wherein growth could simply be taken for granted: indeed the UK suffered a fierce recession between 1857 and 1862, and other more minor ones also. Moreover, economics was, and has always been, a policy-orientated discipline: Mill went as far as to state that the discipline would be useless unless practical guidance could be obtained.

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688 Ibid., p. 969
689 Ibid.
690 Ibid., p. 954
from it.\textsuperscript{692} This applied to economic growth beyond any other matter (even given Mill’s less than sanguine view of the state of wealth-distribution): ‘good governance is that which is most conducive to progress.’\textsuperscript{693} And yet, it is taken for granted in the discipline’s understanding of itself that economic growth, and particularly technological change, were casually ignored in the marginalist era and after: ‘both orthodox and heterodox economic analysts of the 1870-1914 period – with a few exceptions noted later [Rostow is primarily referring to Marshall] – more or less silently agreed: the analysis of economic growth could be dropped from the agenda.’\textsuperscript{694} Indeed, Rosenberg’s celebrated edited volume, entitled \textit{Inside the Black Box}, which states as its mission ‘to break open and to examine the contents of the black box into which technological change has been consigned by economists,’\textsuperscript{695} makes no mention of any economic theorists, Marx excepted, prior to the twentieth century. This is retroactively explained by the apparently prevalent belief that ‘technical change was outside the specialised competence of most economists and had to be tackled by engineers and scientists,’\textsuperscript{696} a notion that we saw Warsh (above) wrongly credit to Mill. We must ask, therefore, whether amongst the sacrifices necessary to accommodate equilibrium analysis we should list, as Robinson believes, any concern with, or notional ability to address, issues of change over time?\textsuperscript{697}

For Meek, the neoclassical revolution was one characterised by ‘the conspicuous absence of any concrete specification about technological change.’\textsuperscript{698} This is no doubt true, but it obscures more than it reveals,

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\item \textsuperscript{692} Mill (1965B), \textit{Op. Cit.}, p. 312
\item \textsuperscript{693} Bonar (1909), \textit{Op. Cit.}, p. 262; Schumpeter notes that, in this era, everyone bar the Marxists referred to economic growth as “progress.” Schumpeter (1954), \textit{Op. Cit.}, p. 892
\item \textsuperscript{694} Rostow, \textit{Op. Cit.}, p. 155
\item \textsuperscript{695} Rosenberg (1982), \textit{Inside the Black Box: Technology and Economics}, Cambridge: Cambridge University Press, p. vii
\item \textsuperscript{696} Freeman, \textit{Op. Cit.}, p. 463
\item \textsuperscript{697} Robinson (1964), p. 61
\item \textsuperscript{698} Meek (1972), p. 504
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because it does not equate to a complete lack of interest in growth and refers only to the explicitly modelled features of marginalism: in technical terms, it amounts to fixed, rather than increasing, coefficients of production.\textsuperscript{699} However, as Spengler’s rather obscure research notes, growth was discussed primarily as an effect of the best possible use of resources.\textsuperscript{700} That is, as long as wealth was distributed in the desired fashion, the expectation was that optimal growth would follow passively. This was particularly the case for Walras, who argued that optimal technological change followed from an optimally functioning system of resource usage.\textsuperscript{701} In other words, he held the ‘belief that action in keeping with their (marginal) principles would assure progress if men wanted it.’\textsuperscript{702} What we see, then, is that ‘progress is thought of as a continuous and almost automatic process that does not harbour any phenomena or problems of its own.’\textsuperscript{703} It is not that technological change or its product, growth, were simply ignored, rather that the theoretical outlook was that technological change emerges from harmony only in such a way as to preserve and prolong it. This should not be in the least bit surprising, since technical progress up to that point had always been modelled as a passive element that worked with harmony even as it emerged from it, its sole duties being the facilitation of substitution and the regular taming of diminishing returns. We are seeing a shift here, though, since in Smith and Ricardo this process occurred only under the conditions of non-intervention. However, that outlook was never justified by much more than a deeply held belief that the abstract theory corresponded to reality. Nevertheless, in his theoretical enshrinement of his ontology, Smith fundamentally changed how the discipline could conceptualise such

\textsuperscript{700} Spengler, \textit{Op. Cit.}, p. 478
\textsuperscript{701} Ibid., p. 495
\textsuperscript{702} Ibid. p. 496
\textsuperscript{703} Schumpeter (1954), \textit{Op. Cit.}, p. 893
processes and thus made marginalism’s sanguine approach to technological change feasible. The key to the issue is time. De Vroey argues that time was eliminated from the process by the marginalists, but, as we saw in chapter four, this is really only half true. Smith had already reduced it to a process of successive repetitions and Ricardo ignored it almost entirely in his focus on distribution.

The subsequent development was therefore entirely logical. Progress being automatic to the static nature of distribution, Ricardo simply ignored time as inessential in creating his parsimonious analytic engine. Smith’s cyclical evolution is halted by him, and the lone remaining cycle purged of its divinity. Mill, as we now have also seen, accepted this bifurcation of Smith’s unified process, ignoring, as Schumpeter points out, all the insights of Rae, and presumably the world around him, in doing so. However, at this point we must recognise the departure from Smith and Ricardo: the latter believed that the theory was an underlying reality, which would itself emerge if permitted. Mill, and later Walras, simply accepted the logic of the theoretical structure and its objects. In other words, to the extent it exists, it will work in accordance with the theory, but the vast complexity of psychological and sociological variables in play in the real world will always limit and pervert its actual performance. It is not, thus, struggling to get out in any sense greater than it reflects the actual culture and beliefs of the people at a given time and place. It is not real, but it is realistic, in the sense of it being possible that, if real people acted in accordance with it, its conclusions would occur. Moreover, in understanding real-world outcomes, it presents to us the essential nature of the relationships that cause them, even if they are never so pure as in theory. Metaphysical analysis thus becomes positive analysis. Hence, and returning to our point of departure, it is only natural that marginalism would ignore growth and

technological change in favour of distribution: the former involve nothing at all that needs to be explained. However, the legacy of Smith’s pantheism is patently visible in the structure of what it made possible – Smith’s invention of something that absolutely did not exist before: what is now commonly referred to as “steady-state progress.” The explicit nature of the connection, and how it has impacted on climate change policy, we will come to in chapter eight. In any case, with the permission this notion of technological change gives for purely static, growth-ignoring analysis, it is reasonable to doubt whether marginal and general equilibrium analysis could have been possible without Smith’s construction.

Alfred Marshall: Discontinuity Suppressed

In the next chapter we begin meeting the theorists immediately preceding Robert Solow, when important discontinuities and rediscoveries occur. However, it would be remiss of us to leave the marginal revolution without discussing Alfred Marshall. Though, as we shall see, his contribution does not fundamentally alter anything from our point of view (at least in the period that directly follows him), he is the only one of the marginalists to have expended considerable energy on growth analysis. Moreover, he is the most obviously influential of them, his Principles replacing Mill’s as the major disciplinary textbook until Samuelson’s emerged in the late 1940s. Marshall was much more significantly influenced by the classics, particularly Mill, than his contemporaries, which no doubt explains his interest in growth analysis. In any case, in writing a textbook he was obliged to describe the state of the art. Marginalism was by this point well-

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705 Robbins, Op. Cit., p. 44
established, if far from entirely accepted, and the tradition in the discipline of economics, after each significant development, is for a textbook to be written that lays out what by then are the broadly accepted doctrines. Perhaps Marshall pre-empted this a touch, but in examining his motives, we must bear in mind that without a textbook it would have been more difficult for the new approach to attain dominance, not to mention teaching and financial considerations. The result is that, contrary to his fellow neoclassicists, he was obliged to state overtly the prevailing view on growth, which the others had taken for granted.

Indeed, Schumpeter even credits Marshall with the idea of steady-state progress: ‘the case of a society in which population and wealth grow at about the same rate and in which “methods of production and the conditions of trade change but little; and, above all, where the character of man himself is a constant quantity.”’ However Marshall, as we shall see in greater detail later, was far more empirically minded than his predecessors. He toured factories and talked extensively with the elite of the business community. The result is that, for a start, he recognised the conflict between Smith’s representation of technological change and the harmony that produced it like no one, barring again, perhaps, Rae, had ever done before. He can thus be fairly identified as the originator of the idea of increasing returns in economics, or at least the first to identify its full import. Perhaps unfortunately, he did so only really on a micro level, and used the tool of spillovers, meaning that the knowledge could not be withheld from competitors, to balance his equilibrium. The resulting growth theory is thus, unsurprisingly, a fair approximation of Solow’s

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710 Rostow, Op. Cit., p. 172
712 Ibid., p. 317
neoclassical growth model,\textsuperscript{713} as indeed was Mill’s.\textsuperscript{714} Likely as a result, his insights regarding increasing returns would not become a matter of concern for the mainstream of the discipline for another century.\textsuperscript{715}

That said, Marshall’s analysis is important in other respects. In short, he is the first non-Marxian theorist since Malthus to doubt whether the theoretical base, from which the real world supposedly deviates, does indeed work as harmoniously as presented by everyone else; in particular, whether technological change operates as harmoniously and passively as always assumed. As we saw above, from sweeping negative progress we moved, with Mill, into a mainstream view where the abstract theory only presented the fundamental relationships, which might then be distorted by beliefs, errors and so forth and may indeed need state intervention to stand. Marshall is the first mainstream economist to argue that, in the abstract, the objects do not in fact conform to the perfect competition model that Mill had felt necessary for economics to even be a science. This is an important precedent for Keynes, who effectively succeeded Marshall as the “great man” about Cambridge’s economics department. Keynes famously never read Marx,\textsuperscript{716} so Marshall’s willingness to doubt the logic of perfect competition would surely have been important in preparing Keynes’s mind for the Malthusian arguments he would do so much to popularise. Indeed, Marshall is described by Schumpeter as the patron saint of monopolistic and imperfect competition; someone determined to mix abstract marginalist analysis with ‘every bit of real life he could possibly leave in.’\textsuperscript{717}

Let us examine Schumpeter’s analysis of his approach:

\textsuperscript{713} Rostow, \textit{Op. Cit.}, p. 178
\textsuperscript{715} Warsh, \textit{Op. Cit.}, p. 255
\textsuperscript{716} Joan Robinson (ed.) (1973), \textit{After Keynes}, Oxford: Basil Blackwell, p. ix
If we are of the opinion, on the one hand, that from all the infinite variety of market patterns pure or perfect monopoly and pure or perfect competition stand out by virtue of certain properties—of which the most important is that both cases lend themselves to treatment by means of relatively simple and (in general) uniquely determined rational schemata—and, on the other hand, that the large majority of cases that occur in practice are nothing but mixtures and hybrids of these two, then it seems natural to accept pure monopoly and pure competition as the two genuine or fundamental patterns and to proceed by investigating how their hybrids work out. This renders the attitude of the theorists of monopolistic or imperfect competition. But instead of considering the hybrid cases as deviations from, or adulterations of, the fundamental ones we may also look upon the hybrids as fundamental and on pure monopoly and pure competition as limiting cases in which the content of actual business behaviour has been refined away. This is much more like the line that Marshall took.\footnote{Ibid., p. 975}

In essence, we are coming back here to Marshall’s thoughts about increasing returns, where firms that develop a new technology gain an advantage over other firms for a period, before, for Marshall, that knowledge becomes part of the public domain, rendering competition even again. This is resonant of Schumpeter’s own analysis, as we shall see, but Marshall was unwilling to run with his insights in the way Schumpeter would. The latter can thus rightly say that, in a broad sense, Marshall and Walras’s models were fundamentally the same.\footnote{Ibid., p. 952} There were plenty of differences in technique, for Marshall was the master of partial analysis, which does not presume to explain the whole system in its various intertwined relationships, but rather deals with equilibria separately in each sector, under the heroic simplifying assumption that each particular sector has no more than a negligible effect on any other.\footnote{Ibid., p. 990} However, with this assumption in place, which we might note in passing is no less problematic
than the idea of ‘universal interdependence,’ Marshall does enough to justify the statement regarding the uniformity of marginalist analysis that: ‘below the phrase-troubled surface, there was no impasse.’ Partial equilibrium analysis is of real importance for much of microeconomics, but it bears little on our concerns.

Lastly, it is reasonable to ask the degree to which Marx, who wrote extensively on monopolisation, may have been an influence on Marshall. Certainly, Marx was the first major thinker since Rae to problematise the discipline’s passive reading of technological change. Like Marshall, he rejected the ubiquity of the law of diminishing returns (though certainly not of falling profits), also citing technology as the reason why. Marshall’s own logic though, particularly in relation to spillovers, was entirely novel. Moreover, the latter’s idea of monopolistic capitalism is only superficially similar to Marx’s: the logic behind its occurrence is entirely different, Marx relating it to the general destructiveness of competition, and effectively as a stage in capitalism’s development, whereas Marshall saw it as temporary and resulting from the technological advantages of particular firms at particular times. In addition, given the research in which Marshall engaged, there is no very good reason to assume he was even inspired by Marx to begin looking in this direction. In any case, and finally, Marshall’s interest in monopolistic competition, while very occasionally taken up by others (Robinson, Chamberlin), would not be of concern to growth theory until he was roughly six decades dead.

721 Ibid., p. 996
722 Ibid., p. 954
Chapter Seven

Keynes, Marx and Schumpeter: The Rationality Challenged

This chapter is about the challenges conceded and the discontinuities overcome by the rationality we are charting. It shows that Keynesianism altered the rationality of economics forever, albeit in a much less significant way than is often thought. After Keynes, mixed progress would always be possible, even if it was, for the most part, suppressed by his American successors until the advent of endogenous technological change. Marx and Schumpeter’s efforts, on the other hand, were successfully resisted by the rationality. Of the two, I show, perhaps surprisingly, that Schumpeter’s theory was the bigger challenge insofar as negative progress is concerned.

John Maynard Keynes: Malthus’s Revenge

The significance of Keynes is easiest to gauge from a comparison with what went before him. In this respect we are thinking not at this moment of the microeconomic equilibrium theory that we have just shown ascending to dominance. For there was an additional – perhaps, in some instances, alternative – line of thought developing alongside it: business (or trade)-cycle theory, which prospered mostly in the years after 1890. This is obviously of interest in any discussion of Keynes and Schumpeter, since it purports to explain roughly the same occurrences that motivated their work. Both Mill and Marshall expressed thoughts on these phenomena, which are variously referred to as “crises,” “fluctuations” and, mostly later on, cycles. However, Mill’s work is clearly derived from his two major predecessors and, perhaps characteristically, he splits the difference.
between Malthus and Ricardo. As Rostow shows, he clearly accepts the argument that at the heart of recessions and depressions is irrationality, but he will not accept the idea that “general gluts” – long-term over-production – are possible.\textsuperscript{725} Marshall’s work on this is overwhelmingly based on Mill’s, and significantly neither is willing to countenance government intervention to mitigate against these downturns.\textsuperscript{726} The automatic mechanism, for both, must be left to operate. Beyond these, once more we can only be struck by how little influence Marx seems to have had, despite the fact that crises of capitalism were a central motif in his work. While Marx and, as we shall see, Keynes and Schumpeter, saw crises as internal to the innate workings of capitalism (albeit in three very different ways), business-cycle theorists, broadly speaking, worked from the overt realities of day-to-day enterprise. In an important sense, most are thus in the Mill-Marshall tradition: the underlying harmony of capitalist life is real and sound, but it is forced to operate in a world where it is surrounded by distorting forces. Alternatively, they were simple empiricists, with little concern for theoretical abstraction. In other words, they did not fundamentally overturn the microeconomic abstractions then in vogue, but rather ‘treated cycles as a phenomenon that is superimposed upon the normal course of capitalist life.’\textsuperscript{727} This can be seen from the fact that the normal starting point is a boom that is ascribed (when not simply taken for granted) to various exogenous forces such as the discovery of new gold reserves, especially good harvests or in the case of Robertson’s interesting analysis, even invention.\textsuperscript{728} The reaction to this then forms the basis for the analysis, with the money and credit system in particular, but also general overdevelopment on the part of industrialists, cited as the cause of the ensuing downturn.\textsuperscript{729}

\textsuperscript{725} Rostow, Op. Cit., pp. 108-112
\textsuperscript{726} Schumpeter (1954), Op. Cit., p. 747
\textsuperscript{727} Ibid., p. 1135
\textsuperscript{728} Rostow, Op. Cit., p. 266
From this, admittedly very generalised, summation of an incredibly large body of thought, two things should be noted: the first is that the ultimate origin is always an exogenously caused boom of some kind, hence Juglar’s aphorism: “the only cause of depression is prosperity.”

It is thus not linked to an economy at rest – tied into the prevailing static analysis – but is rather a process almost parallel to it. It is certainly, therefore, macroeconomics, but not in the manner of Smith or indeed Solow, whose work is connected to an underlying sense of the distributive system, even if, in the latter’s case, mostly implicitly. This is what we will later refer to as microfoundations. The second point is the role played by irrationality, or general errors in judgement caused by insufficient information, in ending the boom. Hayek famously blames central banks, while Hawtrey blames banks in general, for the oversupply of credit that they see at the heart of the subsequent depression. It is from the systematisation, or theoretisation, of the reaction of the banking system to booms that a notion of “cycles” is found. Others – Robertson, Pigou, Spiethoff and Hobson, to name but a few – note a whole range of reactions, the monetary conspicuous but hardly alone amongst them. These latter tend to be more or less empirically informed, but are in general inductive and ad hoc; different crises have different, or at least uniquely mixed, causes, although a broad range of potential ones can be discerned. They are thus mostly, but, crucially, not entirely, in the Malthusian tradition, as per our discussion in chapter five. They differ from Malthus in that their analysis is not part of a broader examination of the functioning of the economic system in general. In other words, these injudicious reactions are predictable and can be mitigated by, for instance, either removing, or expanding the remit of, the central bank, depending on whose analysis one believes. Crucially, however, such moves

are precautionary; irrationality is broadly predictable but not a necessary or innate event. This is what Schumpeter meant when he said the theories were superimposed upon the prevailing orthodox analysis, and what Meek means when he, slightly too sweepingly, declares the entire field as identifying ‘the operation of exogenous factors or the presence of irremovable rigidities’ as the causes of downswings.\textsuperscript{733} These certainly play a central role, but only in the presence of what might be termed “animal spirits.”

I chose the latter phrase deliberately, as it is one rather famously coined by Keynes in his \textit{General Theory of Employment, Interest and Money}.\textsuperscript{734} However, we cannot understand the Keynesian revolution unless we recognise that contingent and possible, even likely, irrationality is not the main driver of his work. Rather, it is the logically necessary and entirely predictable reaction of individuals within Keynes’s system to equally necessary and predictable circumstances that constitutes his major objection to the marginalists, the latter being the “other” against whom he sets himself. To begin, let us get a feel for the contours of this new revolution: firstly, the argument was not carried on in the microeconomic vein of its predecessors; Keynes returned to the aggregation of Ricardo and in the process, if we can be somewhat grandiloquent, ‘more or less invented macroeconomics.’\textsuperscript{735} However, as Hutchison notes, we are not dealing either with a clean break from the immediate past: Keynes returns to aggregates in order to make his argument (which would have been mathematically impossible at the microeconomic level)\textsuperscript{736} but really these are integrated into a broad conception of the prevailing wisdom of the

\textsuperscript{733} Meek (1967), \textit{Op. Cit.}, p. 184
\textsuperscript{735} Schumpeter (1954), \textit{Op. Cit.}, p. 998; Solow 1997, p. 48
\textsuperscript{736} Schumpeter (1954), \textit{Op. Cit.}, p. 1161
marginalists, forming ‘a kind of general “neoclassical synthesis”’ which predates that of Samuelson et al, to whom this term normally applies. The other thing of note is that, while Keynes certainly ‘preferred the more tentative and empirically informed theorising of Malthus and others,’ and was no doubt inspired by the business-cycle work in this vein of, at least, his good friend Robertson, his static, short-run theory goes very much against the “macrodynamics” of their work, instead returning to the realm of the abstract which, if motivated by nothing else, was certainly a necessary move if he was to impact on the timeless verities of general equilibrium and the automatic mechanism.

Hence, Keynes description of full employment equilibrium is, though aggregated, ‘entirely in the neoclassical tradition.’ His essential insight, however, was that rather than this being the normal course of economic life, occasionally disturbed by outside forces, it is rather a “special case” within a range of equilibria where full-employment is likely to be absent without government intervention. To grasp this, let us first recognise that equilibria may be stable, unstable or neutral. Schumpeter’s felicitous metaphor is of a ball at the bottom of a bowl, a ball on top of a bowl, and a ball on a flat surface respectively. The latter is of little importance to economic theory and an unstable equilibrium is the Harrod-Domar kind that we shall come to later. The first, though, had characterised mainstream economic theory until Keynes: a strong automatic mechanism. As Blaug states, the ‘idea that the competitive process continually drives the economy back towards a steady state of full employment whenever it falls below the full-capacity utilisation of the capital stock permeated all

737 Hutchison, Op. Cit., p. 249
739 Rostow, Op. Cit., p. 278
macroeconomic thinking before Keynes. Indeed, it was so widely held that it was frequently implied rather than argued explicitly.\textsuperscript{744} The revolutionary aspect of Keynes’s thought, then, was that, rather than there simply being a single set of equilibrium values with the potential for temporary disequilibria of various levels of intensity, as a result of, like business-cycle theory, exogenous shocks, it must necessarily be the case that at some point unemployment will rise and, rather than being corrected, will see the economy adjust around it, back to equilibrium but with an uncorrected, sub-optimal condition right at the heart of it.

It is not really necessary, even if space were available for it, to give a full account of the logic of this argument, but briefly it falls into two categories, both of which start from empirical analysis of business cycles, and thus seek to understand why the automatic mechanism does not prevail, and indeed cannot be expected to. The first revolves around the interest rate, which a government will naturally seek to reduce in a recession.\textsuperscript{745} This is in order to create an incentive to invest. However, this lowering has an unfortunate knock-on effect: it leads to the assumption that interest rates can only go up, which encourages people to ‘hoard’ money in order that they may benefit from the future increase. This preference for liquidity, in a situation where unemployment is already high, leads to a significant lack of demand, meaning that reduced interest rates provide little incentive for anyone to borrow money for investment purposes, and the potential for an increase in interest rates discourages people, along with a lack of demand, from investing their own. A liquidity trap has come into existence, where the interest rate must be kept low to encourage investment, but in fact does not do so because of people’s perfectly rational assumption that spending now will yield lower fruits than will be garnered by the likelihood of higher

\textsuperscript{744} Blaug (1984), Op. Cit., p. 654
\textsuperscript{745} Ibid., pp. 654-665
interest rates in the future. Without an outside agency stepping in to spend money (“priming the pump” as it were), thereby improving demand, the situation will maintain itself indefinitely. Hence, as Blaug puts it, ‘(the) system is in equilibrium at less than full employment.’ Other potential causes of this are the famous “sticky” wages and prices, but these were really special cases within what Keynes saw as his “general” schema. We know this because wage-rigidities are obviously nothing new: as we have seen, the abstract analysis of the neoclassicals did not preclude them from recognising political or institutional barriers to equilibrium in the real world, such as minimum wage laws or powerful unions. Keynes, on the other hand, wanted to ‘deny that the presumption of wage cutting, even if it were feasible, would increase effective demand’ and hence that ‘there exists no mechanism in a competitive economy that guarantees full employment.’ Without this, there is little originality to his work and it hardly qualifies as a “general theory” as opposed to a “special theory” – universal as opposed to particular – words with plenty of authoritative power given the rather recent publication of Einstein’s great work. Moreover, the general equilibrium of Walras was based on a similar universal claim, which Keynes wanted to dismiss, calling the latter a special case of his more general theory.

There is, however, genuine disagreement as to the degree to which Keynes might be said to have succeeded. Davidson is insistent that he did, and that the subsequent neoclassical synthesis, of which we shall see more below, betrayed his key insight in its return to neoclassical foundations. Blaug argues that in fact Keynes was wrong, and his is not a general theory at the

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746 Ibid., p. 662  
747 Ibid., p. 665  
748 Ibid., pp. 664-5  
abstract level. It must instead, when thoroughly examined, rely on contingent political and other realities to validate its claims that unemployment equilibria are likely to occur, a result much less than Keynes’s desire to show that they will necessarily occur.\footnote{Blaug (1983), \textit{Op. Cit.}, p. 667} However, regardless of which side is correct, Keynes himself certainly thought he had revolutionised abstract thought and thus really for the first time in mainstream economics since Malthus’s tentative efforts in the same direction, a major theorist publically positioned himself “on the other side of the gulf” from “those who believed that the existing economic system is in the long-run self-adjusting, though with creaks and groans and jerks, and interrupted by time-lags, outside interference and mistakes,”\footnote{William Darity Jr. (2009), ‘More Cobwebs? Robert Solow, Uncertainty, and the Theory of Distribution’ in \textit{HOPE}, Vol. 41 (Annual Supplement), p. 150} thereby destroying the dominance that negative progress had enjoyed in the abstract for over a century. Positive progress, through the need for government intervention, was thusly given access to Smith’s objects and the rationality of economics would be fundamentally changed for it.

All that said, Keynes’s work does not in fact constitute a radical change in the discipline of economics, for it does not abandon that core feature of the discipline: the possibility of harmonious progress. Instead it should be understood as a necessary concession in the face of extraordinary circumstances. For a start, the success of Keynes’s \textit{General Theory} cannot be understood without the depression. Keynes had written \textit{A Treatise on Money} in the late 1920s and saw it published in 1930; but, though it expressed many of the same themes as his later and more famous work, as well as garnering much the same criticisms, he was unable to press home his point about the need for state intervention.\footnote{Rostow, \textit{Op. Cit.}, p. 278} However, by the time \textit{General Theory} was published in 1936, events had thoroughly tarnished the credibility of the automatic mechanism. Moreover, Keynes delivered in this
new work – which is of course, at its heart, an explanation of sustained unemployment – a rhetorical performance far surpassing that of *A Treatise on Money*. It would not be overstating the case to call it an instant success. Schumpeter explains: ‘(as) in the case of Ricardo, it was the intellectual performance spiced by the—real or putative—relevance to burning questions of the time which achieved what, in our field, neither could have achieved by itself.’ Indeed, Paul Samuelson – likely the most influential economist of the post-war era – who always self-identified as a Keynesian and who stated that at the time he struggled with the logic of Keynes’s analysis, admitted: ‘(the) way I finally convinced myself was to just stop worrying about it. I asked myself: why do I refuse a paradigm that enables me to understand the Roosevelt upturn from 1933 till 1937?’ Nevertheless, we should be careful to remember that Keynes’s was not a new theory designed to explain the depression, but rather the sudden ascendancy of a train (it can hardly be called a tradition) of thought long-since suppressed. Keynes himself wondered how the ‘great puzzle of effective demand with which Malthus had wrestled vanished from economic literature’ while Ricardianism triumphed, ascribing it to ‘a complex of suitabilities in the doctrine to the environment in which it was projected.’ He also asserts, interestingly, that this issue was kept alive in the works of a few radical thinkers, amongst whom he mentions Marx. Indeed, we have above described the latter, along with Schumpeter and Keynes, as one the three major theorists in opposition to abstract negative progress. However, it is difficult to draw a link between the former and Marx, for a start because, as Robinson noted with exasperation, Keynes

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754 Ibid.
759 Ibid.
'never managed to read Marx,' and secondly because, between Marshall and Malthus, whose writings we know he was immersed in, we have all the influence necessary to explain Keynes’s eventual direction.

Nevertheless, Keynes shares one belief with Marx that cannot be ascribed to his two major influences: a profound faith in both the necessity and capacity of human reason to bring about progress. As Hutchison tells us, ‘he belonged to an apostolic elite of connoisseurs, whose beliefs were imbued with an infallible, scientific certainty, and which included a confidence in human progress and in their own ability to bring it about.’ This was the driving force behind all his work, even before the depression made it acceptable within the discipline, as we can see from his *Economic Consequences of the Peace* (1919). Reconciling this with orthodox economic theory was, of course, a major challenge, given the latter’s foundation in an entirely different concept of progress. Routh explains: ‘*(General Theory)* becomes easier to understand once it is recognised that it contains confusions and conflicts. Keynes was trying to do two things: show how those aspects of capitalism that he valued could be preserved, and show how orthodox economics could be adapted to serve this purpose.’ In other words, how orthodox economics could be adapted to allow for the universal kind of reason he felt necessary to maintain human progress. Indeed, we can, despite the scathing rhetoric with which he addresses his doctrinal opponents, clearly see that the harmony of the economic sphere is retained in the Keynesian system, albeit with what might be called a chronic ailment. Thus Joan Robinson, a more Marxist-leaning follower and colleague of Keynes’s at Cambridge, refers to the Keynesian system as a ‘diminished kingdom,’ insofar as harmony is concerned. Keynes was not shy about this, arguing that his work ought to be used “not to defeat but to implement the wisdom

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of Adam Smith.”764 He described the classical school as embodying “some
permanent truths of great significance,” agreeing with Smith that there are
in the economic sphere “deep undercurrents at work, natural forces one
can call them, or even the invisible hand, which are operating towards
equilibrium.”765 He therefore creates the great exemplar of what I referred
to in chapter five as mixed progress, a move that necessarily involves
conferring in the abstract tremendous power upon the intervening power:
for in making entirely known this now innate problem of capitalism,
Keynes makes the system theoretically perfectible. This was not accidental
or subconscious on Keynes’s part; rather, as we should expect, he openly
‘sought to demonstrate that unemployment could be reduced to any
desired level by appropriate government action.’766 Far from an enemy of
orthodox economics, he instead preserved the influence of that branch’s
harmonious progress rationality at a time when, as we have seen,
Roosevelt’s unorthodox moves were seemingly effective. That basic
element, which as Myrdal argues ‘runs through the development of
economic theory and pervades the structure of its language and thought,’767
is thus able to be carried forward to the growth theory of Robert Solow, as
we shall see. And importantly for our concerns, technological change,
ignored in Keynes’s work,768 is preserved in the same automatic,
harmonious form.

764 In Hutchison, Op. Cit., p. 122
765 Ibid.
766 Routh, Op. Cit., p. 283
Karl Marx and Joseph Schumpeter: Radicalism Re-assessed

However, the latter assumption does not go unchallenged, for it was the centre-piece of Schumpeter’s alternative, evolutionary explanation of the depression and downturns generally. Of course, one could argue that to focus on Schumpeter’s alternative is to overlook the arguably greater one that predates him: that of Marx. However, in relation to Marx, two things are important to note for the purposes of our argument: the first is that he is, on the most basic theoretical level, much less significant a challenger to orthodoxy than is Schumpeter. For Marx, like Keynes, assumes the existence, in a very meaningful way, of the underlying harmony: unlike Keynes however, it is, for Marx, beyond saving. Marx’s general approach is also similar to Keynes’s: he assumes virtually the same cyclical world (model) as his opponents initially – a two-sector, steady-state growth model769 – adds one or two additional variables of his own devising, but mainly tweaks the relationships between the variables that already exist, and from this produces an evolutionary vision of economic growth, where the formerly infinitely repeating cycles are now corrupted by pathological flaws, which produce debilitating effects exponentially, until they collapse the entire system from the inside. The major cause of this collapse, in the final analysis, is technological change, which certainly takes on a far more negative character in Marx’s work than in that of any other major theorist. In the Ricardian style, technological change is entirely labour-saving, but this must necessarily be the case for Marx. His goal is to show that the real source of wealth – labour – is progressively driven out of the productive process by the requirements of competition: that is, the need to make one’s products cheaper than the competition’s leads to the removal of labour and

769 Hagemann, Op. Cit., p. 67
the adoption of ever more machines. There is no real need for our purposes to rehearse the rest of Marx’s famous argument about the progressive self-destruction of capitalism, only to note that there is an assumption about technological change involved in this which is familiar to us: in order for the destructive logic of Marx’s argument to work, whenever technology is desired, it must be available, even though it is expected to function in a very particular way; i.e. replacing labour.\textsuperscript{770} Marx certainly believed that technological change had within it the power to liberate mankind – indeed he was positively Baconian in his optimism for its potential\textsuperscript{771} – but argued that it had been ‘pressed into the service of capital.’\textsuperscript{772} For Marx, rather than functioning \textit{innately} in the way described by his predecessors, technological change it is effectively forced to do the bidding of history, which means assisting in the collapse of capitalism. Marx thus adds a significant amount of depth to the concept of technology found in Ricardo, and changes the eventual effect of it, but he does not threaten its immediate theoretical structure, or to put it another way, the objectification remains the same, merely the explanation of how it came to be so is altered. For Marx expands upon the Ricardian view that machines can put people out of work, taking this beyond the abstract thought of Ricardo, who felt the point to be of little practical relevance. However, this advance does not appear to have had any impact on the discipline, likely because it relies upon his analysis of the destructive nature of competition. Once the logic of this progressive impoverishment of the working – and ultimately, for the most part, capitalist – classes was disputed, and then rendered superfluous by a utility theory of value, the characterisation of technological change no longer goes much further than Mill’s.


\textsuperscript{771} Wendling, \textit{Op. Cit.}, p. 9

Hence, from this perspective Marx must be classed alongside Keynes as an internal critic. As Warsh puts it, ‘the way to understand Marx the economist is as a close student of Ricardo, albeit one who was anxious to turn the master on his head.’\textsuperscript{773} Rostow also notes this, stating that with ‘Marx we are dealing with concepts quite familiar and very much in the classical tradition. They are, however, employed in a highly selective and exploitative way for a pre-determined purpose.’\textsuperscript{774} This is perhaps why Marx’s theoretical influence on the discipline was limited: though in Marx there is much more going on beneath the surface of the model, his work could be dismissed without ever having to engage further than the strictly economic. An orthodox economist can simply engage with his treatment of Ricardo and Smith’s objects, with which they also work, and dismiss his logical development of them. Moreover, the core of his work was then rendered largely irrelevant by the subsequent marginal revolution. This was always a potential hazard for the Marxian approach: he really only identified contradictions in the \textit{theory} of capitalism as he found it in contemporary political economy. Once this theory changed, Marx’s critique became an anachronism, forcing Marxists to defend the superseded classical approach ever after. Hence, aside perhaps from some of the Cambridge scholars we shall meet later, one is forced to agree with Samuelson’s judgement when he says: ‘I do not honestly think that modern developments were much influenced, directly or indirectly, by Marxian writings.’\textsuperscript{775}

That said, to deal only with Marx’s abstract economic core is to ignore the bulk of his work. Though Smith had analysed the development of economics through the progressive division of labour, Marx’s was the first truly evolutionary theory of development, insofar as he saw the process of production changing around him and predicted further changes into the

\textsuperscript{774} Rostow, \textit{Op. Cit.}, p. 124
\textsuperscript{775} Paul A. Samuelson (1967), ‘Marxian Economics as Economics’ in \textit{The American Economic Review}, Vol. 57, p. 617
future also, even before the inevitable collapse.\textsuperscript{776} It is clear to us from our examination of the marginalists that this important identification of the changing nature of the economy – as opposed to a static representation of growing capital stocks – had little or no impact on discipline in the nineteenth century. However, Schumpeter takes a similar view to Marx in the first half of the twentieth, so we should ask the extent to which Marx might be said to have influenced the former’s work. Schumpeter, as we shall see, posed a major problem for the discipline, one that was largely ignored. Can we see in it the legacy of Marx?

Well let us first examine Schumpeter’s contribution. There can be little doubt that the inspiration for his quite radical reinterpretation of economic development was the business-cycle analysis of the late nineteenth century. A passage at the end of the section on this in his final book, \textit{History of Economic Analysis}, gives us a clear hint: referring to the thinkers described above, he states, ‘it never occurred to the majority to look to business cycles for material with which to build the fundamental theory of capitalist reality.’\textsuperscript{777} This was Schumpeter’s life’s work: arguing that rather than being exogenously determined shocks, or generally undesirable breaks on the steady-state growth that was the norm, cycles might in fact be the very substance of economic growth. In short then, developing no less than ‘the fundamental theory of capitalist reality’ was his goal, and for Schumpeter, this revolved around technological change. Already we can begin to see that Schumpeter conceptualised capitalist development in a radically different way to Marx though. While all crises were, for Marx, effectively harbingers of the great crisis that would eventually end capitalism as a stage in history, Schumpeter turns this completely on its head, bringing harmony into a schema dominated by discontinuity, rather than attempting to


introduce discontinuity into a harmonious framework. Meek is thus obviously correct when he says that Schumpeter’s efforts are ‘probably best understood as alternatives to those of Marx,’ rather than developments of them.\textsuperscript{778} Nevertheless, it is probably fair to say that Schumpeter was “attracted by the grandeur of the Marxian system.”\textsuperscript{779} He appreciated Marx’s “vision” of a capitalist system fatally undermined by the consequences of its own development, as is evident from passages in his *History*. For instance, in Marx Schumpeter saw one of those very few thinkers for whom, like him, ‘disequilibrium is the very life of capitalism,’\textsuperscript{780} although, as noted, they differed completely on what this meant. Moreover, there are what might be called local similarities between the two, wherein Marx’s influence might be found. The most significant of these is also Schumpeter’s analytic starting point: entrepreneurs.

It was logically necessary for Marx, in order to sustain his narrative, to have capitalists motivated not merely, or even primarily, by rational financial self-interest.\textsuperscript{781} Marx found himself in a delicate argumentative position when arguing that the least viable firms will be progressively destroyed with each round of competition. One could certainly object that, at a certain point, the few remaining firms might find themselves in a similar position to that occupied by many of the modern world’s most successful companies: all making sufficiently reasonable profits to discourage the more bloodthirsty kinds of price-competition. One thinks of Coca-Cola and Pepsico, for instance. Hence, he maintained that capitalists act more out of *social* pressures and incentives than economic ones, with the consequence being competition of a far more cutthroat variety than could really be justified under purely economic considerations.\textsuperscript{782} Schumpeter

\textsuperscript{779} Hablerer in Ibid.
\textsuperscript{780} Schumpeter (1954), *Op. Cit.*, p. 1051
\textsuperscript{782} Ibid., p. 126
takes a similar line, but for him it is originary, and much more than a vague device. He insists that in order to understand economic development we can have no part ‘of the time-honoured picture of the motivation of the “economic man.”’\textsuperscript{783} While in the normal course of the distribution of wealth we may ‘think of satisfaction of wants as the normal motive. The latter is not true for our type.’\textsuperscript{784} Entrepreneurs, for Schumpeter, are a ‘special type,’\textsuperscript{785} embodying ‘the dream and the will to found a private kingdom,’ ‘the impulse to fight,’ and ‘the joy of creating,’ as opposed to the more mundane sort of rationality employed by regular folk.\textsuperscript{786} This is, of course, very different from the subject of \textit{Wealth of Nations} and indeed every other orthodox schema, which without exception adopt the uniformity Smith conferred upon every person in his system. For Schumpeter, though, the entrepreneur embodies attributes ‘differing \textit{in kind} and not only in degree from those of mere rational economic behaviour.’\textsuperscript{787} We should note here that this makes the entrepreneur unpredictable, since we cannot map out the exact circumstances that will cause her to act, mired as they are in sociological and psychological complexity. Moreover, one cannot even know their number, which effectively means one cannot really gauge how dynamic an economy is at a particular time, especially given the fact that sociological conditions are subject to exactly the sort of qualitative change that economic theory attempts to avoid. Immediately we see that Schumpeter is challenging the repetitive structure of standard abstract theory, both in its conceptualisation of its subject and (as a result) in its predictive capacity.

However, by entrepreneurs, Schumpeter is not referring to CEOs, the traditional “capitalist” or business leaders – someone can even cease to be

\textsuperscript{783} Schumpeter (1934), \textit{The Theory of Economic Development}, London: Oxford University Press, p. 90
\textsuperscript{784} Ibid, p. 91
\textsuperscript{785} Ibid., p. 81
\textsuperscript{786} Ibid., p. 93
\textsuperscript{787} Ibid., p. 81
an entrepreneur, and indeed, most settle down to manage their concerns – but only those that engage in the famous process that characterises, for him, economic development: creative destruction.\textsuperscript{788} We must understand that this latter is not merely the introduction of better versions of existing products, but rather entirely ‘new combinations’ of the factors of production – land, labour and capital.\textsuperscript{789} In describing exactly what are ‘new combinations,’ Schumpeter insists that we cannot look to existing firms for their genesis: ‘it is not the owner of stage-coaches who builds railways.’\textsuperscript{790} In other words, Schumpeter is talking about entirely new innovations, the results of inventive activity turned into marketable products of one kind or another by the most dynamic amongst us. There is a point worth noting here that we will return to later: it is that this description of the economic process may seem a little anachronistic to the twenty-first century reader, used as we are to colossal firms like Samsung and Apple introducing into the marketplace the more significant innovations; however, as we shall see, Schumpeter – and indeed Marx – have anticipated us. In any case, what will not seem discordant is Schumpeter’s dismissal of any notion of “necessity” motivating this aspect of technological change: for entrepreneurship is not simply an automatic response to latent desire in the system, rather ‘the producer...as a rule initiates economic change, and consumers are educated by him if necessary...they are, as it were, taught to want.’\textsuperscript{791} For Schumpeter, there is not really such a thing as “opportunity,” instead, as long as there are entrepreneurs there will be new combinations.\textsuperscript{792} In economic terms, he is saying that incentives are infinitely elastic; hence it is with the \textit{will} of the entrepreneur that we should concern ourselves: it is

\textsuperscript{788} Ibid., p. 75
\textsuperscript{789} Ibid., p. 76
\textsuperscript{790} Ibid., p. 66
\textsuperscript{791} Ibid., p. 65
\textsuperscript{792} Ibid., p. 88
‘more by will than by intellect that the leaders fulfil their function.’ A heroic individual, then, who carries all before him.

However, we ought to pause here for a moment to consider the conceptualisation of invention that must be involved in such a theory, for it cannot be doubted that Schumpeter takes it for granted. Indeed, he goes as far as to call it ‘economically irrelevant,’ given its dependence on entrepreneurial take-up: ‘it may be downright misleading,’ Schumpeter tells us, ‘to stress the element of invention as much as many writers do.’ He is here probably referring to Rae, or perhaps some economic historians. The key point, though, is that invention is not simply being fed into the economic process through the need to replace labour or generally boost productivity; in Schumpeter’s world, it is entirely divorced from “need.” Hence we are all of a sudden faced with an implicit process of invention where what is being created is effectively random, and its effect can as easily be the radical augmentation of an existing manufacturing process as it can the replacement of what is being manufactured. In addition, even though it is also implicit, this treatment of invention contrasts very strongly with the labour-saving or agriculture-improving version the classics propounded. It cannot even be said that the former is more relevant to a later time, for Schumpeter’s railway example refers to the likes of Brunel and Stephenson, innovators of the early eighteenth century, who are comparable with the canal-builders of Adam Smith’s era. We begin to see just how dependant on a particularly complimentary conception of invention is the notion of steady-state growth. Schumpeter’s version, on the other hand, is certainly growth producing, but hardly comfortable with equilibrium. Indeed, Schumpeter’s overriding objective is to show that

793 Ibid.
794 Ibid., pp. 88-89
inventions, once transferred into the system, are quite the opposite of harmony-supporting.

Rather they are ultimately certain to cause long-term unemployment. Indeed, in vibrant contrast to Keynes, Schumpeter maintains that ‘great unemployment is only the consequence of non-economic events...or precisely the development which we are investigating.’ However, Schumpeter, though contrasting right from the beginning his own work with that of ‘the theory of equilibrium,’ still maintains that there is a tendency towards equilibrium, and even, in his earlier work, The Theory of Economic Development, that this in fact exists for a time. How can all this be reconciled with what I have said above? Well the latter point we shall return to, but the tendency towards equilibrium is merely the automatic mechanism correcting the results of each innovating effort. We must remember that Schumpeter is attempting to account for business cycles, and thus describes what at first glance seems a fairly banal process of identical repetition, albeit over a longer term than the structure we have heretofore been dealing with. In fact, by the end of his days Schumpeter had a far more complex notion in mind, but his simpler early work probably serves us better initially from the point of view of exposition. In any case, it all begins with the will of the entrepreneur, but immediately after this there is a requirement for funds. These can either be found in the credit provided by the banking system, which therefore plays as an important role in Schumpeter’s work as it does in Keynes’s, or in the funds accumulated from previous entrepreneurial exploits. However, funds are useless without the other factors of production and Schumpeter recognises a condition of scarcity here, particularly in relation to labour, though also materials to a degree, with the result that these must be detached from their

795 Ibid., p. 67
796 Ibid., p. xi
797 Ibid., p. 72-3
previous employment in order to be allotted to the new needs of innovators.\textsuperscript{798} Naturally, this is done through the offer of increased wages, which begins a boom in general material well-being, but necessitates the destruction of that existing firm, which for reasons that will become clear to us, will very likely have been operating on tight profit margins, making it unable to bear the increased expense. Furthermore, the new enterprises do not exist alongside the old, but rather appear alongside them and eliminate them competitively.\textsuperscript{799} The result is a short period in which our initial innovator commands the marketplace, having destroyed the purveyors of competing but inferior products, and is thus able to demand very high margins – known as ‘monopoly profits’ – on what she sells.\textsuperscript{800} We can think of the first bloom of USB storage devices, or the Windows operating system, as examples. This does not last, however: one entrepreneur having blazed a trail, many other, lesser, figures, seeing the route she has created, now follow her. This secondary movement is referred to by Schumpeter as ‘swarms.’\textsuperscript{801} Through this monopoly profits are destroyed and equilibrium is nominally supposed to remerge, wherein the tight margins of orthodox economic theory are again the order of the day. A very significant tranche of capital should have already been accumulated, though, the use of which allows the process to begin again. In addition, the banks having been repaid, credit is easily available for the next innovating wave. However, this is only the most basic elaboration, for in the effect of swarms we have the process that ends the boom, following which a ‘special process of adaptation becomes necessary.’\textsuperscript{802}

For the simple truth, according to Schumpeter, is that much of this swarming behaviour was unsustainable. Once profits have dropped

\textsuperscript{798} Ibid., p. 71
\textsuperscript{799} Ibid., p. 216
\textsuperscript{800} Ibid., p. 133
\textsuperscript{801} Ibid.
\textsuperscript{802} Ibid., p. 216
through competition, assuming they existed at all for many of the second wave, workers will have to be laid off. Many of them will have been hired out of misguided expectations in any case. For the purposes of explanation, Schumpeter assumes that the previous state was one of equilibrium; now, after the boom has died away, there are fewer jobs than there were then, and wages that are being reduced, potentially severely. The dot-com crash is perhaps our most recent memory of a similar process to that described by Schumpeter. The subsequent recession is only, for him, ‘the “normal” process of resorption and liquidation,’ though.\(^{803}\) We may see it as the new innovations being absorbed into the economic system, as the automatic mechanism corrects itself towards equilibrium once more. However, Schumpeter also paints a rather convincing picture of the further problems that can compound these depressions into crises. In summary, it amounts to the fact that the ‘customary data are altered for every business. The extent and nature of the change, however, can only be learned from experience…the “mere businessman” faces problems which lie outside his routine, problems to which he is not accustomed and in the face of which he makes mistakes which then become important secondary causes of further trouble.’\(^{804}\) Overproduction can then occur and, even worse, banking errors. The results, as no one needs to be told, can be catastrophic.\(^{805}\) However, and perhaps strangely, the period of depression, however severe, does something else for Schumpeter: ‘it fulfils what the boom promised. And this effect is lasting, while the phenomena felt to be unpleasant are temporary. The stream of goods is enriched, production is partially reorganised, costs of production are diminished, and what at first appears as entrepreneurial profit finally increases the permanent real incomes of other classes.’\(^{806}\) Thus we have economic progress for

\(^{803}\) Ibid., p. 236
\(^{804}\) Ibid., p. 238-40
\(^{805}\) Ibid.
\(^{806}\) Ibid., p. 245
Schumpeter. The end product looks very much like that of his predecessors, but the route towards it is radically different. Hence, Schumpeter’s initial conclusion is that ‘the economic nature of depression lies in the diffusion of the achievements of the boom over the whole economic system through the mechanism of the struggle for equilibrium.’

This ought to be made clearer because early business-cycle theorists seemed to be making a comparable argument, in style if not in substance. Juglar, as we saw, expressed a similar view with the statement: ‘the only cause of depression is prosperity,’ which could be used to sum up Schumpeter’s position. However, this would be misleading: Juglar and others, such as Hawtrey, made policy recommendations regarding the excesses of prosperity; they problematised the boom period as something that could be amended, and if not entirely fixed, through, say, a Central Bank’s intervention, at least substantially mitigated. Others, such as Hayek, argued that it was government intervention itself, either directly or in the form of central banks, that caused economic fluctuations. In every case, though, the problems identified were excesses, problems that it was hoped would not occur, and on occasion did not, when better judgement prevailed amongst the actors involved, or when governments successfully mitigated them. Schumpeter stands alone in not seeing the harms as negatives that the world would be better off without, but as situating in them precisely the locus of economic development. His is the only analysis where an economy without the harms is necessarily a worse one.

807 Ibid., p. 251
809 Friedrich Hayek (1935), Prices and Production, London: Routledge
Like Keynes, then, for Schumpeter the naked process of economic development is one in which downturns are a logical necessity. Unlike Keynes, however, they are far from wholly negative, nor is it conceivable that one could have progress without them. We can instead draw much more of a parallel between Schumpeter and Marx, who also saw crises as a necessary part of the process of growth. Once more, the similarity is entirely superficial though, for while Marx makes these derivative of the orthodox economic process, Schumpeter makes of them the substance of the piece, with equilibrium a bit-part player. Of the three, it is Schumpeter who most clearly departs from the prevailing rationality of harmonious progress, for in his work the static space of equilibrium is in fact little more than a shadow. It is important though to reconcile this with Schumpeter’s defence of equilibrium, which we encountered in relation to marginalism. This should not be understood as a defence of steady-state growth, for Schumpeter was insistent that the static model, even when possessed, as it is with Keynes, of temporal relationships, ‘is not coextensive with the theory of economic growth or development or “progress.”’

A brief digression here will be helpful: marginalist analysis, as we have seen, was static, and thus, from Schumpeter’s point of view, not at all representative of a changing economy, despite the fact that, as we saw, it was at the time ‘believed to constitute a self-contained body of doctrine, a body moreover that embraced all or almost all of the essential insights.’ Schumpeter denies that this can be true, and insists that the fallacious assumption to the contrary led thinkers of that era to ‘incessantly (step) out of their statics without having a right to do so.’ In other words, to make the kinds of claims about growth and development that we examined earlier. However, even when time is introduced, say when levels of desire for products are

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812 Ibid.
813 Ibid., p. 967
linked to anticipations of future price, and thus the model made nominally dynamic, it is no more representative, for Schumpeter, of economic progress. Hence, Ricardo or Mill’s growth models, which as we saw maintain essentially static relationships between the variables in spite of time, would only be classed as dynamic for Schumpeter in the most technical sense of the term. Moreover, even though Marx’s work was admired by Schumpeter for its grasp of change, Marx really only adapted the static cycle at the heart of orthodox theory for his purposes. It would be unfair to class it, alongside Mill and Ricardo, as only technically dynamic in Schumpeter’s sense, for he does use it to show how equilibrium disappears as a relevant framework over a long enough timeline, but, as Rostow tells us, the main part of Marx’s work on business cycles and crises, the evolutionary element for both him and Schumpeter, ‘is not systematic... (and) is not linked in a firm and unambiguous way to his theory of growth,’ in spite of his attempts to show a flow from the former to the latter.\[^814\] It might be said that Marx was fighting against the tide in his attempts to fully dynamise a static framework, only partially succeeding. Evolutionary elements are thus rendered mostly \textit{ad hoc}, neither primary, as with Schumpeter, nor fully integrated, as with Keynes, in spite of Marx’s best efforts. It is once more important to remember that here we are only looking at Marx’s strictly economic work. Returning to Schumpeter, though, it ought now to be clear that he only defends equilibrium as a necessary tool in understanding the most basic relationships between essentially \textit{static} variables, not as the primary framework in which to grasp economic growth.

Moreover, the degree to which it is relevant to his theory of economic evolution changes over the course of his work, most likely under the weight of his prevailing argument. It is useful to note that Walras, for

Schumpeter, was the greatest economist in history\textsuperscript{815} and, to make briefly a point elaborated upon below, the latter no doubt wished to attach his own work to the prevailing Walrasian orthodoxy. Later on, Schumpeter does not fail to note that the entrepreneur in the Walrasian system is mathematically required to be reduced to ‘the purely formal role of buyer of productive services and seller of consumers’ goods without any initiative—or income—of his own.’\textsuperscript{816} Effectively he is an entirely altruistic actor within a system that is based on the exact opposite for its motion and stability. For Schumpeter, naturally enough, this assumption is both heroically simplifying and utterly inimical to an analysis of growth. Nevertheless, in his early work we find constant references to equilibrium eventually emerging. Indeed, ‘the essential task,’ of his work, as he saw it then, was ‘to investigate the effect’ of economic development, and ‘the new equilibrium which then emerges’ afterwards.\textsuperscript{817} Even more plainly, he insists that ‘the final result must be a new equilibrium position.’\textsuperscript{818} However, once we give this some thought, it is obviously untenable, except as a tendency, as Rostow also argues.\textsuperscript{819} It works only if one imagines a single-sector world, normally in equilibrium but irregularly, and vitally, disturbed by an innovative explosion. However, in a world of multiple sectors, this equilibrium can never exist, as each must surely be in different stages of the innovative cycle, impacting upon prices in one another all the time. Moreover, there is no reason for us to even assume that each sector is possessed of only one entrepreneur at a time; they may instead have more than one in various stages of the cycle, or none at all. Walrasian general equilibrium would be a world where all innovations had successfully worked their way through the system and where every potential

\textsuperscript{815} Schumpeter (1954), \textit{Op. Cit.}, p. 827
\textsuperscript{816} Ibid., p. 1011
\textsuperscript{817} Schumpeter (1934), \textit{Op. Cit.}, p. 60
\textsuperscript{818} Ibid., p. 131
\textsuperscript{819} Rostow, \textit{Op. Cit.}, p. 238
entrepreneur is effectively asleep. There is no reason under a Schumpeterian framework to assume that this will ever actually emerge.

At every stage in his life, however, Schumpeter insisted upon the separation of static and equilibrium notions from ideas of development. We will remember that negative progress assumes a sequence of identical, and infinite, cycles, with the last flowing seamlessly into the next and with the implicit assumption of perfect temporal regularity everywhere perceivable. However, in complete contrast to the assumption that harmony of itself produces progress, Schumpeter argues that the explanation of change ‘must be sought outside the group of facts which are described by economic theory,’\textsuperscript{820} that ‘(development) in our sense is a distinct phenomenon, entirely foreign to what may be observed in the circular flow or in the tendency towards equilibrium.’\textsuperscript{821} Rather it results from the will of certain individuals, acting on motivations hardly touched by orthodox economics. The result is a theory of economic growth driven by entirely ‘spontaneous and discontinuous’ – effectively unpredictable – forces.\textsuperscript{822} This is perhaps Schumpeter’s most profound divergence from Marx, and pretty much the entirety of economic thought also. Indeed, no less than the latter, Marxian economics is underpinned by a belief in the predictability of the future, which is no more than ‘a rather unimaginative extension of the dynamics of the present and recent past.’\textsuperscript{823} Of course, it does not need to be stated that this was entirely the point for Marx. Schumpeter, however, insists that the changes he discusses effectively nullify the past as a repository of predictive elements, because innovations ‘change the framework, the traditional course’\textsuperscript{824} and present to us a new present effectively detached from what went before. It is hard, therefore, to think of Schumpeter’s ‘productive

\textsuperscript{820} Schumpeter (1934), Op. Cit., p. 63
\textsuperscript{821} Ibid., p. 64
\textsuperscript{822} Ibid.
\textsuperscript{823} Rostow, Op. Cit., p. 137
\textsuperscript{824} Schumpeter (1934), Op. Cit., p. 61
revolutions,825 his cycles, as part of a self-contained process, since, despite
their endogeneity, one does not meaningfully lead onto the next. They are
not even distributed through time with any regularity, for as Schumpeter
tells us, new combinations ‘appear, if at all, discontinuously in groups or
swarms.’826 When we consider this in relation to the point made above,
regarding sectors and multiple entrepreneurs at different stages, it is no
surprise that Schumpeter, in his later work, takes Marx to task for
conceding too much to equilibrium thinking on the point of surplus value,
for ‘(surplus) values may be impossible in perfect equilibrium but can be
ever present because that equilibrium is never allowed to establish itself.
They may always tend to vanish and yet be always there because they are
constantly recreated.’827 What this says, for our purposes, is that in spite of
his earlier attempts to fit his theory within the orthodoxy, by the end
Schumpeter admits that his efforts are irredeemably heterodox. There is a
tendency towards equilibrium, but due to the essential discontinuity of an
economy’s dynamic elements, it is almost meaningless for any theory that
sets itself the task of explaining development.

However, all of this rebellion against the prevailing orthodoxy arises from
one core difference: the fact that Schumpeter ‘seized a nettle none of his
predecessors and virtually none of his successors in mainstream economics
was willing to grasp; namely, that the processes of invention and
innovation were not always exogenous nor incremental.’828 Technology
being by far the most important element in economic development, such a
radical change was always likely to fly entirely in the face of negative
progress. In short, for Schumpeter, progress in economics is an
evolutionary process, not a cyclical-linear one. He effectively exhorts us to
let go of self-contained processes when dealing with growth, something

825 Ibid., pp. 62-3
826 Ibid., p. 223
827 Schumpeter (1976), Capitalism, Socialism, Democracy, London: Routledge, p. 28
entirely at odds with the logic behind economic modelling. Indeed, is not too much to say that Schumpeter would replace Stoical harmony with Darwinian conflict. In a sense though, Schumpeter is still closer to negative progress than positive, but not at all fundamentally. Instead, his attitude to government intervention is *ad hoc*. This must necessarily be the case for him, because if capitalism is an evolutionary process, then the future may well hold scenarios requiring intervention that, as of now, would be ill-advised. He is thus happy to be prescriptive as to the problems of the day, arguing that the state should not attempt to save obviously failing companies, but should attempt to mitigate their crash.\(^{829}\) Indeed, he argues that the various, depression-focused, measures that he advocates are ‘of course nothing but the tritest common sense. But (they are) being overlooked with a persistence so stubborn as sometimes to raise the question of sincerity.’\(^ {830}\) No doubt Schumpeter would have known that attachments to the automatic mechanism motivated this opposition; as Robert Solow is fond of pointing out, *ad hoc* is a pejorative term amongst economists, who insist that all measures be justified down to the theoretical minutiae.\(^ {831}\) Keynes’s work can be seen as a direct response to this need for explicit justification, but Schumpeter is far more sanguine. For him, the unpredictability and changeability of the economic system is such that knowability, in any complete sense, is beyond us. Given this, we can do no more than respond unsystematically to what adherents of negative progress would likely describe as superficial fact. However, there is of course a limit, for depressions are ‘essential elements of the mechanism of economic development and cannot be eliminated without crippling the latter. The economic system cannot do without the *ultima ratio* of the complete


\(^{830}\) Ibid.

destruction of those existences.\textsuperscript{832} This is from his more cautious earlier work, where he would only go as far as to agree that the worst effects of a crisis should be mitigated, since they go beyond the needed destruction.\textsuperscript{833} Even then, however, the logic of his argument could not be entirely escaped, and there are notes of its future development in his admittance that: ‘the postponement of new construction by government enterprises or by great combines to periods of depression appears from our standpoint as a moderation of the consequences of the swarm-lie appearance.’\textsuperscript{834} Later, of course, he would go on to argue for the inherent workability of socialism and planned economies, in contrast to almost every other major Western theorist of the time.\textsuperscript{835} This is all perfectly consistent once we recognise that the kernel of his work – that economies evolve rather than grow, and do so in an inherently unpredictable way – resists nearly every attempt at timeless wisdom.

Returning to an earlier metaphor allows us to define more clearly the difference between Schumpeter’s approach and that of his colleagues. Both Ricardo and Marshall characterised economics as an organic science, and indeed Schumpeter himself describes it as such.\textsuperscript{836} However, remembering Smith, it is no doubt more than just a coincidentally useful pedagogical device. In any case, Keynes’s work, as we saw, can be understood as diagnosing a coherent economic system with a chronic, but treatable, illness. All other analyses that one comes across in economic theory can be fitted into similar metaphors. For instance, Ricardo, and the adherents of negative progress, see the organism as one occasionally hindered by temporary viruses – exogenous difficulties – that are best left to work their way through the system. For Schumpeter, though, the system is almost an

\textsuperscript{832} Schumpeter (1934), \textit{Op. Cit.}, p. 253
\textsuperscript{833} Ibid., p. 253
\textsuperscript{834} Ibid.
\textsuperscript{835} See Schumpeter (1976), \textit{Op. Cit.}
\textsuperscript{836} Schumpeter (1954), \textit{Op. Cit.}, p. 965
afterthought. He clung, ever more tentatively, to the great works of his discipline, but the implications of his contribution are, in the final analysis, ontologically incompatible. For a Schumpeterian organism would be at war with itself, each element destroying the contributions of others, and thereby changing the system, rather than adding to it. Moreover, this does not even happen all at once, but rather in discontinuous movements, here gradually, there in a leap. In the end, it is no longer possible to think of the system as a single organism, but instead as the economic equivalent of a world of Darwinian natural selection. With each single evolution, the relationships between the various parts can alter, and indeed Schumpeter begins to talk about the increasing ‘trustification’ of the economy; in essence, the increasing management of innovation by large companies or, alternatively, government capitalism. With these changes, the process by which production takes place alters. Schumpeter lauds Marx for recognising this also: “(Marx) not only predicted the emergence of big business; he visualized industrial concentration as part of the logic as well as the factual pattern of the accumulation process.” However, for Marx this was a mark of late-stage capitalist decline, whereas for Schumpeter, it was merely another evolution. Of course, those possessed of timeless models might see this as something to be resisted, even corrected, but for Schumpeter, ‘no therapy can permanently obstruct the great economic and social process by which businesses, individual positions, forms of life, cultural values and ideals, sink in the social scale and finally disappear.’ Such changes are not just interference then, which any negative progress scholar would freely admit alters the relevance of their analysis, but rather something that happens spontaneously and necessarily from within the system. This is how growth really takes place, for Schumpeter, in contrast

837 Schumpeter (1934), Op. Cit., p. 253
838 In Elliot, Op. Cit., p. 57
to an idea of a society ‘which is stationary in the sense that its processes reproduce themselves at a constant rate.’

In an important passage from *Capitalism, Socialism & Democracy*, we can see how Schumpeter moves toward embracing the logic of his evolutionary rationality, against the relevance of equilibrium theories:

The Marshall-Wicksell analysis of course did not overlook the many cases that fail to conform to that model. Nor, for that matter, had the classics overlooked them. They recognized cases of “monopoly,” and Adam Smith himself carefully noticed the prevalence of devices to restrict competition and all the differences in flexibility of prices resulting there from. But they looked upon those cases as exceptions and, moreover, as exceptions that could and would be done away with in time. Something of that sort is true also of Marshall. Although he developed the Cournot theory of monopoly and although he anticipated later analysis by calling attention to the fact that most firms have special markets of their own in which they set prices instead of merely accepting them, he as well as Wicksell framed his general conclusions on the pattern of perfect competition so as to suggest, much as the classics did, that perfect competition was the rule. Neither Marshall and Wicksell nor the classics saw that perfect competition is the exception.

Schumpeter then elaborates on a major theme of his from his earlier work: monopolistic competition. A basic tenet of mainstream economics is that all actors are “price-takers.” That is, they accept the price given to them, as a function of demand, by the market. In his early work, Schumpeter considers it important to note that, in the first bloom of their innovation, entrepreneurs receive monopoly profits; their products or services are such that demand for them does not change substantially with price increases, allowing for huge rewards to innovation. It is with these that entrepreneurs then go on to fund subsequent enterprises. This does not last, however, as the swarm follows and competition nullifies these profits, allowing equilibrium to reassert itself. However, by 1942

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840 Ibid.
841 Schumpeter (1976), Op. Cit., p. 74
Schumpeter has relinquished his already tenuous attachment to the standard model. Now he recognises a capitalism which has undergone significant change, one that therefore, if it ever did, no longer resembles the capitalism of Walras:

If we look more closely at the conditions—not all of them explicitly stated or even clearly seen by Marshall and Wicksell—that must be fulfilled in order to produce perfect competition, we realize immediately that outside of agricultural mass production there cannot be many instances of it... as regards practically all the finished products and services of industry and trade, it is clear that every grocer, every filling station, every manufacturer of gloves or shaving cream or handsaws has a small and precarious market of his own which he tries—must try—to build up and to keep by price strategy, quality strategy—“product differentiation”—and advertising. Thus we get a completely different pattern which there seems to be no reason to expect to yield the results of perfect competition and which fits much better into the monopolistic schema.842

The major point is that Schumpeter no longer recognises the infinite applicability of the equilibrium, harmonious model. Instead he is insisting, as he began to do in his earlier book, upon the historical nature of the economy. We cannot even talk, as the logic of abstract theory always seemed to insist, of an ideal process inhibited to greater or lesser extents by the vagaries of the real world. Instead, given the evolution of the system, there can be no ideal system; the changes themselves denote progress, and thus, in principle, the irrelevance of an old model is not to be regretted; its wisdom is not simply being ignored, it genuinely no longer applies to the new technological, not to mention social circumstances in play. Hence, there is certainly no infinitely repeated process going on; instead the process changes over time and any genuine understanding of economics must reflect this. This is a radical conclusion because its implication flies in the face of all abstract modelling: that the past is a reliable guide to the future. If there is no intrinsic truth to the economy; no natural process that

842 Ibid., p. 79
lies below the surface of the messy real world – a harmony, struggling to get out or otherwise – then we cannot see the future, even without the interference of reason, as necessarily going to replicate the identified mechanisms of past development. Economic purists, certainly, and the mainstream, generally, fall back against such notions to the final redoubt of outside interference: they explain deviation as the product of unpredictable shocks – earthquakes, wars – or the cold hand of the state; that is, their old enemy: reason. The economy itself is supposed to be a self-sustaining organism, growing but remaining essentially the same in the absence of such tremors. What Schumpeter is telling us is that the economy mutates, and does so unpredictably and with great consequence. It is a typically Darwinian conclusion: ‘The essential point to grasp is that in dealing with capitalism we are dealing with an evolutionary process... (it) not only never is but never can be stationary.’

At this point I wish to quickly note that the above is not meant as an endorsement of Schumpeter’s position; rather it simply serves to show an important, if you like, revolution against orthodox thought. Schumpeter’s ideas constitute a very different system to that of the mainstream, filled with notably different objects that relate to each other in novel ways. It is aimed at precisely the same phenomena, however. We must be able to distinguish this kind of rebellion from that of the Keynesian variety, which, while significant, embodies most of the prevailing rationality. We are not, in other words, simply talking of different theories. Keynes plainly identified a qualified harmony, with the same eternal rules and processes, but with a significant kink that an educated elite might correct. Such thinking led to the downfall of Keynesianism, to a large extent, in the ashes of “impossible” stagflation. In truth, with the two theorists we are seeing different realities: Keynes a harmony that needs a dose of reason to emerge.

\footnote{\textsuperscript{843} Schumpeter (1973), \textit{Op. Cit.}, p. 82}
in full flow, Schumpeter a changing world where no moment in time can be resonant of forever. Schumpeter’s work provides a wealth of pithy lines with which to illustrate his position, and it is indeed difficult to decline his more choice invitations, but one more is necessary to drive home this vital new reality he describes: ‘the problem that is usually being visualized is how capitalism administers existing structures, whereas the relevant problem is how it creates and destroys them.’\footnote{Ibid., p. 84} In other words, in focusing on the problems of a particular process of capitalism, we lose sight of the fact that this process can only ever be transitory. It is the argument of this thesis that only by a very particular rendering of technological change was it possible for this myopia, insofar as economic growth is concerned, to develop. Schumpeter’s work thinks through an alternative rendering of technological change, with far-reaching consequences.

Few seem to agree with Schumpeter, however. For instance, Robert Solow makes a telling, somewhat snide, comment about his former teacher and his work on creative destruction: ‘Schumpeter is a sort of patron saint in this field. I may be alone in thinking that he should be treated like a patron saint: paraded around one day each year and more or less ignored the rest of the time.’\footnote{Solow (1994), ‘Perspectives on Growth Theory’ in The Journal of Economic Perspectives, Vol. 8, p. 52} This pretty well sums Schumpeter’s legacy, for there is probably no thinker in the discipline who is simultaneously so lauded and so ignored. In seizing the nettle of technological change, as Rostow put it, Schumpeter starts to show how it in fact confounds harmonious progress, jeopardising the discipline’s scientific claims in a way Keynes and, in his economic thought, Marx did not. It did not accord with the essentially static treatment of time to which the other two effectively bowed and thus fell afoul of what Punzo calls the discipline’s ‘relentless demand for a
unified framework. However, as Foucault tells us, many of the most important unifying elements are historically, rather than scientifically, produced and more or less hidden also. Smith’s *homo œconomicus*, even with its very thin and specific inventive powers, had been the sacrifice Ricardo made in order to give economics (to adopt Foucault’s words) ‘at the time when it was written and accepted, value and *practical application* as scientific discourse.’ Schumpeter’s work, despite its overwhelming relevance, would reduce or nullify the predictive powers, the claims to progress, that always conferred upon the discipline its practical relevance. It was, as Rostow puts it, ‘theoretically explosive’ and totally at odds with the mainstream, Walrasian, equilibrium approach. It was a challenge to the prevailing rationality and was thus rejected. This example illustrates the importance of Foucault’s investigations, noted in our methodology as a secondary meaning of ‘conditions of acceptability,’ into the underlying thought that serves to *constrain* scientific disciplines in what they can bring into being as knowledge or truth, or the kinds of scholarly work that can become part of what might be called the canon of the discipline.

Nevertheless, Schumpeter’s prominence (he was a professor at Harvard) and undeniable brilliance meant that his points about innovation, though they hid an arguably more radical treatment of invention, demanded some manner of response. The subsequent solution though, as we shall see, was effectively to disregard ‘the Schumpeter problem,’ treating technological change exactly as it was treated in Ricardo and Mill. Moreover, as Warsh tells us, Schumpeter’s work was, despite its novel account of technological change, ‘almost completely ignored by the textbooks that taught the new

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doctrines of marginalism.\textsuperscript{851} There have, however, been attempts to bring Schumpeter’s insights within the framework of the mainstream, the best known of which is Aghion and Howitt’s.\textsuperscript{852} While this model manages to capture many important elements, it is unable to account for the most significant uncertainty within Schumpeter’s work: the motivation or lack thereof of the entrepreneur. Indeed, as Baumol notes, despite nominally working from a Schumpeterian point of view, the word \textit{entrepreneur} fails to appear even once in Aghion and Howett’s work.\textsuperscript{853} Moreover, the model it is overwhelmingly deterministic, assuming that technological change is entirely market driven, which Schumpeter, as we have seen, rejected. In reality, formal macroeconomics is effectively unable to cope with this vital aspect of his work because it would introduce far too much randomness.

In any case, this model is a very recent development and, all things considered, it is not at all surprising that, insofar as explanations of the depression were concerned, it was Keynes’s approach that triumphed, preserving as it did the scientific claims of the discipline, and in the process a static approach to time and technological change. However, the extent to which Keynes can be seen as the guiding light of US economics, to where the cutting edge of the discipline migrated in the post-war era, is a matter of some dispute. The mystery is apparent from the fact that the economists of MIT, then and now the world’s foremost department, are referred to by their great rivals in Chicago as “Keynesians” (and call themselves this also), whereas from the point of view of Cambridge University’s Robinson, Kaldor, Sraffa and their followers, Solow, Samuelson \textit{et al} of Cambridge, 

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\item \textsuperscript{851} Warsh, \textit{Op. Cit.}, p. 123
\item \textsuperscript{852} Philippe Aghion and Peter Howitt (1992), ‘A Model of Growth Through Creative Destruction’ in \textit{Econometrica}, Vol. 60, pp. 323-351
\item \textsuperscript{853} W.J. Baumol (2009), ‘Endogenous Growth: Valuable Advance, Substantive Misnomer’ in \textit{History of Political Economy} (HOPE), Vol. 41, p. 311
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Massachusetts are “neoclassicals.” Indeed, the famous Solow growth model is normally referred to as the “neoclassical growth model.” This is not merely an idle semantic dispute, for underlying it is the question of the extent to which, having adopted Keynesian aggregation, Solow dispensed with his disharmonious insights in favour of simplified marginalist micro-foundations. The answer, we can say confidently, is to a very great extent.


We ended the last chapter by noting Solow’s rejection of Keynesian disharmony. In this chapter we begin by showing how this was managed. The overall purpose of the chapter, however, is to show how the technological optimism of economic growth theory was able to be transferred to climate change mitigation policy.

**Robert Solow: Disharmony Lost**

The precise nature of Solow’s Keynesianism, which relates to Paul Samuelson’s development of microeconomic field theory,[^856] is beyond the scope of this thesis; however, the broad strokes we can paint are sufficient for our purposes. In sum, it is a product of the dispute we briefly detailed above, about whether Walrasian general equilibrium is a special case of Keynesian economics, or vice versa. Samuelson’s mathematical contributions pushed the discipline towards the later: as he says himself “we [Keynesians] always assumed that the Keynesian underemployment equilibrium floated on a substructure of administered prices and imperfect competition.”[^857] In other words, they rejected Keynes’s most cherished argument: that even in perfect competition – at the innate level – an economy will automatically gravitate towards a sub-optimal state. Instead, Keynes is given the lesser role of a theorist of the real world and its exogenous impacts: ‘Samuelson...argued that Keynes’s general theory was

simply a Walrasian general equilibrium system where, if there is an exogenous decline in effective demand, rigid wages and prices created a temporary disequilibrium that prevented full employment from being restored in the short-run. In effect, Samuelson had always maintained the position that Blaug outlined for us above; he did not buy the notion that Keynes had really provided the world with a general theory. However, he did believe that Keynes had identified some very important real-world truths, and that his model was vital in the treatment of probable, if non-systematic, problems. Integrating this with his renovation of microeconomics, Samuelson is the man most responsible for the neoclassical synthesis, upon which the overwhelming majority of the discipline agreed at least until the first oil crisis rocked one of its core foundations. However, many decades prior to this, Samuelson could say with confidence that ‘(solving) the vital problems of monetary and fiscal policy by the tools of income analysis will validate and bring back into relevance the classical verities.’ In other words, using Keynes’s tools, which as we saw allow for the perfectibility of the economy, we can restore to prominence the harmonious picture of the market that was so tarnished (by exogenous forces) during the great depression. It is upon this basis that Solow built the growth model that would come to dominate how technological change is understood in economics right up to the present day.

For this move allowed Solow to return to kind of abstract growth models that Keynesianism had appeared to have rendered impossible: steady-state expansion. Once again, however, this turn in economic analysis cannot really be understood outside of the economic context in which it was produced. As we have noted already, prior to the 1930s, Marshall’s was the

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858 Ibid., p. 9
860 In Ibid., p. 2
last piece of formal growth analysis that might be described as reasonably significant. However, Keynesianism began to dominate almost immediately following the publication of *General Theory* and shortly after, in 1939, Roy Harrod, a friend and follower of Keynes’s and later his biographer, wrote ‘An Essay in Modern Dynamic Theory,’\(^{861}\) the article which began modern growth analysis. This was a necessary step because Keynes’s own work only dealt with the short-run, meaning it could say little with assuredness about long-term growth which, given the breakdown in confidence in neoclassical theory and its complacency with regard to the long-term, was quickly becoming important. As Hagemann tells us, ‘growth theory stopped being a major issue for most economists until the end of World War II, when modern growth theory was born with the works of Roy Harrod (1939, 1948) and Evsey Domar (1946, 1947). Growth became almost everybody’s concern, first because of fear of stagnation and soon afterward because of reflections on the remarkable growth process in the Western world since the early 1950s.’\(^{862}\) The growth models produced reflect very much the differences between the two eras. What is now called the Harrod-Domar model, produced when the depression was still the overriding economic memory, emphasises disequilibrium and innate, Keynesian, sub-optimality. Solow’s model, on the other hand, produced in the headiest period of the ‘Golden Years’ (the phrase is Hobsbawm’s), emphasises the kind of easy-going prosperity that must have seemed economic normality in 1956.

However, in the early twentieth century the only economic work that focused on the long-term was business-cycle analysis. As we have seen, these theorists were in the main empirically minded, and in the decades leading up to Harrod, were ‘focusing on fluctuations and abandoning all attempts to explain equilibrium growth paths, which were considered to be

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empirically irrelevant.\textsuperscript{863} Unsurprisingly then, given the period and the influences to hand, the Harrod-Domar model ‘creates a secular instability problem, which is thoroughly Keynesian in spirit and a kind of extension of the unemployment problem to the long run.’\textsuperscript{864} In formal terms, the two theorists were honouring equilibrium in the breach, for as Solow tells us, they were attempting to ask a straight-forward question, resonant of this Keynesian spirit: ‘when is an economy capable of steady growth at a constant rate?’\textsuperscript{865} The answer, of course, was that most ‘economies, most of the time, would have no equilibrium growth path.’\textsuperscript{866} More specifically, in this model, unless economic growth matched or exceeded population growth and all saving was used for investment purposes, the economy could lapse into high unemployment or high inflation. Indeed, the balance was fragile enough so as to place steady-state growth on a ‘knife edge.’\textsuperscript{867} Remembering Schumpeter’s metaphor, we have here an unstable equilibrium, a ball on top of a bowl, which once knocked, could veer very far from its perch.

All of this gives us something of an insight into the modelling process: in general, the economist tries to identify ‘a few axioms, as close to “self-evident” as they can be...and then tries to work out all the logical implications of those axioms. Formalist economics starts with a small number of assumptions about the behaviour of economic agents, and a few more about their interactions with each other, and goes on to study what can then be said about the resulting economic system.’\textsuperscript{868} Of course, much of this is down to intuition; a successful model will represent what broadly seems to be an intuitively fair interpretation of reality. Much of this

\textsuperscript{863} Punzo, Op. Cit., p. 96
\textsuperscript{864} Hagemann, Op. Cit., p. 72
\textsuperscript{866} Ibid.
\textsuperscript{867} Solow (1956), Op. Cit., p. 65
intuition will be shaped by the available data but the reverse, as is apparent
when we realise that Solow was working with only a little more data than
Evsey Domar in the late nineteen-forties, is also highly significant.\textsuperscript{869} Hence
Harrod-Domar was initially successful because their approach, which was
very much concerned with reconciling regular bouts of depression with
periods of growth, and thus portrayed an extremely unstable economy, was
‘\textit{prima facie} realistic’ for the era in which it was produced.\textsuperscript{870}

But of course, there are two sides to Keynesianism: the first, as above, is
instability and fluctuations, the legacy of his attack on neoclassical
harmony; the other side, however, is the perfectibility of the economy that
can be attained through government intervention. In the 1950s and ‘60s, it
must have seemed as if economic theory had mastered the job: as
Hutchison argues, ‘profound disequilibria seemed to be much less serious
and more easily preventable, thanks to advances in economic theory.’\textsuperscript{871}
What we can see is that Samuelson’s efforts in re-establishing marginalism
within the Keynesian framework were not of themselves sufficient to
produce Solovian growth; pure Keynesians like Harrod could produce
models without Samuelson’s advances right up until the moment that they
no longer seemed credible (although, to be fair, Samuelson’s path-breaking
PhD thesis was not published until 1947, not long before the last of the
Harrod-Domar efforts). Hence: ‘the growth process in advanced
economies after the Second World War was not as wildly unstable as the
Harrod-Domar model implied...that observation inspired Solow to develop
his own neoclassical model.’\textsuperscript{872} Solow was thus blessed with a perfect
storm: a major change in economic theory reconciles Keynes with
harmonious progress, while in the real world, Keynesian economic
management appears to have produced just the sort of ‘classical verities’ of

\textsuperscript{870} Rostow, \textit{Op. Cit.}, p. 333
\textsuperscript{871} Hutchison, \textit{Op. Cit.}, p. 252
\textsuperscript{872} Hagemann, \textit{Op. Cit.}, p. 85
which both Keynes and Samuelson spoke. In short, there seemed an obvious problem with the Harrod-Domar model, which advances happening literally down the corridor from Solow’s office seemed to address. Solow thus follows Samuelson’s lead and returns to neoclassicism in the attempt to address these perceived inadequacies. Indeed, he was not even alone in developing the new steady-state model on this basis, for Trevor Swan produced a nearly identical effort from Australia.\footnote{Trevor Swan (1956), ‘Economic Growth and Capital Accumulation’ in \textit{Economic Record}, Vol. 32, 334–61} The neoclassical, or exogenous, model, is thus formally referred to as the Solow-Swan growth model. Given, however, that without the former’s solo efforts a year later in regard to technological change,\footnote{Solow (1957), ‘Technical Change and the Aggregate Production Function’ in \textit{The Review of Economics and Statistics}, Vol. 39, pp. 312-20} the model may well have never achieved its place as ‘economists’ chief tool for thinking about [states’ relative wealth],’ it is on Solow that we will focus.

In specific terms, Solow argued that the Harrod-Domar knife-edge arose due to one major assumption within the model: that labour and capital are in a fixed-proportional relationship; one cannot be substituted for the other in production.\footnote{Solow (1956), \textit{Op. Cit.}, p. 65} With Samuelson’s minimisation of Keynes, Solow was able to treat the deviations this was designed to represent as transitory, rather than innate. In other words, he could argue that they were not essential to tracing the “natural course” of the economy. In the process, Keynes is, in Solow’s own words, ‘shunted aside.’\footnote{Solow (1956), \textit{Op. Cit.}, p. 91} Now no longer intrinsic to an economic system, but rather an important tool for dealing with exogenous, albeit real, problems, Solow is able to focus his efforts on the neoclassical core, and assume that the perfectibility permitted by Keynes’s efforts is in operation. In other words, his model is “based on the assumption of an ideally successful Keynesian policy which at every point

of time manages to keep the value of investment at the desired level."\textsuperscript{877} Hence, for the next forty-odd years, in mainstream economic theory, ‘oscillations would again be transient deviations from a (globally) stable equilibrium.'\textsuperscript{878} Obviously Solow could have completed all of his work without Samuelson’s influence, as indeed, aside from Swan’s, there is another model, by Tinbergen, that looks rather similar to Solow’s, written in 1942.\textsuperscript{879} This only serves to tighten our understanding of Samuelson’s contribution though: it was not that the neoclassical synthesis made Solovian growth possible in a technical sense, rather it made it possible that a nominally Keynesian theorist, at the top department in the profession, could plausibly create a model that returned to neoclassical microfoundations and which would go on to dominate the mainstream of the discipline. It is easy to see that Tinbergen’s efforts failed precisely because his work met none of the conditions for success that assisted Solow, nor indeed any other set. In other words, Samuelson changed the ‘conditions of acceptability'\textsuperscript{880} within the discipline.

Let us ask, then: what does a return to neoclassical microfoundations mean exactly? Well, remembering that the key obstruction to steady-state growth in Harrod-Domar was the assumption that labour and capital enter into the production process in fixed proportions, Solow merely adopted a production function that allowed for perfect substitution between these two.\textsuperscript{881} In other words, when labour becomes expensive, capital can be instantly substituted for it, just like in the Ricardian model we saw in chapter five. A production function is essentially an equation that structures how the variables in any productive process interact with each other. The one Solow adopted, the Cobb-Douglas we saw Daly attacking in

\textsuperscript{877} In Hagemann, \textit{Op. Cit.}, p. 84
\textsuperscript{878} Punzo, \textit{Op. Cit.}, p. 101
\textsuperscript{880} Foucault (2007), \textit{Op. Cit.}, p. 62
chapter one, is descended from a fairly standard marginalist type, as Spengler shows. But in general, as Schumpeter tells us, by 1900, the production function, alongside the function that accounted for the marginal utility principle, was one of the ‘two pillars’ of neoclassical analysis. Given Solow’s aim, to be ‘deliberately as neoclassical as you can get,’ this was a natural move, solving the problem of instability by returning to a tool – perfect substitution – which, although only formalised in the 1870s, had been a feature of economic theorising since Smith. However, it would be unwise to see this as simply the correction of an obvious flaw. The idea that capital can be substituted for labour is somewhat reasonable (although hardly instantaneous), but the reverse is very problematic, since it involves the assumption that machinery can be instantly converted back into ready cash at a moment’s notice. As we shall see later, this was the subject of a major attack by the Cambridge School. However, the point is that such simplifications are necessary in economic modelling, and are justified as long as they are not entirely ludicrous and, most importantly, as long as the model one ends up with is a broadly plausible representation of reality. Schumpeter argues that ‘the full logical meaning of the concept of production functions reveals itself only if we think of them as “planning” functions in a world of blueprints, where every element that is technologically variable at all can be changed at will, without any loss of time, and without any expense.’ This may seem very unworldly, but it should be remembered that one is essentially looking for simplifications whose corresponding real-world processes, were they properly represented, would not in fact change the outcomes of the model to any great extent.

884 Solow (1956), Op. Cit., p. 93
Of course, whether this is the case in any particular circumstance is up for debate; production functions were designed for static analysis, but have been rendered dynamic in Solow’s model by the simple addition of exogenous technological change (discussed in detail below). Indeed, the entire concept is resonant of a notion of an infinite repeating cycle, of the structure of economic negative progress. For if nothing ever becomes fixed, both labour and capital are forever in a sort of *a priori* stasis at the beginning of every cycle, there is no qualitative way to represent change. This is the point of difference between negative progress and positive: the latter, based on reason, must leave its mark. There has to be a definite structural improvement. Negative progress, which assumes this also, cannot represent it because of its stricture against pre-decided change (reasoned ends). As a result, the kinds of evolutionary structural changes about which Schumpeter writes, after which the process of capitalism is changed, are simply assumed to be of no material significance. Again this bifurcation, with the “natural course” of the economy set against exogenous changes, is in operation. Technology, represented here by capital, is always ready to replace labour, just as it was in Ricardo, because the beginning of each cycle is an entirely new beginning of itself. We can perhaps now also begin to understand the technological optimism regarding the substitution of natural resources that we saw in chapter one, although it does not play a serious role in most climate change models (Nordhaus’s, as we saw in chapter two, being the exception). In any case, the assumption of perfect substitution, as Solow tells us, along with diminishing returns continuously offset by technology, ‘explains why the model feels comfortable to economists.’\footnote{Solow (1994), *Op. Cit.*, p. 47} They support the notion of equilibrium, and thus in misrepresenting reality slightly, they allow for the solid analytic tool of the “natural course,” which can of course be
mathematised in its simplicity, rendering economics scientific. We can thus see how equilibrium serves to justify important simplifying distortions on the basis that its own innateness is true and must be brought forth. Given how this innate harmonious progress is dependent upon a certain structure of technological change, exogenous and universally positive, we can see how important the latter notion in fact is to validating so much else within the structure of economic growth theory. It makes possible the disciplinary rationality of negative progress which then permits and constrains what ends up being uttered as truth. Other than this modification (substitution) though, and most importantly exogenous technological change, there is not much to distinguish between Solow’s model and that of Harrod and Domar.\textsuperscript{887} In terms of broad effect, though, we are immediately returned to a world of negative progress, where an identical cycle, static bar one element, is infinitely repeated.

For what the model shows is that the natural, long-term course of the economy, regardless of the particular road it may in fact be on, is to return to steady-state growth. This is of course implied by Samuelson’s reading of Keynes and amounts, in effect, to the return of the automatic mechanism to aggregative growth modelling. As Warsh tells us, the ‘cardinal characteristic’ of the Solow model was that ‘its equilibrium was general...Now the system could adjust to any given rate of factor growth and eventually reach a steady state of proportional expansion.’\textsuperscript{888} To explain: as we saw, Harrod-Domar had predicted that increases in the labour-supply (a factor of production) as a result of population growth, could throw off the entire equilibrium. Solow’s substitution assumptions meant that the model would now adjust to this, allowing the system to ‘develop toward a balanced growth at the natural rate,’ ‘whatever the initial value of the

\textsuperscript{887} Solow (1956), \textit{Op. Cit.}, p. 66
\textsuperscript{888} Warsh, \textit{Op. Cit.}, pp. 145-6
capital-labour ratio. What is meant by the natural rate? It amounts to nothing more, in fact, then the rate of technological change, for Solow’s model found that nothing else, in the final analysis, is at all significant in determining growth. To understand this, let us elaborate on the overall structure of Solow’s model:

Solow (1956) set out an aggregative, competitive general equilibrium perfect-foresight growth model built around three equations: a constant-returns-to-scale production function with smooth substitution and diminishing returns to capital and labor; an equation describing capital accumulation on the assumption of a constant rate of savings (investment) as a fraction of output; and a labor-supply function in which labor (population) grows at an exogenously given rate...To account for increasing income per capita, Solow briefly introduced technical change and worked out the solution for the Cobb-Douglas case, with the result that, along the balanced growth path, output per worker and capital per worker both grow at the same rate of exogenous technological progress. Technological improvement, therefore, offsets diminishing returns to capital accumulation, permitting steadily rising labour productivity and output per worker.

The last of the functions, labour-supply, we have already discussed, and in reality it is just a simplification exercise, since Solow does not believe population growth really matters in the long-run. The production function we have discussed to an extent already, but it is worth pointing out that technological change works to offset diminishing returns in exactly the manner it did for Ricardo, albeit now, necessarily, in an explicit, mathematical way. As for returns to scale, this is the big issue Paul Romer would take up in his model, so we shall leave it aside for a time. Briefly, it works to make sure that technological change does not disrupt the harmony. It is the middle equation that is of interest to us now, however. In Smith, as we saw, capital accumulation, though important, is no more than a necessary cog in the growth process, designed to facilitate

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technological change. It functions, implicitly, in precisely the same way for Solow, since one of his most important conclusions was that the growth rate was independent of the savings rate. This was a major finding because the savings rate is, in formal terms, coequal with the investment rate (remembering Ricardo’s espousal of the same notion). Nominally, this limits the scope of government intervention to a very large degree, which is serious since the capacity of government to boost growth, whether in instances where demand is stilted or not, is an intuitive extension of Keynesian logic. Solow was indicating here that such measures will only have temporarily positive results at best, and that the real determinant of growth is outside of governmental control: technological change.

This is of course our key concern, but let us first allow that Solow, later in life, would reflect unhappily upon this last result. It is not that he feels government investment can in fact boost the growth rate over the long-term, but rather that, when we consider business cycles and deviations from equilibrium growth, it is certainly far more important to maintaining the equilibrium path than his model would have one believe. He is, however, unable to escape from the logical strictures of the negative progress rationality he helped to reintroduce. For, in spite of his insistence that business-cycles are important, they cannot, for him, be any more than deviations, and in the attempt to understand the “natural course” or fundamental nature of growth, are easily, perhaps necessarily, ignored. He goes as far, indeed, as to cite the failure of his model to cope with disturbances on the demand-side as its greatest weakness: ‘(there) was one bad by-product of this focus on the description of technology. I think I paid too little attention to the problems of effective demand. To put it differently: a theory of equilibrium growth badly needed - and still needs - a theory of deviations from the equilibrium growth path. I can honestly say

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that I realized the need at the time.\textsuperscript{892} To make this clearer, he goes on to say, ‘it is impossible to believe that the equilibrium growth path itself is unaffected by the short-to-medium-run experience. In particular the amount and direction of capital formation is bound to be affected by the business cycle.’\textsuperscript{893} Solow’s problem here is obvious: in shunting aside Keynesian insights, his model in fact seems to support \textit{laissez-faire}, something that worries him greatly. Perhaps the most revealing of all of Solow’s comments on his work follows from this recognition: ‘In the neoclassical model it was quite natural and practical to describe equilibrium paths and to work out the price and interest rate dynamics that would support an equilibrium path. It did not occur to me the time that in doing this I was bringing good news and bad news. The good news was that economists instinctively like to think that way...The bad news is that the connection is a bit too pretty and too interesting and unleashes a standing temptation to sound like Dr. Pangloss [optimistic], a very clever Dr. Pangloss. I think that tendency has won out in recent years.’\textsuperscript{894}

Overall, Solow is telling us that business-cycles are important, and indeed require government intervention if they are to be overcome. Let us not forget, he is still a Keynesian, even if, to some minds, of a watered down variety. Indeed, his mentor and colleague, Samuelson, spent most of his life writing duelling columns in \textit{Newsweek} against the non-interventionist Milton Friedman.\textsuperscript{895} It troubled Solow’s conscience to produce a model that appeared to render stimulus efforts more or less unnecessary; hence his regret that he could not show how difficult it is for an economy to return to his equilibrium path upon entering into recession. Nevertheless, the statement ‘economists instinctively like to think that way’ is a very telling one. It hints that Solow’s model was successful because it fit with a

\textsuperscript{892} Ibid., p. 309  
\textsuperscript{893} Ibid. pp. 311-12  
\textsuperscript{894} Ibid., pp. 308-9  
\textsuperscript{895} Warsh, \textit{Op. Cit.}, p. 204
structure of thought already dominant in the discipline. Gunnar Myrdal has already told us something similar about this assumption of harmony. Once more we should note that the merits of this kind of thinking, at least insofar as distribution is concerned, are not the subject of our argument. The significance for us is that, once established by Smith and Ricardo, the transfer of this kind of thinking to economic growth (which we have called negative progress) was so successful that it rendered plausible a remarkably harmonious construction of technological change. It was the latter that made the transfer possible in the first instance, but once accomplished, the draw of the scientific authority that came with it was such that it could not be successfully challenged. Solow hints this also when he says, almost mournfully, that his approach ‘has won out in recent years.’ Indeed, as we have seen, Schumpeter’s challenge against this tendency was effectively ignored. Let us turn then to Solow’s treatment of technological change.

Solow felt that the major contribution of his model was to help ‘make a deliberate choice between current consumption and current investment.’ In effect, it showed, given the relative unimportance of the savings rate to the growth rate, that the government need not concern itself overly with boosting long-term growth through its own investment. Exogenous investment will certainly boost the growth level (say from four to five percent) but it will not change the rate of increase thereafter. This is because the overwhelming determinant of economic growth is technological change, and in the Solow model it is treated exogenously; in other words, it is unaffected by anything mapped out in the model (as with all the negative progress models we saw earlier, bar Smith’s). Hence, not being related to investment or anything else visible, there is no dependent variable that the government might seek to boost. As he says himself: ‘(Increasing) the rate of per capita growth is not only not easy in this

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896 Ibid., p. 309
model, it is impossible unless the rate of technological progress can be altered deliberately.\footnote{Solow (1994), Op. Cit., p. 48} This conclusion, that technological change is the overwhelming determinant of growth, is reinforced in a piece of empirical work Solow submitted a year after he produced his growth model.\footnote{Solow (1957), Op. Cit.} The article, entitled ‘Technical Change and the Aggregate Production Function,’ gave full licence to what would soon be called ‘the Solow residual.’\footnote{Darity, Op. Cit., p. 152} That is, the exogenous, growth-determining force that Solow referred to as technical change. The term residual comes from the fact that within its remit falls practically everything that might plausibly improve growth, from superior machinery to an increase in the general sense of well-being, though really it was intended to refer to technology. However, the ‘influence of Solow’s “Technical Change and the Aggregate Production Function,”’ as Mata and Louca tell us, ‘cannot be overemphasized.’\footnote{Tiago Mata and Francisco Louçã (2009), ‘The Solow Residual as a Black Box: Attempts at Integrating Business Cycle and Growth Theories’ in HOPE, Vol. 41 (Annual Supplement), p. 335} It gave scientific credibility to the use of this exogenous monolith.

The article is at its heart an attempt to separate productivity increases from scale effects, or in even more incomprehensible jargon, ‘shifts of the aggregate production function from movements along it.’\footnote{Solow (1957), Op. Cit.} In less esoteric terms, Solow has figured out a way, using an interpretation of time-series data, by which he might show how much of economic growth over the period 1909-1949 was down to increases in investment and how much can be attributed to increases in the productivity of each unit of capital and labour. The answer is significant: about 87.5% of the growth recorded in that period, based on some very rough but reasonable calculations, can be credited to technical change.\footnote{Ibid.} Naturally, this supported his earlier model in a rather useful way. However, this was not the only windfall; Solow had
also argued in his model, following the structure of his Cobb-Douglas production function, that technological change is “neutral.” Again, we have some esoteric language with which to explain this: ‘shifts in the production function... (that) leave marginal rates of substitution untouched but simply increase...the output attainable from given inputs.’\(^{903}\) In other words, technological change does not increase the productivity of capital any more than it does the productivity of labour. They both become more efficient, but in such a way as to avoid upsetting the relative desirability of either from the point of view of a firm. This is also a useful result, since it reinforces a harmony-supporting assumption within the original model. Nevertheless, the article was written in 1957, so it is not surprising that the finding has subsequently come under serious fire,\(^{904}\) albeit with plenty of defence also.\(^{905}\)

However, this finding is not of particular interest for our purposes. What is more interesting is the structure that framed how the investigation was carried out. For the measurement, aside from being able to test the fairly marginal issue of whether technological change is, on average, biased towards labour or capital, simply assumes away all of the disharmony intrinsic to the Schumpeterian theory. This begins with the production function itself, in which ‘the “technology” component... (is the) dynamic and independent element.’\(^{906}\) Solow simply adapted a static, marginalist production function, introduced a single exogenously determined constant to account for all time and change, and then proceeded to work out the rest of the model. It is exactly the sort of dynamising of static elements against which Schumpeter railed. More importantly, since technological

\(^{903}\) Ibid., p. 312
change is thereby represented as a purely positive input that affects only productivity, any potential for disharmony – what we might now call “the Schumpeter/Smith problem” – is killed at source. Without this move, naturally, steady-state growth would be impossible. As Punzo tells us, ‘only a steady and continuous process (at a positive rate) of productivity enhancement is compatible with smooth growth. It is this assumption that generates the steady-state path associated with neoclassical predictions and growth accounting.’

Rostow is rather irritated by this move it seems, arguing that it is little more than a feeble attempt to avoid the problems raised by Schumpeter’s analysis. However, we can go further, for not merely is harmonious innovation taken for granted within the model, but invention, in regard to which Schumpeter said little enough, must necessarily be assumed to be operating in an identical fashion. If we recall, for Schumpeter inventions are as likely to disrupt as to support harmony – the railway and the mail-coach, for instance. Now, if Solow’s goal was simply to measure the growth of an economy over a lengthy span of years, then perhaps his treatment would be allowable. We can accept for a moment the possibility that the destructive effects would even out over a long enough timeline. But this is not what Solow is saying; his argument is rather that the natural course of the economy, free from deviations, is at every stage an equilibrium one or will, in the absence of external shocks, develop in that direction, and that therefore, we must assume, invention operates only in such a way as to support this equilibrium. Without this assumption, the entire idea of steady-state growth, of an internal equilibrium that merely swells in size over time, is patently ridiculous. In effect, Solow’s investigation only examines the net effect, reduces it to an average (constant), and then assumes that it supports his a priori objectification: that is, a regular, beneficent and reliable technological change.

907 Punzo, Op. Cit., p. 100
It seems, therefore, that Solow merely altered the tools that came to hand from his neoclassical tool-box in order to produce a picture of growth. Not for a moment did he pause to consider Schumpeter’s objections; his sole concession to disequilibrium, though simply assumed to work as he would like it in the original model, is to ask whether this entirely positive technological change might be labour or capital biased. In reality, all of these decisions were essentially determined by the original choice to return to a neoclassical harmony as a microfoundation, as opposed to dealing with innate disharmony. Once he began working with the marginalists’ static framework, Solow simply represents what, as we saw, had originally been taken for granted: the harmonious operation of technological change. Harrod-Domar’s focus on the long-term had necessitated this much, since with a mathematical model, Solow could not simply imply technological change over the long-term as Ricardo did. Even exogenised, it had now to be concretely present and quantifiable. Rather than a break, therefore, what we are really seeing here is continuity. Ricardo and Mill had maintained an image of technological change that effectively nullified it as an object of analytic import. It did not alter the fundamental model, and hence could be ignored. Marginalism, as we have seen, took this to heart, and focused entirely on what was seen as determining: the distributive, static foundation. Solow does nothing more than reanimate technological change, allowing him the claim of representing time and change, which really never mattered at all to mainstream economics, even after Schumpeter’s objections.

It is upon precisely this line – the inability of the production function to represent change – that the well-known (in economics) “Cambridge capital controversy” arose. So named because most of the protagonists represented universities situated in places called Cambridge, it pitted proponents of harmony, or neoclassical economics, against scholars
devoted to ideas of inequality and imperfect competition. Massachusetts claimed the loyalty of the neoclassical-Keynesians; Cambridgeshire of the Marxian ones. Overall, one could certainly make a case that never has an academic discipline been host to a conversation involving deafer participants. Later Solow would describe the entire quarrel as ‘a waste of time, a playing-out of ideological games in the language of analytical economics.’ At the time, in what Harcourt reasonably describes as a rare show of temper, the famously good-humoured Solow opened an article with, ‘I have long since abandoned the illusion that participants in this debate actually communicate with one another, so I omit the standard polemical introduction and get down to business at once.’

There is a serious dispute in the middle of the ‘ideological games,’ however. Robinson, Kaldor and the other more Marxian-influenced scholars attacked the neoclassical synthesis on its representation of change: they found fault, firstly, with the notion that capital is always ready to be deployed where needed, arguing that it must take on the form of actual machines, and therefore cannot be easily redeployed (as the neoclassical notion of substitution would maintain). This is just a flavour, though, of their fundamental theoretical challenge: as Robinson puts it, the neoclassical approach, ‘by concentrating upon the question of the proportions of factors...has distracted attention from the more difficult but more rewarding questions of the influences governing the supplies of the factors and of the causes and consequences of changes in technical knowledge.’ For Robinson, changes in the economic sphere must necessarily change how the economic sphere operates, therefore

912 Harcourt, Op. Cit., p. 16
technological change matters. In essence, she identifies a more formal, and likely independently generated, version of the Schumpeter problem.

Solow, Samuelson and the rest of the “neoclassicals,” on the other hand, never seem to have persuaded Robinson and her colleagues that what they in fact were working with was not the real-world, but essential tendencies, justified as such by Samuelson’s mathematical microfoundations. Robinson’s continued description of their models as ‘thought experiments’ that will not ‘help us very much with the problems of today’\textsuperscript{913} suggests that this was an answer she could not accept, or to which she would not listen. With a quite brilliant analogy, she sums up her critique of neoclassical growth: “we might suppose that we can take a number of still photographs of economies each in stationary equilibrium...This is an allowable thought experiment. But it is not allowable to flip the stills through a projector to obtain a moving picture of a process of accumulation.”\textsuperscript{914} For Robinson, the economy is on no particular course other than the one effected by the day-to-day operations of people and ideas within it. Again, she refuses to accept or recognise the notion of an underlying harmony facilitated by an automatic-mechanism: ‘there is no such thing as a position of long-run equilibrium which exists independently of the course which the economy is following at a particular date.’\textsuperscript{915} However, her calls for a return to classical modes of thought, where apparently change is represented, are misplaced. Under Sraffa’s influence, she maintains a Marxian reading of Ricardo, one involving disharmonious friction between the classes and biased distribution,\textsuperscript{916} which, as shown in chapter five, fails to grasp his actual views or, at the very least, his actual influence.

\textsuperscript{913} Robinson (1964), \textit{Op. Cit.}, p. 61  
\textsuperscript{914} Cohen and Harcourt, \textit{Op. Cit.}, p. 204  
\textsuperscript{915} Ibid.  
\textsuperscript{916} Harcourt, \textit{Op. Cit.}, p. 15
For what is clear to us now is that the neoclassical growth model, in its essential features, is no more than a continuation of the conception of progress that has always defined the discipline. As we have seen, Schumpeter in fact credited Marshall with the invention of steady-state growth; Warsh tells us that Mill is Solow’s influence: ‘(it) could be said – indeed, it was said – that Solow was merely translating Mill into calculus; Romer seems to agree, arguing that ‘even by the middle of the 19th century, all of the elements of the neoclassical theory of growth could be discerned;’ in chapter five I showed its presence even further back in Ricardo, while Stathakis and Vaggi argue, in relation to Adam Smith, ‘with an appropriate simplification of the sequence, it is possible to reproduce most of the modern views of growth and development. We can have an “endogenous growth” model or...if we are prepared to leave aside non-decreasing returns, one can end up with Solow’s growth model. In short, economists are constantly discovering the origins of the neoclassical growth model in earlier and earlier texts. This is unsurprising, for Fine tells us ‘a standard history is now usually told of old (exogenous) growth theory, presumably to new generations of students. Rarely is reference made to classical political economy or to Marx. Rather, growth theory begins with Harrod–Domar and moves forward to Solow/Swan. Here, it stagnates sometime in the late 1960s until endogenous growth theory brings the subject back to life.

The truth is that the model, in its essentials, is nothing more or less than the embodiment of the rationality upon which the discipline of economics was founded. It has always been there because the mainstream attachment

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918 Warsh, Op. Cit., p. 147
919 Romer (1992), Op. Cit., p. 4
to harmony, upon which its claims to science are founded, cannot be justified without Smith’s view of the subject, even if this subject is, as it were, disembodied: as Amariglio and Ruccio tell us, ‘it is a matter of seeing that there is no fixity to the body and its forms of appearances…the view that the human body must be presented as whole rather than dispersed…prevents the possibility of “seeing” the body’s appearance in economic discourses, such as contemporary neoclassicism’ in which much is ‘pushed to the background.’

In spite Ricardo’s splitting of homo economicus, the ingenious subject is always still present. Tellingly, Punzo notes the oddity of having a harmonious, yet exogenous, technological force. His point is obvious: how can technological change work harmoniously unless it is simply responding to needs within the economy, which if not met, will result in disharmony? Exogenous should mean random, or ‘stochastic,’ as the discipline prefers, rather than perfectly dovetailed because, by simple odds, two completely unrelated forces are unlikely to be infinitely in harmony with each other. Indeed, as we shall see, Romer’s attempt to endogenise the neoclassical model works on precisely this premise: that homo economicus, in short, is still operational within it, driving and facilitating negative progress.

However, before we get on to Romer, we must consider Solow’s efforts in light of the climate change models we examined in chapter two. As we saw, it was Solow’s view of technological change – in the form of the exogenous AEEI – that dominated the earlier models, particularly those that made up the SRES scenarios. What happened is effectively the severing of a conception of how technological change operates – in a continuous, regular and identical way – and the redeployment of it in a different context: no longer relating to all technology, but instead to just efficiency-improving...

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923 Punzo, Op. Cit., p. 100
ones. This did not just occur in relation to climate change modelling; as Mata and Louca explain, the Solow residual ‘gained a life of its own in the research of other authors and was autonomous of his intentions or interpretations.\textsuperscript{924} As the only mathematical way of representing technological change within the discipline, it assumed a ‘privileged role in the construction of comprehensive models of economic dynamics.\textsuperscript{925} As in economic growth modelling, so it was with mitigation models: technological change is assumed to be a fixed quantity, operating in an identical fashion at any point in time. This is why the vagaries of invention are hardly considered: each static economic cycle being representative of every other one in the chain – stills in Robinson’s projector – technological change in the past has to operate in the same fashion \textit{ad infinitum}. But on a deeper level than this, what Solow’s effort really contributes, given its now mathematical form, is scientific prediction. The abstract notion of technological change in Smith was designed to allow a positive future to be predicted without description of what it would actually entail, but this was a literary effort and indefinite. The ascent of modelling allows for coefficients to be introduced into the now mathematised objects, and hence the future is able to be quantified, if not actually described. In short, through Smith, \textit{Solow made possible in the first place the notion that abstract technological futures could be predicted, and made economists, with these tools, experts on technological change}. There are two primary results, then: an object representing technological change passed into usage in climate change mitigation models, one that, like the rest of the objects in the models, allows the past to be parsed, averaged out, and then applied to the next century as a scientific basis for predicting the effect of future technological changes on the climate; but even before this, the presence of technological change in economic models as an abstract quantitative effect that can be

\textsuperscript{924} Mata and Louca, \textit{Op. Cit.}, p. 336

\textsuperscript{925} Ibid., p. 349
predicted, allowed the discipline to take its place as the primary actor in relation to climate change mitigation. In other words, it was thusly rendered a problem for economics and the resultant solution able to function as truth. This recognition allows us, finally, to understand the uncertainty/certainty problem we encountered in chapter two: economics is a science insofar as economists are concerned and its results are thus scientifically credible. The entire basis of the discipline’s ability to predict growth rests on the veracity of its treatment of technological change, as we have seen. Doubting this element is to doubt a crucial pillar of the subject’s claims to being a science and, moreover, the rationality of negative progress upon which it has always operated. Hence, in spite of the recognition that invention cannot actually be modelled, and thus that there is a distinct lack of empirical proof supporting this predicted future, its knowability and reliability are proclaimed nonetheless.

**Paul Romer: The Return of Mixed Progress**

However, as we saw in chapter two, a change is in process within climate change mitigation modelling: the old exogenous approach to technology is being replaced by an endogenous one, wherein technological change occurs in direct response to incentives produced within the model. As with Solow’s effort, this new approach to modelling can claim under its rubric a vast array of books, papers and model variations. The core of the idea, however, and all of this subsequent work, can be traced to Paul Romer’s article of 1990, in which the structure of endogenous technological change, something not unfamiliar to the discipline,926 was finally produced in a

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workable form. Warsh’s book, *Knowledge and the Wealth of Nations*, traces the birth of this approach to modelling technological change, and describes its efforts as ‘the story of a single technical paper in economics.’\(^{927}\) This paper, for Warsh, ‘doesn’t fit our conception of a classic, to be placed on the shelf alongside the works of other great worldly philosophers. But it *is* – for reasons that are relatively easy to explain.’\(^{928}\) The greatest of these reasons is that research and development (R&D) can now be explicitly represented and largely as a result, motivated to even greater heights through government intervention.

This “new growth revolution” (for a discipline that ignored Marx, they are fond of revolutions) seems to have come as something of a surprise to the discipline as a whole, for interest in economic growth had declined to almost nothing following the petering out of the “Cambridge capital controversy.” There are at least two explanations for why this was, although perhaps they are not mutually exclusive. Warsh tells us it happened because ‘the main issues of growth theory were considered to have been largely settled’ by the early 1970s.\(^{929}\) Rostow, however, suspects that the ‘palpable irrelevance of formal growth models to the central problems of the world economy’ after the 1972 oil crisis, led to its temporary decline.\(^{930}\) Whatever the case, the extent of the “revolution” ought not to be overstated. As Romer tells us, in the absence of this special treatment of technology, ‘the model is almost identical to the Solow model.’\(^{931}\) It still treats technology, in the final analysis, as simply a tool for offsetting diminishing returns to capital and in the process produces ‘steady-state balanced growth,’ just as in its Solovian counterpart.\(^{932}\) However, in order to make the objects of endogenous analysis fit this

\(^{928}\) Ibid., p. xviii
\(^{929}\) Ibid., p. 176
\(^{931}\) Romer (1990), ‘Endogenous Technological Change’ in *Journal of Political Economy*, Vol. 98, p. 89
framework many ad hoc ‘special assumptions’ are needed to avoid the growth rate either declining severely or accelerating beyond what might be considered plausible.933 As Punzo tells us, in order to maintain the “natural course” that has been the basis of the discipline since its inception, they bent ‘manifold phenomena, even the vision of the innovation process as essentially discontinuous [as was Schumpeter’s], to fit steady-state analysis. They were the product of a discontent with certain, also empirical, implications of the neoclassical theory, more than of the search for a new theoretical framework.”934 Hence, ‘in many fundamental respects endogenous growth theory represents a continuity rather than a break with exogenous growth theory,’935 or as Solow put it, “there is not really any competing model.”936

In short, then, the endogenous growth literature, in its essence, merely sets out to explain that vital part of Solow’s model that is entirely assumed. Romer interprets technological change in Solow’s model as a ‘public good,’ conferred upon the economy equally from the outside.937 This is obviously an unfairly literal reading of Solow’s model, for it is certain that Solow, in his own mind, merely abdicated explaining the causes of technological change, focusing instead on the effects. However one would assume that Romer is aware of this and that his critique refers to what the simplification implies about the process of technological change, rather than the actual beliefs of the modeller. Of course, given the nature of economic modelling, wherein a simplification is perfectly forgivable when it has little or no impact upon the closeness of the model’s results to the reality it is trying to represent, this critique indicates to us that Romer sees reality differently from Solow, and believes that this simplification is one that misrepresents

933 Ibid.
934 Punzo, Op. Cit., p. 102
936 In Boianovsky and Hoover, Op. Cit., p. 18, footnote 21
937 Romer (1990), Op. Cit., p. 77
it in a serious and unacceptable way. In fact, Romer has two issues of sizeable import with the Solow model, which we shall address in order: the first is that, as Romer describes it, the actual operation of technological change under capitalism is sub-optimal. That is, capitalism in a state of equilibrium systematically under-invests in ingenuity because it is incapable of providing the necessary incentives, with the result that economic growth is sub-optimal also. However, the second issue is that, far from having no real impact, government investment, through the support of technological change, can not only boost long-term growth, but is also required if the optimal level of growth is ever to be achieved.

This problem is both introduced and resolved by Romer’s description of technological change. In effect, the new growth literature ‘reinterpreted the Solow “technology” residual as disembodied human capital.’ In other words, and in a return to *homo economicus*, they believe it to be nothing more than an aggregation of the technological creativity of each and every individual economic actor. Romer’s initial aim, then, was to provide a mechanism that would heal the Ricardian split without sacrificing negative progress. In other words, he takes up the challenge avoided by everyone since Smith’s founding of the discipline: reconciling *homo economicus*’s harmonious side with its ingenious side. To a very great extent, this move is mathematics led: what was practically inconceivable in its complexity for Mill is *prima facie* possible for Romer. Interestingly though, he fails; or, to be clearer, he chooses not to succeed. What I mean by this is that in his PhD thesis, his original statement on the subject, he manages to preserve perfect competition and the optimal equilibrium that, for neoclassicals, goes with it. This involved a mathematical exposition that is apparently daunting even for the most able mathematical economists. Like Marshall

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940 Ibid., p. 211
had done earlier, albeit now at the macro level, Romer employed the concept of “spillovers” – which are addressed in more detail below – “in order to deal with technical problems, to make sure the math came out right.”⁹⁴¹ A student at the University of Chicago, famous for its devotion to the creed of harmonious progress, Romer seems to have simply bowed to the faculty norm.⁹⁴² By the time of his 1990 paper, however, he had decided that this was untenable, leading to his slight deviation: a sub-optimal (in other words, Keynesian style) equilibrium. Let us examine the understanding of technological change that leads him to this.

In most senses, the Romer model functions exactly like the Solow one: a constant rate of equilibrium growth that is completely supplied by the effect of technological change. The mechanism by which it achieves this is very different, however. Romer assumes three sectors in the economy, a research sector, a sector producing durable goods and a final output sector. (The first and last of these are easily understood; the durable goods sector, as we shall see below, is responsible for turning ideas into products.) For the sake of simplicity, and just as in the Solow model, the last of these is a “representative firm,” which means that the entirety of the final goods produced in this simplified economy are made by one firm, although one that acts in the precisely the ways that a firm would under conditions of perfect competition (this latter is an indication of his microfoundations). The other two sectors, however, operate very differently in order to produce Romer’s desired endogenous explanation of change. First of all, this simplified economic world is made up of a very particular kind of subject, one ‘endowed with fixed quantities of labour L and human capital H that are supplied inelastically.’⁹⁴³ This means that they ‘decide whether to

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⁹⁴¹ Ibid., p. 222
⁹⁴² Ibid., p. 211
⁹⁴³ Romer (1990), Op. Cit., p. 88
work in the research sector or the manufacturing sector.\footnote{Ibid.} Of course, we have here the reintroduction of *homo œconomicus* in a more elaborate form, but we can ignore this highly significant fact for a moment and concentrate on the functioning of the model. Under equilibrium, the rate of those working in the manufacturing sector to those working in the research sector will be constant, which results in a constant flow of technological change. This is a product of the make-up of the research sector and its relationship with the durable goods sector. That is, in Romer’s model, new ideas – in other words, technological change – are the product of inventive humans mixed with the existing stock of knowledge. Furthermore, and this is a key point for Romer, ideas are non-rival: that is, the possession of them by one person does not inhibit the possession of them by another (we can imagine a scientific theorem written on paper that can be photocopied basically for free).\footnote{Ibid., p. 74} Hence, with each cycle of the economy, the ideas produced through this mix get added to the stock of knowledge as a knock-on effect of their production in the first place (a spillover), which makes the relationship more productive in the next cycle than it was in the cycle that produced the ideas, and so on *ad infinitum*: ‘the production of a nonrival, nonexcludable good (is) an unintentional side effect of the production of a conventional good.’\footnote{Ibid., p. 77} By this mechanism, Romer is able to show what Solow had to take for granted: that technological change is capable of permanently seeing off diminishing returns to capital.\footnote{Ibid., p. 89} The latter is still in play in Romer’s model, but is now continuously offset from within. However, the number of ideas produced, though growing at a constant rate, is still restricted by the limited number of people working in the research sector and the size of the stock of knowledge in a given cycle. Every idea that is produced in each cycle is then bought by a separate firm
in the durable goods sector (meaning this sector has a potentially infinite number of firms), which can therefore can be understood as making an investment in R&D. The explanation for why each firm makes this investment is the second of the key points in Romer’s model: because all ideas are partially excludable. That means that once you have developed an idea into a product, you alone have the capacity to sell it or rent it to the final manufacturing sector. We must assume here that everyone knows how to make the product, and therefore can utilise whatever technological insights are involved, but only one firm is allowed to sell or rent it, which is only really explicable with patent restrictions. There are difficulties with this formulation, but we shall return to them later. In any case, once the durable goods sector has procured an idea, it turns it into a capital good, which can be understood as a machine that makes the finished products. These machines are then rented to our single representative firm, which sells the final products back to the consumers (who are also the workers). The key to this final stage is that these machines, while staving off diminishing returns, augment both labour and capital equally in the representative firm and are thus neutral as per the Solow model.

What we have then is an identical model to Solow’s in precisely the two ways that the latter is important for our concerns: first of all, we have a flow of technological change that functions entirely harmoniously. Once more, there are no Schumpeterian inventions or innovations, which replace existing technologies in discontinuous ways, or rather all inventions and innovations arise at precisely the desired time, when they do nothing but battle diminishing returns. Moreover, as is necessary for harmony, the process of invention and innovation is identical in each cycle; no evolutionary change takes place, and thus progress is rendered entirely

948 Ibid., p. 77
949 Ibid., p. 85
950 Ibid., p. 89
predictable into the future. In essence, then, we so far have no notable change, despite the introduction of new concepts like non-rivalry and partial-excludability. However, in the reunification of *homo economicus* a very significant tool is added to economic policy-making. Visible in the model for the first time since Smith, she operates in precisely the same way as her disembodied essence does in the Solow model, and every growth model that preceded it. However, this visibility is cushioned on a key assumption, that she is motivated by material self-interest: ‘technological change arises in large part because of intentional actions taken by people who respond to market incentives.’\(^{951}\)

This is the overwhelming point for Romer, as indeed it must for anyone who thinks that technological change can be explained solely by market forces. However, Romer does include the phrase ‘large part,’ which he clarifies as meaning innovation rather than invention. Nevertheless, as we saw in the model description above, the phrase ‘large part’ is analytically meaningless; Romer’s ingenious subject produces all aspects of technological change, with the result being imperfect competition. This is a genuine departure from what went before; as Schumpeter indicated, the creative and harmonious sides of *homo economicus* have never been reconcilable within an economic framework and thus the former has always been left out. Indeed, it was this inability to resolve the two that necessitated Ricardo’s separation in the first place. Romer, however, is in a position rather different from his classical and marginalist predecessors: whereas, as Routh tells us, the pre-Keynesian era was dominated by textbooks that downplayed or ridiculed the likes of Malthus or Sismondi, who criticised notions of harmony, hence allowing ‘a utopian image of capitalism (to be) passed from generation to generation of writers and

\(^{951}\) Ibid., p. 72
teachers, the Keynesian revolution made the notion of imperfect competition necessitating government intervention acceptable, as long as the justification for it is reached mathematically. Indeed, though it had yet to appear in an acceptable form within growth theory, the discipline, through the likes of Stiglitz and Krugmann, was increasingly describing logical difficulties within the competitive structure.

Nevertheless, given that, through the non-rivalry of technology, the ideas that are paid for by monopoly spill over into the general bank of knowledge, thereby benefiting all, the model does not result in a sub-optimal distribution of resources, barring one vital respect: having identified non-rivalry as the source of technology’s manna, the problems come at the hands of the excludability issue. Recognising that his formula for monopoly wobbles more than a little when one considers how patents can be gotten around, Romer also tries to make reference to firms hiding how the product is made, in order to make it excludable (for instance, by having the code of a computer program encrypted). This is a silly thing to introduce, however, since it necessarily means that the idea does not add to the general stock of knowledge, or at least does not increase it by as much as it is assumed to in the model, because the world at large cannot be entirely aware of the full nature of the contribution when it is encrypted.

We are of course identifying here a small but significant problem for Romer: the reality of technological change is that, rather than all technologies being partially-excludable to the same degree, they are in fact excludable to very different degrees: one can reverse engineer certain products very easily (computer hardware), but from others one can only

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952 Routh, Op. Cit., p. 267
955 Romer (1990), Op. Cit., p. 89
956 Ibid., p. 74
draw inspiration (much computer software). For some technologies, the
use they are put to, and the nature of their owners, keeps their make-up
obscure: we know, for instance, that the secrets of military weaponry (even
when made privately) have always been protected, though with uneven
success. In addition, excludability is itself a function of technological
change: with increases in encryption technologies, software becomes harder
to unravel, while hacking has allowed the spread of technical information
that would otherwise have been kept under lock and key. Nevertheless, the
monopoly issue is not our concern here, so we can let this formulation lie
and allow that the general stock of human knowledge is increased while
patents/encryption work perfectly.

For Romer, excludability has two negative consequences under equilibrium.
For a start, as we have seen, he formulates the spillover effect very
differently from Marshall: it no longer prevents monopolisation, but only
adds to the stock of knowledge. In short, Romer finds he cannot explain
investment in research without monopoly profits, so he embraces them.
However, this feature actually leads to a situation where, for Romer, ‘too
little human capital is devoted to research.’957 What he means here is that it
is the monopolising firm that gains the reward from the research rather
than the researcher, with the result that the incentive these profits might
provide is not passed on (why the researcher, who in Romer’s model is
selling research she knows will garner monopoly profits, does not simply
negotiate for a better split of those profits, is not explained). It is important
at this point to remember that, for economists, the “correct” payment for
any good or service is its marginal product. However in this scenario,
where the researcher is being paid much less than she contributes to the
monopolising company’s revenues, this is obviously not the case. Were she
paid in line with these, then naturally the incentive for research would go

957 Ibid., p. 96
up, leading to more human capital being devoted to research. Hence Romer, assuming (as we would expect) that the optimal amount of research is that which would take place under a scenario where researchers are paid their marginal product, argues that the equilibrium is under-performing.

He has a second, independent, reason also though: since a large part of the benefit of the research to society comes from the spillover of the knowledge into the entire stock, thus meaning that the researcher gives this benefit away for free, we must assume ‘human capital to be undercompensated’\(^\text{958}\) in relation to their overall societal contribution. This is important since, given that researchers only produce knowledge for financial gain, every additional amount of gain leads to more researchers and/or research. Hence, were this undercompensation to be rectified, we would have more researchers and thus more research. That financially unrewarding basic science actually produces the most significant breakthroughs, as we saw in chapter two, is mentioned by Romer at the beginning of his article,\(^\text{959}\) but is entirely ignored in the model. Now, we can certainly accept that were the rewards to innovation greater, more innovation would occur, but given the fact that basic science, aside from being a vocation to a greater or lesser extent, is significantly divorced from the ultimate market value of the research it produces, one would have to question whether the impact would be all that great. To put it in economic terms, without basic science being increased, there are diminishing returns to R&D. Romer effectively ignores this and assumes that the research induced by greater remuneration would be identical in impact to that under the status quo (or, more accurately, equilibrium), and hence, given the determining effect of technological change, would improve growth to exactly the same degree.

\(^\text{958}\) Ibid.
\(^\text{959}\) Ibid., p. 72
The crucial question then becomes: since we now know that growth is sub-optimal, can we do anything about it? Solow tells us, as we will recall, that greater government investment can boost the output of an economy in a single cycle, but not the rate at which it subsequently grows. With the Romer model, however, this is no longer the case as a result of the increasing returns to scale that arise from non-rivalry. To explain: with the neoclassical model, where technology is not intrinsically examined, all of the factors of production have constant returns to scale. That is, a doubling of size, for instance, leads to a doubling of output. However, with Romer’s conception of technology – its non-rival nature meaning that it does not need to be replicated in order to meet any scale – a doubling of size will result in net output increasing by more than double. The effect of having one factor of production that is essentially infinite in supply once bought, and thus requiring no further costs at any higher scale, allows for increasing returns, rather than the constant ones we see in other models. Significantly, Romer imagines this effect operating for the entire economy. To explain: if we will allow that the entire stock of knowledge costs, say, five units to produce, and the wages of researchers another five, leading to an output of ten (sold for an income of twelve units, two being profit), in doubling the amount of researchers to ten, one can double the amount of output to twenty without having to pay a penny more for the knowledge, which can be understood as doubling automatically. Hence while an output of ten garnered a profit of two, an output of twenty garners a profit of nine (as opposed to four, as it would be under constant returns). If we imagine, for simplicity, that we double the size of the economy under a Solow model, and continue with our example as laid out above, we now make a four unit profit, but if this is added on to the factors of production in the next cycle, it is still only 20% of the economy added on every year. With

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Romer’s model, the same investment in scale, assuming again profit is added on every year, suddenly means that we have a growth rate of 45% per annum. Even though, obviously, we are dealing with far smaller differences in a real economy, the logic is the same. Hence, with Romer, the growth rate itself can be improved, not merely the level one grows from, both because of increasing returns and because, in his model, we have access to the key component of that growth.

Therefore, the problem that Romer creates with the logic of nonrivalry is effectively solved by the same mechanism, as long as government intervention can be counted upon. That is, monopolisation, which results in an underinvestment in technological change under equilibrium – a sub-optimal equilibrium then – is rendered unproblematic because government can now subsidise the accumulation of knowledge and allow the economy to reach ‘the social optimum’ of both this and growth.\textsuperscript{961} The same idea is true for all endogenous models, whether focusing on R&D or learning-by-doing. However, the notion is empirically dubious. As Solow tells us, ‘endogenous growth all rest at some key point on an essentially arbitrary linearity assumption, on the claim that the rate of growth of this is a function of the level of that, where "that" is some fairly simple and accessible variable that can be manoeuvred by policy. Of course such a claim can be true, but the ones I have seen have been neither empirically verified nor overwhelmingly plausible \textit{a priori}.\textsuperscript{962} We have already noted a couple of reasons why this might be: first of all because the argument for why research is under-rewarded, at least insofar as the model is concerned, does not appear to make sense: those working in the R&D sector are likely to have a reasonable idea of the worth of their products, which are innovations designed for the market after all, and thus will not likely

\textsuperscript{961} Romer (1990), \textit{Op. Cit.,} p. 97
undersell them. Moreover, Romer neglects the limiting effect that being unable to influence basic science and invention has on his capacity to boost long-term growth. In addition to these, ‘the pseudo-dynamics’\textsuperscript{963} of endogenous technological change do not stand up well to scrutiny. First of all, research by Hollander and Townsend found that the ‘great majority of innovations did not come from formal R&D,’ even in those organisations that had ‘strong in-house R&D facilities.’\textsuperscript{964} Rather it seems Smith was closer to the reality, with the actual workers themselves contributing the greatest share. This would seem to lend support to the learning-by-doing approach, as opposed to Romer’s R&D, but, aside from the fact that these improvements did not arise in any accordance with any noticeable patterns, qualitative analysis in a diversity of industries is repeatedly confirming ‘the importance of early scientific and technological breakthroughs permitting and triggering an upsurge of inventive activity and technical innovation.’\textsuperscript{965}

In other words, innovations, whether in R&D or from the workers themselves, do not progress evenly or in a way that can be clearly motivated, given the significance of basic research and invention, which everyone agrees cannot be modelled. Indeed, more and more research on the nature of technological change emphasises that it should ‘not be viewed as a linear process, whether led by demand or by technology, but as a complex interaction linking potential users with new developments.’\textsuperscript{966}

We should not ignore Romer’s real contribution, however, in spite of the above. While he avoids most of the difficulty of technological change, in attempting to model its complexity at all, he could not avoid weakening the optimality of Smith’s original conception. Like others since Keynes, he is moving further away from the perfect competition that has dominated the

\textsuperscript{963} Solow (2010), \emph{Op. Cit.}, p. 1116
\textsuperscript{964} Freeman, \emph{Op. Cit.}, p. 474
\textsuperscript{965} Ibid. p. 480
\textsuperscript{966} Ibid.
discipline right up until the later part of the twentieth century, albeit in a form that, like Keynes, permits negative progress to flourish under conditions of intervention. Indeed, the fact that this model is effectively irreconcilable with empirical research on technological change should not come as much of a surprise given that the mechanism was always designed to function in such a way as to maintain harmonious progress, albeit at a necessarily sub-optimal level. As Solow tells us, temporarily playing the gamekeeper here rather than his usual role of poacher: ‘this literature has little or no interest in the descriptive ‘content’ of technology or technological change. It is all about the economic role of technological change in determining a steady-state rate of growth. Indeed, I rather think the theory has been somewhat deformed by its exclusive focus on that single question.’ All of the discontinuity about which Schumpeter spoke, in spite of him being referenced stridently in the 1990 paper, is quietly buried: for instance the notion that much innovation, despite having considerable money spent on it, proves fruitless, and that these failures are a necessary part of economic change; indeed, the central notion of the destructiveness of invention insofar as harmony is concerned, that this is the governing principle of how economies function, is once more ignored. Invention, given that it only serves harmony, is assumed to occur just as it is needed, and the resultant innovation entirely in response to the profit motive, just as Smith had desired. In effect, the realities of technological change are simply too discontinuous to model, but modelled they must be, and thus Schumpeter’s objecting economic rationale can never be exhumed. We must not assume that this is a knowing decision though; as Krugmann states in a telling sentence, when reflecting on his own work, “I suddenly realised the remarkable extent to which the methodology of

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969 See for instance Romer (1990), Op. Cit., p. 78
economics creates blind spots. We just don’t see what we can’t model." More important than that, the failure to recognise these blind-spots allows subsequent models to be proclaimed as truth, or at least function as a scientifically plausible version of it. Given the influence of economics, particularly insofar as climate change is concerned, these truths then shape how the rest of the world acts, leading to policy-recommendations of tremendous import.

In the final analysis, the greatest influence of Smith’s negative progress formulation of the discipline, a harmonious, infinitely repeating cycle of time, is the minimisation of uncertainty that it necessarily produced. The heterodox challenges, from Rae, to Schumpeter, to Robinson, have always emphasised the fact that the static equilibrium that predates Smith cannot represent a sequence of time, and that allowing it to do so allows for a knowledge of the future that cannot be justified: ‘(if) the vast majority of economists can proceed, unquestioningly...to treat uncertainty as if it is a beast that has been tamed, they can continue to construct theories of growth and the business cycle without paying attention to cracks in the foundation.’ What they have always missed is the role that Smith’s *homo economicus* played in facilitating the dominant rationality that they so rejected: it was only by assuming technological change acts in a harmonious way, an assumption that at its heart was underpinned by God, that allowed Smith to project this static model forward into the future. Smith announced the conditions of possibility for Baconian progress at that moment, and the world has lived with the legacy ever-since. In attempting to finally explain the operation of the ingenious subject of his discipline, Romer is forced to make some tremendously powerful assumptions, most importantly that all technological change comes from the profit motive.

Nakicenovic and the others who took this object and applied it to climate change models could simply be criticised for taking it out of context though; that, unsure as it is in relation to general technological change, there is certainly no warrant to apply it to technological change in a specific industry. However, to make this objection is to miss the entire basis of economic rationality: for the static cycle to be predictive, and thus for negative progress to be justified, it has to be representative of the past and future, which are necessarily then linked. As a result, the operations of all of its objects are the same for all times: hence, if invention and innovation happened in the energy sector in such a way in the past, this must be representative of the present and future. Were it to be admitted that abstractions from the past cannot be projected forward, even if only those limited to particularly industries, uncertainty would be introduced into the very heart of the discipline: the infinitely repeating, identical cycle. Instead, as with Keynes, a fixable problem is introduced, mixing the objects of negative progress with the will of positive. The result is that *homo œconomicus* is put to work in climate change policy, and with the complete knowability of her motivations based on a parsing of the past, a money-to-technology ratio can be constructed, therefore proving scientifically that mankind’s ingenuity, sufficiently motivated, is capable of solving it in a given timeframe. *Homo œconomicus* will respond just as inventively to the artificially created incentives in climate change models as to the “natural” ones in Romer’s depiction of economic reality. Moreover, even though caution is regularly sounded insofar as invention is concerned, in real terms, as we saw in chapter two, this is ignored. With endogenous technological change, therefore, comes the presumption ‘that inventions can be dreamed up or manufactured in laboratories when the situation calls for them and the prices are right.’\(^{972}\) This last quote is once more from Solow, giving us a

clear indication that the logic of his own model is lost on him, since Romer does little more than endogenise his assumptions. Solow does not see how the presence of an ever-harmonious technological change involves a tremendous amount of faith, and is repelled by the sight of the economic subject necessitated by it. Yet these two approaches represent that status quo that climate change mitigation was faced with; a discipline made scientific by its assumptions in regard to technological change now able to speak truths about it on the basis of those assumptions. The subsequent technological optimism, in spite of the empirical reality that places it under such doubt, is necessarily scientific and reliable as a result. As Smith would always have had it, the exact nature of the progress cannot be known, but that it is assured cannot be doubted.

In these last three chapters we have surveyed the development of the understanding of technological change within the discipline of economics right up to its deployment in climate change mitigation modelling. In sum, we found that the harmonious structure of it, which was always premised on its complete knowability and a divine logic, has been preserved to the present day. This is unsurprising, since the entire ability of economics to predict the future, from Smith’s desire to defeat reason to Solow’s growth model, rests on this crucial pillar. We first of all saw that Mill, while he makes clear the methodological advance that appears to separate positive economics from its Smithian metaphysical base, effectively maintains the Ricardian split in *homo economicus*, and thus the exogenisation of technological change. With the advent of marginalism – neither a paradigm shift nor a product of ideology – a formal set of mathematical tools is established to replace the literary exposition of the classics. However, harmonious progress is maintained, even strengthened, in Walras’s abstract, general equilibrium performance, since after all it is the prevailing structure of technological change that allows this static approach to take growth and
technology effectively for granted. Of all the marginalists, only Marshall discusses growth, and indeed sounds some notes of the future with his discussion of increasing returns and monopoly competition, but ultimately maintains negative progress as the dominant rationality right up until Keynes. The latter, influenced somewhat by the empirical business-cycle analysis, and more concretely by Malthus’s emphasis on the logic of irrationality, and most importantly boosted by the depression, is finally able to get elements of positive progress through the stern barriers the discipline always erected against it. For the Keynesians, though imperfect, the economy is yet perfectible, meaning that harmonious progress merely requires an element of government intervention to be set free. This is an important development, for it happens in the mainstream, and makes possible the later, similar efforts of Romer by altering the conditions of acceptability. We then examined two further challengers to the mainstream rationality, in Marx and Schumpeter, finding that while the former was in fact less radical, they were both equally ignored. Marx developed a partially evolutionary approach to economics, and thus anticipated Schumpeter, but working with the same objects as the mainstream, he permits his logic to be defeated and his work dismissed. Schumpeter is more difficult to counter, since his ontology is entirely different from that which has always prevailed, dealing as it does with evolution and change in the economic structure. This all begins with his radical conception of economic man and hence the logic of technological change, which shows up how the harmonious conception of the latter underpins mainstream efforts. Moreover, this serves as an attack on negative progress and, later explicitly, the assumptions regarding the automatic mechanism that sustain laissez faire. Towards the end of his life, Schumpeter even embraces the heterodoxy of his evolutionary approach, but has for his monument only the discomfort
of mainstream economists when they construct, on familiar lines, their static model of technological change.

One of these is Solow, who advances on the neoclassical synthesis and the seeming realities of the ‘Golden Years’ to assume away any disharmony, including in relation to technological change. He thus returns, through a bare dynamisation of what was rendered static in marginalism, to the structure of technological change created by Ricardo. For Solow, the natural course of the economy, a universal equilibrium, is kept in motion by this exogenous technological change which, now rendered quantifiable, makes economists experts on the future of technology, since its essentially static nature within each identical cycle allows the past to represent the future, and thus, ultimately, climate change to be technologically solved.

Decades later, following the re-emergence of growth as an issue, Romer reproduces the dominant Solow model, except with technological change represented once more by Smith’s ingenious subject. Utilising the gap left by Keynes for sub-optimal equilibria, Romer is able to reconcile \textit{homo economicus}’s harmonious side with her ingenious side, albeit only with the inclusion of monopolisation and sub-optimal utilisation of technological resources. However, now granting government access to this objectification, which responds solely to financial gain, he permits the creation of incentives to produce further technological change of any variety. This mechanism is then detached in response to climate change, with its scientific credentials used to support a notion of what is effectively a money-to-technological change ratio, thereby proving that radical responses to the planets warming are unnecessary. Technological change always acted as desired under negative progress, and so does the same in climate change mitigation models. In the final analysis, the construction of abstract technological change allowed the discipline to claim to be able to predict the future abstractly, claim to be a science of the nature of progress.
on that basis, and thus speak as experts on technological change, using the ingenious subject of Smith, either implicitly or explicitly, as their analytic tool. Transferred to climate change mitigation, nothing is different, with the result being a technological optimism that can function as true and which thus renders radical social, political and economic change unnecessary. Far from being scientific, in the final analysis, this confidence rests on faith alone.
Conclusion

This conclusion will briefly sum up the achievements of the thesis, its major contributions to knowledge and the analysis that makes up those contributions. Let us firstly remind ourselves of the research question: what history made possible the technological optimism of climate change economics? This research question flowed directly from the aim of the thesis: to unsettle the idea that climate change mitigation and the present mode of economic organisation are broadly commensurable; an idea for which the technological optimism of climate change economics provides crucial support.

Summary

In the first chapter I located the thesis within what I broadly called “the environmental literature,” and specifically the previous critiques of technological optimism found therein. I drew two primary conclusions from my analysis of these. First of all, that these critiques were inadequate because, while they undermined existing claims, they failed to undermine the very heart of the notion of technological optimism: that future ingenuity can save us from present irresponsibility. So for instance, while Daly, Georgescu-Roegen and others argued convincingly that the world is subject to irreversible qualitative change, they could not make that matter for present problems, because the latent theoretical power of future technological change allowed Solow, Stiglitz and others to make worrying implication of this seem almost impossibly distant. I argued, then, that, in the case of climate change technological optimism, it was vital to destabilise
this confidence by undermining the conceptualisation of technological change that powers it. Second of all, I noted how technological optimism can be read as intrinsically tied up with a vision of progress. In other words, if we are willing to accept the existence of an overarching narrative of progress, which sees its continuation as synonymous with the continued improvement of material well-being, then technological optimism would perform a defensive role against the threat posed by environmental degradation. I further noted that an existing methodology, that of Jurgen Habermas, could supply an alternative critique of the problem of this thesis on exactly these grounds, taking each instance of technological optimism as manifestations of a greater ideology of scientific-technical progress. I thereby set up the methodological discussion of chapter three.

Before this, however, there was need to understand the explicit nature of the problem under examination. Hence, in chapter two, I analysed the mitigation scenarios of the IPCC and the literature that underpins them, showing the huge expectations of future technological change maintained by both. I argued that these projections could not be separated from an assumption that invention would act as needed. This was done in light of the universal agreement that invention cannot be modelled. I then noted, though, that the problem of invention was one accepted by the IPCC and the literature more generally, but that they still maintained a confidence in their predictions based on the idea that the past is a representative guide to the future. I resolved then to undertake a genealogical critique of the conceptualisation of technological change that could produce such simultaneous caution and confidence.

In chapter three I established a method for doing so by returning to the methodological problem raised in chapter one: whether to analyse technological optimism as part of an overarching problem of progress, or whether to treat the findings of climate change economics as a local and
unique progressive claim. In other words, to judge whether a global

critique, which would characterise the problem as a manifestation of the
great problem of modernity, is better suited to the problem at hand than a
local one, which would insist on the specificity of individual discourses.
Through my subsequent analysis of Habermas’s work, I found the global
explanation to be wholly inadequate. This was because in returning
instrumental rationality (the heart of the Frankfurt School problem of
modernity) to its Weberian origins – that is, removing from it the notion of
an internal mythic corruption – Habermas lost his ability to criticise its
“proper” usage. In short, Habermas made himself incapable of criticising
economics on anything other than its own terms. I then examined the
Foucauldian approach, finding in his genealogical and archaeological
methodology an ideal set of tools for the problem at hand. My critique
would therefore be genealogical, and would seek to identify the particular
rationality in play in the present, the conception of the subject at its heart
and the ruptures and discontinuities in its history, as well as the continuities
and hidden assumptions, that together allow climate change economics to
produce particular kinds of knowledge as truth in relation to technological
change. As Dean tells us, a genealogy ‘emerges as a “history of the present”
because it is able to undertake an analysis of those objects given as
necessary components of our reality.’

My genealogical critique begins in chapter four with the Wealth of Nations
which, as I show, marks the first appearance within economics of an
abstract notion of technological change. Smith’s work involves the merging
of three distinct influences, but with the aim of attacking a particular
rationality of government: the idea that through interference, based on
reason and plan, things can be made better. I describe this as positive progress
and thus its counterpart, the fundamental rationality of economics, as

973 Dean, Op. Cit., p. 33
negative progress, borrowing a little from Isaiah Berlin. Negative progress emerges as a product of primarily three influences: Baconian technological enthusiasm, which sees Smith identifying man in general with an essential technological creativity; the static conception of the economic flow that Smith inherits from the Physiocrats, which Smith employs as his template; and a pantheistic notion of natural law, Smith’s Stoic theology, without which his argument for non-intervention is inexplicable. From this assemblage we get a particular conception of the subject, beyond merely a rational utility-maximiser, but rather involving a divine essence which manifests itself only when the economy is left to its own devices. This is the real homo economicus, the effect of whom is a harmonious progress, where intervention is rendered unnecessary and technological change allowed to blossom to its fullest. However, in order to show that intervention is unnecessary, Smith must account for all of these elements in the present. In other words, he must create an implicit, static model, based on that of the Physiocrats, that now not only shows the distribution of wealth, but also how production will progress into the infinite future. This allows him to predict the future of economic growth and therefore defeat positive progress. In the process, though, technological change is rendered abstract, divorced from actual technologies, but still acting in such a way as to generate the best of all possible worlds. It is an abstract object whose development is entirely predictable. It is this objectification, located in the subject, that allows time to be rendered cyclical; nothing more than a repetition of this static flow, with successive productions rendered equally knowable. This is what the rationality of economic growth really entails: that the future is entirely predictable, because it is nothing more than a repetition of the structures of the present and past.

The full implications of this abstraction were, however, likely unknown to Smith. Ricardo, though, as we see in chapter five, utilises them to their
fullest and in the process creates the method of economics. The theological convictions that underpinned his predecessors’ work are seemingly excised, and the result presented to the world as the first truly scientific economic performance: a simplified, abstract, deductive analytic engine. In order to accomplish this, however, Ricardo must make a number of leaps. The first is that Smith’s description of how technological change works is entirely correct, and merits no further analysis on the abstract level. As a result, technological change is exogenised, and *homo economicus* split, with her technological effects hidden in factor substitution and curiously harmonious interventions from the outside that allow for the defeat of diminishing returns. When we analyse this in the context of Malthusian economics, a much more empirical and sociological effort, we see why Ricardo had to act in the way that he did. For technological change does not act in the harmonious way Smith described, nor indeed does the utility maximising subject. *Homo economicus* is not a generator of a perfect progress, but rather an individual perfectly capable of disrupting progress. Through abstraction, though; through the concretisation and scientisation of Smith’s objects’ “natural tendencies,” Ricardo is able to preserve the rationality of negative progress and thus defeat government intervention. This was only possible, however, because of the particular conditions of acceptability in which the Ricardo-Malthus debate took place. The utilitarian radicalism, with its antipathy to government intervention, that dominated the discipline, preferred Ricardo. Moreover, his claims of Newtonian, scientific status for the discipline, claims that the messily empirical Malthus could not make, allowed him to effect in practice what Smith had argued for: non-intervention. Economics therefore became a coherent whole, with Malthusian *mixed progress* – the hybrid of positive and negative progress he was forced into – dormant until Keynes.
In the final three chapters, we traced this formalised, cyclical conception of time, which marks the rationality of economic growth, up to the climate change economics of the present day. In chapter six we saw how Mill elaborated on the method of Ricardianism, but maintained the exogenous conception of technological change and the negative progress rationality. Indeed, the only significant development until Keynes, comes with marginalism, which takes a previously literary subject and turns it into calculus. The seeds of the quantification of progress are thus sown. However, after this, in chapter seven, we note the three major challenges faced by the rationality. I argue that the Marxian challenge is the least of the three, and has no discernible impact on the rationality of economic growth. Keynes, however, has a significant impact. As a result of the great depression, he is able to make an economic theory that necessitates government intervention utterable within the mainstream of the discipline. The mixed progress of Malthus is therefore rendered possible once more. Even more subversive than this, however, is the challenge of Joseph Schumpeter. His analysis, which is inspired by an evolutionary conception of the economy almost entirely divorced from the prevailing rationality, insists as its major contribution on the disharmonious and unpredictable nature of technological change. This, however, the discipline refuses, since it would destroy the very basis of its scientific claims, casting it adrift in incoherent empiricism and sociology. Keynes’s analysis is adopted instead, though his important alteration to the rationality is mostly swept below a surface of negative progress in the efforts of Samuelson and, ultimately, Robert Solow. As we see in the final chapter, the latter is the creator of the single most significant model of economic growth, a model that dominates the sub-discipline to this day. However, we see that he merely translates into formal economics – the economics of marginalism – that which was present in the classics: exogenous technological change. As a result,
however, a formal tool is created which economists can use to speak as experts on the future of technological change. It is this external force, acting entirely predictably and harmoniously, which forms one half of the two major modelling approaches within climate change economics: the Autonomous Energy Efficiency Improvement (AEEI) coefficient. It allows climate change modellers to generate the technologically optimistic findings that continuously repel “radical” alternatives. The other approach arises as a reaction to Solow’s exogenous conception of technological change, and is characterised by the return of *homo oeconomicus* from her Ricardian displacement. Utilising the possibility of mixed progress that Keynesianism introduced into the dominant rationality, Paul Romer produces a theory wherein the subject of economics responds directly to incentives within the model. It is this endogenous form of technological change that, at the moment, seems to be gaining the ascendancy within climate change mitigation models, since it allows states to induce whatever technological change is desired simply by producing incentives. It is the formal transfer into climate change mitigation of the notion that necessity – here characterised by monetary incentive – is the mother of invention. With this now in place, even the mitigation scenarios analysed in chapter two can be surpassed in terms of technological optimism, since technological change is rendered nothing more than a matter of sufficient monetary incentive. With the power of God at its disposal then, reason is thus free to produce any degree of progress it can imagine.
Achievements

The major achievement of this thesis is its effective critique, through the use of a Foucauldian genealogy, of the technological optimism of climate change policy. The critique took two equally vital but inextricable forms. First of all, I showed how it became possible that technological change could be considered predictable at all, and thus how economists came to be reliable speakers of powerful truths in regard to its future. This happened because technological change was required to be predictable within an economic framework in order for the negative progress rationality of the discipline to be conceivable and then maintained throughout its history. The conditions of acceptability I described allowed this rationality to become the dominant one in relation to matters of economic growth and thus the knowledge it generates to be powerful. However, in showing how this historical development involved dubious victories and important partial defeats, all based on power and historical circumstance rather than scientific merit, I also showed how unsteady are its claims to being a generator of scientific truths. Second of all, I displayed how the projections of the IPCC, which show technology solving a huge part of the climate change problem, are only feasible if one accepts that human ingenuity is divinely provided. This is because the tools for modelling technological change used in the mitigation literature are inexplicable without the theological base that originally engendered them; that is, one could not expect them to act as they do if one did not have faith in a pantheistic God. They did not come to be as a result of a smooth process of scientific discovery and experimentation, but rather because their fundamentally metaphysical essence was hidden in the ascent of the economics to scientific status. The powerful position of the rationality of economic
growth theory then allowed this knowledge to become decisive in climate change mitigation.

These findings are also the major original contribution of the thesis to scholarly knowledge. As argued throughout the thesis, they provide vital assistance to those arguing for political, rather than technical, solutions to the problem of climate change. The critique shows that the projection of a tremendous contribution from future technologies to solving climate change cannot now be considered safe and further, that idea of progress it underpins is no longer tenable. As a result, alternative means of cutting greenhouse gas emissions must be found. What these means might look like is not a matter addressed by this thesis, but it is not unreasonable to assume that major lifestyle changes would be involved. This is a significant advance on the existing critical literature, examined in chapter one, because it weakens not merely the findings of technologically optimistic policy approaches, but the entire basis upon which these findings are made. It removes the scientific sheen that gives the findings all of their power and thus adds a new dimension to the strong sustainability critique and its alternative approach to solving environmental degradation. Moreover, it takes away what was described in chapter one as the crucial buttress of weak sustainability: the harnessing of the conceptually unlimited power of unknown future technologies. This opening up of possibilities in the present, as a result of the destabilisation of powerful knowledge, is an important effect of any genealogy.

In addition, the thesis makes a significant contribution to our understanding of the rationality of economics. Charting the development of the particular rationality in play is a vital part of a genealogy also and thus the thesis reveals a significant amount about its history and how it operates, particularly the growth theory part of it. Using this aspect of Foucauldian methodology, the thesis explains how modern growth theory
became possible and how it developed the rationality we see today. Moreover, it shows how it could have been otherwise, by charting the challenges it bested, as well as the accommodations it made with successful alternatives. The thesis also reveals, through its focus on the subject, an additional, and crucial, aspect of economic man: his ingenuity. This is shown to have been essential for the emergence of economics as we know it and its ever-present technological optimism. Given how significant *homo economicus* is in many critiques of economics,\footnote{Cf. Richard H. Thaler (2000), ‘From Homo Economicus to Homo Sapiens’ in *Journal of Economic Perspectives*, Vol. 14, pp. 133-141; Samuel Bowles and Herbert Gintis (1993), ‘The Revenge of Homo Economicus: Contested Exchange and the Revival of Political Economy’ in *The Journal of Economic Perspectives*, Vol. 7, pp. 83-102; Edward J. O’Boyle (2007), ‘Requiem for Homo Economicus’ in *Journal of Markets and Morality*, Vol. 10, pp. 321-338} this is a finding that should be of significant use to scholars.

This thesis has been about undermining a rationality, one responsible for the production and power of a very dangerous technological optimism. In showing that we need not accept that “truth” as given, or the rationality as scientific, alternative approaches are suddenly able to move past the single greatest obstacle to their realisation. However, as Foucault would no doubt remind us, such efforts only open up *possibilities* in the present. Making something of these spaces remains a tremendous challenge.
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