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Self-interest, Sympathy and the Invisible Hand: From Adam Smith to Market Liberalism

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Abstract

Adam Smith rejected Mandeville's invisible-hand doctrine of 'private vices, publick benefits'. In *The Theory of Moral Sentiments* his model of the 'impartial spectator' is driven not by sympathy for other people, but by their approbation. The innate capacity for sympathy makes approbation credible. Approbation needs to be authenticated, and in Smith's model authentication relies on innate virtue, which is not realistic. An alternative model of 'regard' makes use of signalling and is more pragmatic. Modern versions of the invisible hand in rational choice theory and neo-liberalism are shown to be radical departures from the ethical legacy of Enlightenment and utilitarian economics, and are not consistent with Adam Smith's own position.

Since the 1980s, public policy in English-speaking countries has been guided by two doctrines. The first is selfishness (or more grandly, 'rational choice'), namely that people are motivated primarily by self-regarding interests which they pursue in market exchange. The second is that the primacy of self-regard is good. Adam Smith's 'invisible hand' ensures that market exchange is socially efficient. Wherever possible, therefore, production, distribution, and exchange should be transacted in markets, and should respond to prices. I call these doctrines 'market liberalism'. There is however a long-standing question as to whether Adam Smith's notion of the invisible hand can be reconciled with his ethical motive of 'sympathy' in the *Theory of Moral Sentiments* (Montes, 2003). I argue here that what matters in Smith's conception of sympathy is not our sympathy *for* others. Rather, it is approbation, the sympathy of others *for ourselves*. This reading reconciles selfishness and sympathy and is altogether more credible. It also has a bearing on the efficiency attributes and on the ethical authority of the norms of self-interest and market freedom in the present.

Despite their venerable lineage and normative centrality, we do not know whether the doctrines of self-interest and market efficiency are true. Their core premises are insecure. It has never been proven that they are always more efficient than other arrangements; it is not even easy to define what such efficiency would consist of. As for self-interest, it is either an *a priori* axiom, or a psychological speculation. In reality, choices are not always intended to maximise economic advantage. Financial motivations are often crowded out by intrinsic ones, such as obligation, compassion, and public spirit. As for aggregate efficiency, those who buy and sell for their own advantage have no incentive to seek it, and it has never been proven that efficiency happens by itself.

The doctrines of selfishness and of market efficiency are sometimes presented as hard-nosed conceptions of immutable reality. It is supposedly not the business of economists to make moral

judgements. Implicitly, however, and often openly as well, these doctrines also imply ethical claims: self-regard and market payoffs are presented not only as true, not only as efficient, but also as just and proper. Milton Friedman wrote, 'The ethical principle that would directly justify the distribution of income in a free market society is, "To each according to what he and the instruments he owns produces"' (Friedman, 1962, pp. 161-2). An alternative view is that both types of claims, from reality and from justice, are asserted because they are self-serving. Indeed that is what we should expect if we truly believed them. This critical view is also developed here.

Since selfishness and the invisible hand remain unvalidated, they provide a bad model of reality. Like other bad models, and because they are bad models, in a normative role they can serve to justify harm. How these doctrines inflict harm is described in a companion study, of the American medical system (Offer, 2012). An alternative normative model is set out below, which also comes out of Adam Smith. Economics today has arrived at what appears to be a blind alley: the doctrines of efficient markets and the policy norms they endorsed, have failed repeatedly and badly. They are not sufficient to explain the success of capitalism and its variants, and they do not account for its failures.

I dwell on Smith here at some length, because his authority is claimed by market liberals as providing support for their doctrines, and also because his real doctrine is different, more attractive ethically and more compelling empirically. In his view, the drive for personal advantage is tempered by the quest for approbation. Individual well-being depends on interpersonal acceptance. In contrast, according to Smith, market exchange is efficient only when it is impersonal and truly competitive. In reality, and even in modern societies, such competitive and impersonal settings are not the rule. Whenever there is personal interaction (as in a good deal of economic and social exchange), mutual obligation enters the calculus of advantage.

Section I

Every economic exchange creates a transient condition of dependence. Much of the time, this makes no difference: buyers and sellers have ways to police each other. Conventions, law, morality and regulation keep defectors in check. But when knowledge and bargaining power are unequal, opportunities for duplicity and defection can open up. The doctrine of self-interest provides an adequate motive. Another justification for defection is that self-interest promotes collective welfare. As Bernard de Mandeville put it in 1714, 'Private Vices, [are] Publick Benefits'. 'The worst of all the multitude,' he wrote, 'did something for the common good' (Mandeville, 1714, p. 9, l. 17).

The two interlocking doctrines of self-interest and market efficiency carry through to the present day. But are they true? We still don't know. The primacy of self-interest is no more than speculation. The invisible hand remains an article of faith. As norms for conduct, these two doctrines are asymmetric in time. Self-interest is a licence for defection now. In contrast, the 'Publick Benefits' promised are delayed and uncertain.

The concept of an 'invisible hand' is identified with Adam Smith. The two most famous passages in *The Wealth of Nations* align it with the interests of the businessman who

> … intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention. Nor is it always the worse for the society that it was no part of it. By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it (Smith, 1776 (1976), IV.ii, p. 456).

Note that Smith's criterion is not the benefits for the individual, but for society. The other famous passage says,

> It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest. We address ourselves, not to their humanity but to their self-love, and never talk to them of our own but of their advantages (Smith, 1776 (1976), I.ii, p. 27).

These lines can be taken as a warrant for self-seeking. In the spirit of Mandeville, do your worst, it is only for the best. But Smith held Mandeville in contempt. Mandeville, he wrote disapprovingly in his first book, *The Theory of Moral Sentiments*,

> seems to take away altogether the distinction between vice and virtue, and of which the tendency is, upon that account, wholly pernicious… All public spirit, therefore, all preference of public to private interest, is, according to him, a mere cheat and imposition upon mankind (Smith, 1759 (1976), VII.ii.4.6, p. 308).

Smith's first chapter, 'Of Sympathy', opens resonantly, 'How selfish soever man may be supposed, there are evidently some principles in his nature, which interest him in the fortune of others (Smith, 1759, I.i.1, 9).' In this passage, 'sympathy' is independent of, and as real, as selfishness. These generous words impart a benign aura to the book. But the claim is a little puzzling. How soever attractive such innate sympathy for others might be, it is not entirely credible as a prime motivator.

The primacy of sympathy is more believable, however, if what really matters is not our sympathy *for others*, but the sympathy of others *for ourselves*: 'nothing pleases us more than to observe in other men a fellow-feeling with all the emotions of our own breast (Smith, 1759 (1967), I.i.2.1, p. 13).' Note that 'nothing pleases us more'. The motivational primacy of other people's sympathy is meant here literally. Likewise, in the passage below, it is described as the prime mover of economic activity.

> What are the advantages which we propose by that great purpose of human life which we call bettering our condition? To be observed, to be attended to, to be taken notice of with sympathy, complacency, and approbation, are all the advantages which we can propose to derive from it. It is the vanity, not the ease, or the pleasure, which interests us (Smith, 1759 (1967), I.iii.2.1, p. 50).

As a motive that is equally compelling as self-interest, the approbation of others is more credible than benign altruism. But in order to give satisfaction, the approbation of others has to be genuine. Unmerited approbation is not worth having (Smith, 1759 (1967), III.2.5, p. 115). So the approbation of others needs to be authenticated. And that is why Smith opens his argument by asserting the existence of unilateral sympathy. To make it clear, approbation is not an alternative to sympathy, it is animated by sympathy. To make the model work, for the sympathy of others to be credible to us, we need to believe that they have a capacity for unilateral sympathy. And for this capacity to be credible in others, we need to observe it in ourselves. Our capacity to sympathise *with* others, has to be assumed in order to make the sympathy *of* others credible to us. This need for approbation is wired in:

> Nature, when she formed man for society, endowed him with an original desire to please and an original aversion to offend his brethren… She rendered their

> approbation most flattering and most agreeable to him for its own sake; and the disapprobation most mortifying and most offensive (Smith, 1759 (1967), III.ii.6, p. 116).

How to authenticate the approval of other people? We do not have access to their minds. But we can see into our own. Smith uses the device of 'the impartial spectator'. Approbation needs to be deserved (in an echo of the Golden Rule, 'As every man doth, so shall it be done to him (Smith, 1759 (1967), II.ii.1.10, p. 82.') In order to take satisfaction in praise, one needs to have earned it. Individuals know whether they are praiseworthy better than an external observer. They should wish for no more praise than a well-informed and fair-minded stranger might be willing to accord:

> We endeavour to examine our own conduct as we imagine any other fair and impartial spectator would examine it… We suppose ourselves the spectators of our own behaviour, and endeavour to imagine what effect it would, in this light, produce upon us (Smith, 1759 (1967), III.1.2, p. 110, III.1.5, p. 112).

The agent views his own conduct as other people might see it, and cannot, in fairness, claim any special consideration, unless it was truly deserved. This point of view, of the 'impartial spectator', is internalised so that the sense of desert no longer depends on the presence or absence of actual praise (Smith, 1759 (1967), III.1.5, p. 115). For this model to work, Smith needs to assume that the individual not only has a natural desire for praise, but also an innate desire to *be* virtuous:

> Nature has endowed him not only with the desire of being approved of, but with the desire of *being* what ought to be approved of (Smith, 1759 (1967), III.2.7, p. 117).

But that may be a step too far: is this really credible? Even Smith admits that the capacity for sympathy is not restricted to the virtuous and the humane (Smith, 1759 (1967), I.i.1.1, p. 9).

A similar concept to Smithian approbation is provided in my own account of 'the economy of regard' (Offer, 1997). In economics it is assumed that individuals form their preferences independently of each other. In contrast, the concept of 'regard' implies that they form their preferences in response to each other. The ultimate benefit is self-worth. As Smith argued, self-worth requires the validation of others. The term 'regard' has two meanings: The first is 'to be noticed'. The second is 'to be valued'. Validation needs to be independent and impartial. Instead of relying on self-validation by the 'impartial spectator', in my model it is achieved by evaluating the signal of approbation. A good signal, in theory, is one that is difficult to make and difficult to fake. Hence, the recipient should be in a position to evaluate it (Camerer, 1988). Approbation is communicated as a signal from the counterparty, by means of a 'gift' (the term is applied to any voluntary transfer). The glow of acknowledgement in the cycle of reciprocal exchange is the authentication device.

Regard takes many forms: attention, acceptance, respect, reputation, status, power, intimacy, love, friendship, kinship, sociability. Withholding signifies indifference and rejection. To convey authentic regard, a genuine signal requires discrimination and effort. But it does not require virtue. Regard can motivate anyone, villains as well as the virtuous, and is sustained so long as it is reciprocated. The reciprocal motive of regard is less demanding, and more realistic, than assuming, as Smith needs to do, that people are imbued with 'the real love of virtue, and the real abhorrence of vice (Smith, 1759 (1967), III.2.7, p. 117).' But Smith was right to perceive that some level of shared virtue helps to motivate the cycle of reciprocity. Nevertheless, if social norms are benign, then a good deal of co-operation, prosocial behaviour, and reciprocity, can be motivated by the quest for approbation alone.

For Smith, ethical obligation does not mean self-denial: it is grounded in the pursuit of personal benefit, in 'reflected self-interest' (Montes, 2003, p. 74). The value of benevolence is not diminished even if it is motivated partly or wholly by self-love (Smith, 1759 (1967), VII.ii.3.16, p. 304). Ethical norms have consequently evolved as part of human nature. This is also consistent with recent experimental findings, which have a shown that the commitment to fairness is widespread, but falls short of being universal (Camerer and Fehr, 2004). For Smith, sympathy is an objective in the pursuit of self-interest, which is guaranteed to pay off:

> No benevolent man ever lost altogether the fruits of his benevolence. If he does not always gather them from the persons from whom he ought to have gathered them, he seldom fails to gather them, and with a tenfold increase, from other people. Kindness is the parent of kindness; and if to be beloved by our bretheren be the great object of our ambition, the surest way of obtaining it is, by our conduct to show that we really love them (Smith, 1759 (1967), VI.ii.1.19, p. 225).

In other words, the best way to obtain the regard of other people, is to provide them with our own.

The 'invisible hand' is invoked only once in *The Wealth of Nations.* Its effectiveness is understated: it is merely 'not always the worse for society'; and it does not *necessarily* promote the interests of society, it only does so 'frequently'. The miraculous powers it has subsequently acquired may not have been intended by its author (Grampp, 2000; Rothschild, 2001, ch. 5; Samuels, 2011). In contrast, the 'impartial spectator' (the internalised norm of propriety), is invoked sixty-six times in Smith's first book, *The Theory of Moral Sentiments*, and its authority, the authority of conscience, is taken as binding. It was also Smith's final word: a revised sixth edition was published just before his death.

The contradiction is real. How to square the doctrines of *laisser-faire* and 'natural liberty' with those of moral obligation that seem to coexist in Smith, and even more so, how to square the difference between Smith and Mandeville? My response is that much of the time we do not have to choose. The invisible hand applies where markets are impersonal and competitive, and where they trade in uniform commodities. In contrast, the impartial spectator's ethical norms apply whenever exchange is mediated by personal relations. Approbation may be valued highly, but impersonal markets cannot supply it (Offer, 1997, pp. 454-467).[1]

This is demonstrated in Smith's chapter, 'Digression concerning the Corn Trade And Corn Laws', in *The Wealth of Nations* (Smith, 1776 (1976), IV.v.a-b pp. 524-543). In the British *ancien regime,* the grain trade was regulated by means of maximum prices and restrictions on export and hoarding. Their purpose was to prevent extreme price rises in times of shortage. E.P. Thompson regarded these arrangements as a reciprocal 'moral economy', in which the poor provided deference, and the rich guaranteed subsistence (Thompson, 1971). Smith argued that these regulations were misguided, and that a free market was more likely than any regulator to ensure subsistence, except in the most extreme circumstances. Grain production and trade, the largest industry in the country, was too extensive for any monopolist to capture. Merchants who raised prices above the competitive level would be undercut by the others.

The popular belief that merchants hoarded grain deliberately in times of dearth gave rise to food riots; the fear of riot deterred respectable traders, and the business therefore attracted 'an inferior set of dealers… together with a number of wretched hucksters (Smith, 1776 (1976), IV.5.47, p. 541)'. The

[1] Nieli (1986) applies the impartial spectator in the case of personal intimacy, the invisible hand for impersonal relations. Viner (1972, pp. 80-82) has an analogous concept of 'social distance'. Both cited in Montes (2003).

accusation of impropriety became self-fulfilling. The implication is that in impersonal, competitive markets, virtue does not matter; it makes little difference that the grain trade middlemen are short on virtue. The impersonal discipline of competitive markets made them serve the public good. This chapter demonstrates how the invisible hand can operate when markets are impersonal.

Section II

The advocates of market liberalism naturally concurred in this analysis. The Mont Pélerin Society is an influential and well-funded global society of academics, businessmen, and their acolytes, all of them hostile to the welfare state, which has assembled annually since 1947 (Hartwell, 1995; Walpen, 2004; Mirowski and Plehwe, 2009). In 1976, it went to Scotland to commemorate the bicentenary of the *Wealth of Nations*. In one of the papers presented, the Chicago economist Ronald Coase explained

> For that extensive division of labour required to maintain a civilised standard of living, we need to have the co-operation of great multitudes, scattered all over the world. There is no way in which this cooperation could be secured through the exercise of benevolence. Benevolence, or love, may be the dominant, or, at any rate, an important, factor within the family or in our relations with colleagues and friends, but as Adam Smith indicates, it operates weakly or not at all when we deal with strangers…The great advantage of the market is that it is able to use the strength of self-interest to offset the weakness and partiality of benevolence (Coase 1976, fol. 13).

Milton Friedman also differentiated between the intimate sphere where obligation was appropriate, and the impersonal one, where it was impractical.

> On the moral level, Smith regarded sympathy as a human characteristic, but one that was itself rare and required to be economised. He would have argued that the invisible hand was far more effective than the visible hand of government in mobilising not only material resources for immediate self-seeking ends but also sympathy for unselfish charitable ends (Friedman, 1976, fol. 9).

Friedman's assertion that love is scarce may have come from an essay by Robertson, 'What do Economists Economize On?' (Robertson, 1956). But Smith himself never regarded sympathy as being scarce. He considered it to be innate and universal.

Like Friedman, Coase also twisted the existence of benevolence into an argument against collective provision:

> …this should not lead us to ignore the part which benevolence and moral sentiments do play in making possible a market system. Consider, for example, the care and training of the young, largely carried out within the family and sustained by parental devotion. If love were absent and the task of training the young was therefore placed on other institutions, run presumably by people following their own self-interest, it seems likely that this task, on which the successful working of human societies depends, would be worse performed (Coase, 1976, fol. 13).

So much for education and schools. In this market-liberal argument, everything hangs on the relative scale of impersonal markets, in comparison with the aggregate scale of those forms of exchange that involve personal interaction.

Chicago economists assume that impersonal markets predominate. This is also suggested by the common usage which implies that we live in competitive market societies. But for one thing, a good deal of commercial activity is anything but competitive. And incentives of inter-personal regard continue to pervade large sectors. They dominate production and exchange within the household (including the creation and raising of children), and those segments of production which depend on personal interaction: health, education, personal care, small teams, relational salesmanship, family farming, the military, the professions, and hierarchical bureaucracies of various kinds. The boundaries of self-regard, pseudo-regard, and authentic regard shift in response to technological conditions, modes of production, cultural norms and personal preferences. Overall, taking the imputed money value of household production (including childcare), not-for-profit activity, and public and collective goods, less than half of the imputed money value of final welfare is allocated through markets.[2]

In advanced societies, people have deliberately avoided impersonal markets for most of their satisfactions. Even within markets, a good deal of exchange involves interpersonal interaction, e.g. in marketing, hospitality, and personal services. The share of services has come to dominate output in western developed societies, and services typically require interpersonal interactions and trust. Teachers, doctors, lawyers, waiters, hairdressers, salespeople and financial managers too, all owe the client a duty of care. Hence, both Mandeville and Smith can be right at the same time, in different sectors and activities. The challenge for policy is not to get the invisible hand to displace the impartial spectator, or vice versa, but to identify the appropriate sphere and scope for each. As the relative share of commodity production declines in advanced societies the impartial spectator's duty of care only gains in importance.

Section III

In view of the enduring influence of the invisible hand doctrine, and of Smith's authority, one might assume that it is founded on compelling analysis. Most of his argument, as in the Corn Trade chapter, is descriptive: Smith's 'System of Natural Liberty' is appropriate to competitive markets, which can discipline market traders. Analytically, however, invisible hand statements take the form of causal propositions: action A leads to result B – they imply a mechanism at work. But Smith did not try to show *how* it worked, except, as above, by anecdote, example, or assertion. The invisible hand itself is alchemy – a felicitous phrase but without any transcendental clockwork to support it.

And so it has remained. The invisible hand is at the heart of economics, and provides a social justification for the primacy of self-regard. But it is no more than an article of faith. Taken as a formal theorem, for almost two centuries nobody was able to prove it. In the 1950s, the 'Two Theorems of Welfare Economics', were proven mathematically by Arrow and Debreu. These theorems were proclaimed as the final demonstration of the invisible hand theorem (Arrow and Hahn, 1971, p. 5). They show that every general equilibrium is associated with a state of Pareto efficiency (in which no one can be made better off without someone else being made worse off). This notion of efficiency has generally been adopted as the touchstone of economic performance. Like other economic terms which diverge from their ordinary meanings, Pareto efficiency is quite different from the lay concept of efficiency, which is defined by the relation between input and output. The Two Theorems, the purported proof of the

[2] Roughly quantified in Offer (1997).

invisible hand postulate, are not in fact such a great advance: the proof is clever and difficult, but it only obtains if there are always markets open for all goods and prices available to everyone until the end of time. Such conditions are not easy to satisfy. Furthermore, the criterion of Pareto efficiency is not particularly attractive (Bromley, 1990). The point of departure is a demonstration by Edgeworth that for two persons trading with each other there is a deal that maximises their joint payoff (in fact, the deal has such a single solution only under restrictive assumptions, and is otherwise indeterminate) (Mirowski, 1994, pp. 24-29). Likewise, in the two theorems of welfare economics, there is a general equilibrium (of all simultaneous trades in the economy) that maximises collective payoffs for every set of initial endowments. When the butcher and the baker are trading bread and meat in order to make their sandwiches, the joint maximum is easy to measure. But what units can be used to measure *everybody's* satisfaction or utility? How can we compare even the value of a single dollar, for the rich and for the poor? If it is 'willingness to pay', that surely depends on 'ability to pay', that is to say, on initial endowments and their ownership. The rich can always outbid the poor. And why should the property rights of the rich be taken as prior? As Bentham pointed out, property is created by society and depends on it (Bentham, 1838, vol. 1, pp. 307, 309). If one person has everything and everybody else has nothing, then welfare will be raised by redistributing from one to all, even at the expense of pre-existing claims.

The Pareto criterion of so-called efficiency endorses existing property rights and the status quo, and does not take into account what other distributions might be more equitable or could provide more welfare overall. Indeed, no objective criterion for maximizing welfare overall is provided. Every person is the sole judge of their own welfare. Every person has a veto, and can cry a halt. The criterion is undemocratic. It is equivalent in this respect to the principle of unanimity demanded by Public Choice advocates such as James Buchanan. And like Public Choice doctrine, its main effect is to provide legitimacy and protection for the existing distribution of property, however acquired, and however unequal.

But the pre-requisites even for this underwhelming notion of efficiency are non-existent. Kenneth Arrow (himself one of the two authors of the welfare theorems) has written that 'a complete general equilibrium system, as in Debreu (1959), requires markets for all contingencies in all future periods'. Another High Theorist (and Arrow's co-author), Frank Hahn, wrote that 'the complete market hypothesis is completely falsified' (Arrow, 1987, p. 72; Hahn, 1984, p. 121). John Williamson, the senior IMF economist who had coined the term 'Washington Consensus', has written,

> One does not have to be some sort of market fundamentalist who believes that less government is better government and that externalities can safely be disregarded in order to recognize the benefits of using market forces to coordinate activity and motivate effort. This is a proposition that is such a basic part of economic thinking *that it is actually rather difficult to think of a work that conclusively establishes its truth*. But there are a variety of indirect confirmations (Williamson, 2008, p. 26).

This is just it. Theorists agree that general equilibrium cannot be made to work (Ackerman and Nadal, 2004). A set of analytical results (Sonneneschein-Debreu-Mantel) from the 1970s showed that individual preferences could not be aggregated reliably into a unique and stable general equilibrium (Kirman, 1992). That markets are the best systems of delivery is not a universal truth, and depends on local circumstances. And perfection cannot be achieved incrementally. It is all or nothing. Short of the invisible hand there is only the 'Second-Best' (Lipsey and Lancaster, 1956). Even in theory, the economy does not improve incrementally as railways (for example) are privatized.

In classical economics from Adam Smith to John Stuart Mill, the object of policy was not the various interests of individuals, but the welfare of society. Smith insisted on the primacy of the common good over self-interest,

> The wise and virtuous man is at all times willing that his own private interest should be sacrificed to the public interest of his own particular order or society. He is at all times willing, too, that the interests of this order or society should be sacrificed to the greater interest of the state sovereignty, in which it is only a subordinate part (Smith, 1759 (1976) VI.ii.3.3, p.235).

Note the role for virtue and wisdom: man is not the slave of desire. He is capable of self-command, and of acknowledging a greater good beyond himself. This is also consistent with nineteenth-century Utilitarianism, an other-directed ethical doctrine endorsed by most English Victorian economists, whose precept was 'The Greatest Good of the Greatest Number'. Like Smith and Hume, Bentham, Mill, Jevons, Sidgwick, Marshall, Edgeworth, and Pigou also held a view not unlike the Stoic doctrine that, in the words of Smith,

> We should view ourselves, not in the light in which our own selfish passions are to place us, but in the light in which any other citizen of the world would view us (Smith, 1759 (1976), III.3.11, pp. 140-141).

In contrast, more recent economics makes a virtue of self-regard: it prides itself on being counter-intuitive. Concern for others is soft minded 'cheap talk'. It may be an ethical injunction, but that is only a 'value'. Those who want to understand the world are told to separate 'ought' from 'is'. Modern social science prides itself on 'Value Freedom' (Bromley, 1990, pp. 89-91). Scientists describe things as they are, not as they ought to be. But the tough-minded economist who has no time for ethics is also making an ethical stand. The Pareto-efficiency criterion has nothing to say about prior distribution, which it takes as given. It is silent about equity. That is an ethical position, which relies on the counter-intuitive assumption that well-being is entirely subjective and cannot be compared from one person to another. For Lionel Robbins, an influential exponent of neoclassical doctrine in the 1930s, 'me-first' was founded on the 'Indisputable Facts of Experience' (Sugden, 2009). Following on Robbins, in standard microeconomic theory, e.g. in the theory of household consumption, 'me-first' is simply taken as a premise which needs no justification.

But the facts of experience are no such thing. Others have different intuitions (Sugden, 2009). As an empirical postulate, self-interest is tautological: any choice observed can be attributed to self-interest. If, however, it means that everyone is always maximising a material or financial or market advantage, then it is manifestly untrue. The psychological model of unbounded self-regard is not credible. Friendship, love, loyalty, charity, patriotism, civility, solidarity, integrity, impartiality, which are ubiquitous and compelling, depend on the premise of unbounded self-regard being wrong. The family, religion, the workplace, the judiciary, the state, the nation, military service–some of the most powerful and enduring institutions assume that people will not always put themselves first. And values are not inscrutably subjective. The focal points of market prices and their elasticities indicate a broad social consensus on what is valuable. Market-liberals themselves have realized that for microeconomics to have any predictive power, it is necessary to assume that preferences are 'assumed not to change substantially over time, not to be very different between wealthy and poor persons, or even between persons in different societies and cultures (Becker, 1976, p. 5).' They have extended this into

macroeconomics with the device of 'representative agent', i.e. a model of the economy as a whole in which multitudes of people are assumed to act as one. And in advocating business-friendly de-regulation, market liberals are happy to use cost-benefit analyses based on 'willingness to pay', and have no problem aggregating dollars which have very different subjective values to different people.

Section IV

The self-regarding actor re-appeared in a particularly de-socialised guise in the 1940s. He featured in early game theory and in the Savage axioms of rationality, laid down in the 1950s. Duncan Black defined the self-seeking rational voter, and laid the foundation for Anthony Downs's *Economic Theory of Democracy* in the 1950s. In the 1960s, Mancur Olson argued the futility of collective action. By the 1970s, methodological individualism and rational choice had become the standard assumptions in economics and political science. These doctrines are so pervasive now that it is easy to overlook how radical they were initially. This 'selfish turn' may neutrally be described as sociopathic, i.e. inimical to social co-operation. In social science discourse, the criterion of common good was simply set aside. Rational choice theory does not even need to be blessed by the invisible hand (Elster, 2001). The 'hand' is bolted on as an afterthought.

There is a puzzle as to why, from the 1950s onwards, such an extreme form of self-regard should have beguiled academics in economics, political science, and philosophy, as being so manifestly self-evident. In evolutionary biology as well, the tide flowed from group to individual selection. Even John Rawls's *Theory of Justice,* the dominant work in moral and political philosophy, took individual self-interest, 'behind the veil of ignorance', as its point of departure. It is not generally known that Rawls was briefly a member of the Mont Pélerin Society. Rawls was put forward for membership by Milton Friedman in 1968, and withdrew from the Society three years later, before the publication of the *Theory* in 1971.[3] In keeping with the Society's orientation, Rawls privileges 'freedom' as the highest good. Many other philosophers and political scientists have followed his lead. But other social sciences, notably sociology, anthropology, and psychology, maintained a sceptical distance, and earned the disdain of 'tough-minded' rational choice colleagues.

Maybe this posture of 'toughness' is a clue. Decisiveness can be attractive, and it is only a short step to extol the rough virtues of manliness. In American culture in particular, 'toughness' is held out as a virtue. A robust Social Darwinism coexisted in nineteenth-century America with an intense religiosity – indeed the two were regarded as being complementary. Success was Godly, failure deserved (Hofstadter, 1955).[4] The British gentlemanly ideal was the opposite: self-control rather than self-assertion, 'gentility' rather than hardness (Girouard, 1981; Mason, 1982).

Toughness is worthy of admiration when it signifies the ability to *endure* pain. But in the social and political rhetoric since the 1970s, toughness has mutated into a willingness to *inflict* pain: the rhetoric is 'hard choices' (hard for me to hurt you), 'cruel to be kind' or more directly 'if it ain't hurting, it ain't working'. When combined with a license for self-seeking, such 'toughness' might well inspire wariness rather than admiration.

The ideal of 'freedom' is associated with toughness, to the extent that it means a 'rugged' independence, 'standing on one's own feet'. Freedom has an exalted lineage in the historical struggle against religious oppression and in resistance to external and domestic tyranny. The historical quest for

[3] Mont Pelerin Society, Proposals for Membership, September 1968, Mont Pelerin Society Papers 44/1, Hoover Institution Archives; Mont Pelerin Society, 'List of Members' [1970], Friedman Papers 87/5, Hoover Institution Archives; Mont Pelerin Society, list of lapsed members, 1972, Friedman Papers 87/2.

[4] Especially chapter 3 on William Graham Sumner.

freedom is replete with martyrdom. In the European tradition of Rousseau and Kant, 'freedom' is also about the scope for moral or personal autonomy. In the Anglo-Saxon tradition, however, it stands primarily for the security of property rights, although both other meanings are implied as well (MacPherson, 1962; MacGilvray, 2011). In the American and British traditions, 'freedom' was compatible with the ownership of slaves: indeed, it dignified the ownership of slaves (Brown, 2010a, 2010b). Chicago economist Robert Fogel won the Nobel Prize in part for a book that argued that slavery was 'efficient' (Fogel and Engerman, 1974). No Pareto efficiency veto for the slaves; no more than for the subjects of the Pinochet dictatorship, lauded for its market liberalism and advised by Milton Friedman and James Buchanan. For market liberals, freedom does not extend to speech: both the Mont Pélerin Society and the Chicago Department of Economics, the sectarian incubators of market liberal thought, have restricted access to those with like-minded opinions and have not gone out on their way to debate with their critics. Protection of property is commonly conflated with individual autonomy and discretion, although possession of property and freedom for some, as Bentham once recognised, limits the freedom of others. In the market discourse of the 20th century, 'freedom' has become just another term for self-interest, ubiquitous on right-wing mastheads. As in the case of 'toughness', personal virtue has transformed into social license: freedom from tyranny has mutated into freedom from obligation. In its more extreme from, as among the followers of Ayn Rand, it is a kind of juvenile revulsion from parental tutelage – indeed, 'paternalism' is one of the freedom advocates' greatest evils.

For all its rhetoric of freedom, neoclassical economics, at both micro and macro level, is not comfortable with actual choice. In microeconomic consumer theory, the agent has a set of innate preferences. He or she is presented by reality with a complete set of opportunities, prices and their probabilities. Given their immutable preferences and the information they have, consumers can only make one choice, the one that maximises their preferences. They have no more discretion than a piece of clockwork. This rigid determinism leaves no room for ethical choice, and justifies any outcome as being inevitable. Likewise, at the macro level, policy-making is delegated to so-called 'independent' central banks with a rigid and narrow mandate, to achieve a given rate of inflation. Even that discretion is a concession designed to hold down the unruly pressure of wage demands. When it comes to asset prices, no intervention is warranted at all. In other words, one rule for labour, another for capital.

In reality choice is never so easy. In contrast with the premises of deterministic economic modelling, a good deal of the future is unknowable, and time- inconsistent discounting means that choice is often genuinely intractable, with no optimising algorithm available (Offer, 2006, ch. 3). In the face of such imponderables, choices still have to be made (Bhide, 2010). This indeterminacy opens up room for genuine discretion, including an ethical choice, for 'doing the right thing'. In the absence of clockwork procedures, people fall back on established commitment devices, which allow them to place a larger conception of welfare beyond what might seem to be their own immediate interests. These commitment devices are established social conventions and strategies which often embody ethical norms, and which make it possible to overcome myopic preferences. Examples of this at a personal level are marriage, education, insurance, prudence, and patriotism; at the social level, constitutions, law, religion, money, calendars and clocks, government, and taxes. Before the relativism of Robbins and his amoral successors, the utilitarian doctrines of Victorian economists were also commitment devices of this kind.

Many of these commitment devices can be thought of as 'ethical capital'. They form a reliable inventory of expectations about how people are likely to act. They underpin trust and facilitate exchange. They economise on monitoring and enforcement. Ethical capital takes us back to Adam Smith, the impartial spectator, and the assumption of innate virtue.

Seen this way, the 'selfish turn' of the 1960s and 1970, the rise and acceptance of rational choice doctrines, constituted a wholesale destruction of ethical capital, an episode of normative

demolition. ‘Freedom’ has a transcendental appeal in American culture and politics. But for a self-regarding rational individualist, it comes down to calculation: how much self-seeking is it useful to allow, if the same license is available to others. The choice depends on socio-economic standing: freedom from obligation is more valuable to the rich and powerful than to others, because there is more for them to lose.

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Mathematics, Science and the Cambridge Tradition

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Abstract

In this paper the use of mathematics in economics will be discussed, by comparing two approaches to mathematics, a Cartesian approach, and a Newtonian approach. I will argue that while mainstream economics is underpinned by a Cartesian approach which led to a divorce between mathematics and reality, the contributions of key authors of the Cambridge tradition, like Marshall, Keynes and Sraffa, are characterised by a Newtonian approach to mathematics, where mathematics is aimed at a study of reality. Marshall was influenced by the Newtonian approach that still characterised many aspects of the Cambridge Mathematical Tripos, where the emphasis was on geometrical and mechanical examples rather than on symbolic (Cartesian) mathematics. Keynes, who criticised (Cartesian) symbolic mathematics, was indeed an admirer of Newton and of his method. Sraffa's mathematical constructions are also in line with the Newtonian approach where arithmetic and geometry were strictly separated, since Sraffa's mathematical constructions typically use arithmetic without engaging in the mixture between geometry and arithmetic that occurs in the Cartesian approach.

Keywords: Mathematics, realism, ontology, Cambridge tradition, Newtonianism.
JEL classification: A12, B41, C02

Introduction

This article aims to establish three theses. The first thesis is that since the modern age started there has been a tension between a Cartesian approach to mathematics, and a Newtonian approach to mathematics. The second thesis is that contemporary mainstream economics is characterised by a Cartesian approach to mathematics, which indeed became the dominant approach to mathematics, leaving the Newtonian approach in the shadow. The third thesis is that central authors of the Cambridge tradition in economics, like Alfred Marshall, John Maynard Keynes, and Piero Sraffa, are closer to the Newtonian conception of mathematics than to the Cartesian conception of mathematics.

I shall start by explaining the first thesis, concerning the distinction between the Cartesian approach to mathematics, where geometry and arithmetic (and thus algebra too) are not carefully separated, and the Newtonian approach to mathematics, where geometry and arithmetic (and thus algebra too) are kept carefully separated. I will then move to the second thesis showing that mainstream economics is characterised by a Cartesian algebraic approach, and then defend the third thesis, showing how a Newtonian approach, in which there is a strong interplay between mathematics and reality, was once dominant within the Cambridge tradition.

This interplay, and the search for mathematical truths that can be known with certainty, led to a tension between a given philosophical conception of reality, and the search for certainty through

mathematical methods, which characterises the work of Marshall (and exists also in Newton's work). This tension springs from the incompatibility between an ontological conception of reality where the latter constitutes an open system, and the limitations that mathematical methods which aim at certainty face in such situations.

Mainstream economists eliminated this tension by embracing a conception of mathematics where the latter is divorced from reality (following a Cartesian conception, which in mathematics culminated in Hilbert's program and the Bourbaki school, and in economics led to the general equilibrium analysis of Kenneth Arrow, Gérard Debreu and Lionel McKenzie). Keynes resolved this tension by focusing on the open nature of social and economic reality. This led Keynes to replace the search for certainty in logical relations for a conception where statements can be known with a given degree of probability (given the available evidence), and where the probability distribution may not even be represented numerically (unless in case of exhaustive, exclusive and equal-probable alternatives). In Keynes' conception, the open nature of social and economic reality means that we are typically in a situation of uncertainty, and not of certainty, as will be argued here.

Sraffa also provides an example of the Newtonian approach, since one of the characteristics of the latter is a strict separation between geometry on the one hand, and arithmetic and algebra on the other hand. This separation does not exist in the Cartesian approach. Sraffa's mathematical constructions, by drawing upon arithmetic without simultaneously drawing upon geometrical notions like a continuous line full of real numbers when showing the existence of (or indeed constructing) the main notions used in his work, maintains the Newtonian emphasis on the separation between geometry and arithmetic.

Cartesian and Newtonian Approaches to Mathematics

As Immanuel Kant argued, our pure intuition of space provides us the subjective conditions of possibility for our representation of geometrical figures, while our intuition of time, and of the process of counting through time, brings us the series of natural numbers. Hence, spatial figures are our primary elements in geometry, while natural numbers are our primary elements in arithmetic, and also in algebra. Indeed, algebra can be seen as a development of arithmetic that emerges when arithmetic operations are applied to both sides of an equation, and thus an arithmetical operation performed on one side of the equation has also to be applied to the other side of the equation, balancing the equation by restoring the equality between the two sides.

The separation between geometry and arithmetic (or algebra), that existed until Descartes, can then be seen as a natural consequence of the fact that these two fields are built upon these very different notions, geometrical figures on the one hand, and natural numbers on the other hand, which according to Kant come from different sources of our intuition (namely, space and time, respectively).

But when Descartes introduces numbered axes into geometry (the famous Cartesian coordinates) we have a mixture of these two fields, which emerges in the Cartesian approach, and was criticised by Newton. Michael Atiyah argues that Newton and Descartes follow two different traditions within mathematics where the relative weight of each of these two fields, geometry and algebra, is very different:

> "Geometry and algebra are the two formal pillars of mathematics, they are both very ancient. Geometry goes back to the Greeks, and before; algebra goes back to the Arabs and Indians, so they have both been fundamental to mathematics, but they have

> had an uneasy relationship. Let me start with the history of the subject. Euclidean geometry is the prime example of a mathematical theory and it was firmly geometrical, until the introduction by Descartes of algebraic co-ordinates, in what we now call the Cartesian plane. That was an attempt to reduce geometrical thinking to algebraic manipulation. This was of course a big breakthrough or a big attack on geometry from the side of the algebraists. If you compare in analysis the work of Newton and Leibniz, they belong to different traditions, Newton was fundamentally a geometer, Leibniz was fundamentally an algebraist." (Atiyah 2005: 655)

Newton thought that geometry, the study of figures produced by mechanical constructions, should be kept separate from arithmetic, which is the study of numbers and the operations associated with it. Thus, when Descartes introduces algebraic coordinates into geometry, he is mixing the two fields that Newton thought should be kept separate.

Indeed, the implications of the Cartesian method are very deep, and raise enormous issues, which are still being discussed today. The Cartesian axes presuppose the idea of a line where a real number can be attributed to every point of the line. We are in the habit of calling this line the "real line", which we take to be a continuous line, since no space is left between the points that constitute it, and thus those infinite points of the real line are "already there", rather than being constructed through arithmetical approximation.

However, it was not through this notion of a "real line" that we first reached the set of real numbers. Rather, it was from arithmetic that we got there. For example, if we start from a purely arithmetical procedure, performing various operations such as addition, subtraction, multiplication and division of natural numbers, we reach the set of rational numbers, which includes not only integers, but also the fractions of one integer by another. By engaging in more operations we may also ask ourselves what is the number that multiplied by itself will lead to a given number, for example to the number two. The number that satisfies such a condition is, of course, what we call the square root of two. But we will then find that this number, the square root of two, is not part of the set of rational numbers, since we cannot find any fraction of natural numbers that is exactly equal to it. Thus we have found an irrational number. It is through the performance of arithmetical or algebraic operations like this that we reach irrational numbers, and add them to rational numbers in order to reach the set of real numbers.

But from an arithmetical perspective, it would be misleading to take the set of real numbers as something that is "already there". Rather, those numbers are obtained through algorithmic procedures of approximation, through operations on natural numbers. We cannot know exactly the square root of two in any way other than computing further decimal cases through arithmetical operations of approximation. However, when we mix arithmetic with geometry as Descartes did, we are easily inclined to accept the idea that the irrational numbers are "already there" in the "real line", since we see the line as a continuous line, taking however the notion of continuity from the geometrical line, not from the arithmetic where the numbers (that we place in the geometrical line) came from.

In short, since the emergence of the Cartesian approach where geometry and arithmetic are not separated, we are in the habit of seeing the real line as being made up of real numbers, which include also irrational numbers like the square root of two. But how can we think of such numbers as being already there in the real line, if we cannot identify any of these numbers outside the context of an arithmetical procedure of approximation? A solution that emerged in the Cartesian approach is to think of points in the "real line" as possibilities, rather than an actual number. This leads to the notion of a variable, that is, a possibility of various numbers, rather than an actual number, which was developed by

Descartes. A variable starts indeed to be seen as an existing entity, while before Descartes only actual numbers (and not possible numbers such as a variable) would be seen as a mathematical object.

The differences between Newton and Leibniz regarding differential calculus are also related to the distinction between geometry and algebra. Leibniz, who was in the tradition of Descartes, had the aim of 'formalising the whole of mathematics, turning it into a big algebraic machine' (Atiyah 2005: 655). Newton saw essentially two problems with Leibniz's approach. First, the use of infinitesimals in Leibniz's differential calculus. An infinitely small quantity is not something that we can conceive in our mind as an existing entity. Rather, it is the result of an algorithmic procedure undertaken indefinitely (effectively, "infinite" means something that is not finite, that does not end, and is thus "indefinite").

In fact, Leibniz himself emphasised how this algorithmic operation was the more important part of his calculus, since he wanted to keep mathematics free from philosophical problems. Infinitesimals would thus be not an entity, but rather the shorthand for an algorithmic operation. But because Leibniz and his followers were drawing upon the Cartesian tradition where geometry and algebra are not separated, it became easy to interpret the "infinitesimally small quantity" as a Cartesian variable in a "real line", and thus as an entity, rather than as the name of an operation, as probably Leibniz would have wanted.

This leads to the second problem with Leibniz's approach. This problem springs from the fact that even if Leibniz could avoid the mixture of geometry and algebra by taking his calculus to be an algorithmic procedure where infinitesimals are only a name for an operation rather than a variable, for Newton an algorithmic procedure is only a method to find truth, not a rigorous demonstration that provides a construction of the problem. That is, for Newton, only through geometry can we "show" truth, and algebra is only an instrument to get close to truth through a process of approximation. And Leibniz's infinitesimals, either interpreted as an entity or as an expression for abbreviating reasonings, are never an exact finite quantity. And thus, even assuming that Leibniz could successfully separate arithmetic from geometry avoiding the problem of whether infinitesimals are a real entity in a line, he was still using the less appropriate method: arithmetic, rather than geometry. For arithmetic can lead to the solution only through successive approximation, while geometry would provide an exact demonstration that does not work through particular symbols, as Leibniz's calculus, but through areas and lines without resorting to symbolic calculus that can only proceed through analytical approximation.

There are other reasons for Newton's position. The fact that geometry provides a more natural method, that can be used more intuitively than symbolic calculus was also important for Newton, since for him mathematics should provide a description of Nature that could also be easily explained to the non-mathematician. Note that Newton valued not only the fact that a demonstration could be more accessible to the non-mathematician through geometry rather than through symbolic calculus, but also the fact that geometry can more easily describe Nature, where we find continuous motion as in the mechanical process of drawing geometrical figures.

Furthermore, it is certainly true that given Newton's voluntarist philosophy, in which the universe is always open to the intervention of God, he would not like the idea of turning the world (or God) into an algorithmic machine. But this latter issue is a side issue, since Leibniz did not want to mix philosophy with mathematics, and Newton's own criticism of Leibniz focuses on the mathematics too, rather than on the philosophical divergences.

From Algorithmic Arithmetic to Set Theory

While the Newtonian approach remained the dominant approach in Cambridge and England after Newton's death, the European continent was dominated by the Cartesian perspective. Within the European continent, the tension which resulted from the Cartesian mixture between geometry and algebra remained. Surely, many mathematicians, from Carl Friedrich Gauss (an admirer of Newton) to Leopold Kronecker, were able to keep a rigorous separation between geometry and arithmetic. But the use of Cartesian coordinates to represent geometrical figures that became widespread contributed to blur the distinction between the strictly arithmetic operation of approximation of any real number by a rational number, and the strictly geometrical representation of a continuous line.

But once we juxtapose the arithmetical operations over natural numbers with the geometrical notion of a line, as the Cartesian coordinate axes do, a problem emerges. Because strictly arithmetical operations over natural numbers can only lead to a rational number, and rational numbers are only a subset of the real numbers that constitute the continuous real line, when we juxtapose the smaller set of rational numbers over the larger set or real numbers that constitutes the "real line", there will be "holes" left unfilled in the real line. For although we can approximate a real number by a rational number as close as we want through an algorithmic procedure, we will never be able to reach the real number in a finite number of steps.

Richard Dedekind suggested that we fill those "holes" through a procedure known as "Dedekind cut". A Dedekind cut provides a partition of rational numbers into two non-empty subsets. The cut can be a rational number that belongs to one of the subsets, and sections the set into two subsets. But imagine that one of these two subsets is not complete, and has an open interval, such that it may have no rational number as its lowest element (if it is the subset of rational numbers higher than the cut) or no rational number as its highest element (if it is the subset of rational numbers lower than the cut). In any of those situations, the "cut" which divides the two non-empty subsets of rational numbers must be an irrational number. Thus, according to Dedekind, the cut creates a new irrational number, which is completely defined by the Dedekind cut. Since for every Dedekind cut we have either a rational number or an irrational number, we may fill the real line through these cuts with the rational numbers and irrational numbers that were missing, and achieve a continuous "real line" with no "holes".

This procedure is clearly grounded in the Cartesian mixture between geometry and arithmetic, since the idea of cutting a line appeals to geometrical intuition. The cuts which are being used to fill the real line with numbers are thus inspired in our geometrical intuition, but are employed in order to fill the gaps of the real line where a rational number could not be placed.

Dedekind's procedure allows one to simply posit the existence of any given real number, defined by the cut, rather than indefinitely approximating it through arithmetical operations on natural numbers. But once we are allowed to simply posit the existence of a mathematical entity, rather than obtaining it through indefinite arithmetical approximation, new perspectives emerge for mathematics.

In fact, if an indefinite algorithm can be substituted by an existing entity, it is not only the infinite decimal cases of a real number that can be taken as given (rather than approximated through arithmetical operations on natural numbers), but also the infinite itself that can be taken as given. That is, rather than focusing on the indefinite procedure of counting, which generates as many natural numbers as we want, we can simply take the infinite set of natural numbers as an existing entity. And the same can be said of the set of even numbers, or rational numbers, or real numbers. This is what Georg Cantor did. But Cantor saw that once we take those sets as given, all the infinite numbers they contain must be "already there". This led to an approach that treats infinite sequences as if they were finite.

Note that if we choose to count only a finite quantity, for example until ten, we can see that the set of natural numbers obtained is constituted by ten elements, while the set of even numbers obtained will be constituted by five elements. Thus, when dealing with these two finite sets, we can say that the latter set is smaller than the former set. But once we take the infinite number of members of those sets to be already given too, we will then see that the set of even numbers also contains holes that can be filled with other natural numbers (namely the odd numbers), that the set of natural numbers has holes that can be filled with other rational numbers (namely the fractional numbers), and that the set of rational numbers has holes that can be filled with other real numbers (namely the irrational numbers). In other words, we can establish a correspondence between elements of those sets and see that one set contains all elements of the other, but not vice-versa. Thus Cantor concludes that there are infinities of different cardinalities.

We would not be led to this conclusion if we had simply taken infinity to mean an indefinite algorithm of construction of numbers, in which case we would not compare algorithms which operate indefinitely on different sets of numbers. But once we take mathematical entities like numbers to be "already there", for example in a "real line" (a geometrical line populated by numbers), we will reach this type of conclusion.

In fact, the Cartesian method is at the origin of this type of conclusion, since it was the Cartesian method which led us to posit the existence of various points that can be numerically juxtaposed to a geometrical line, thus bringing in the notion of a variable, which leads us to posit the existence of an arbitrary number, rather than to construct an actual number through arithmetical approximation.

The assumption of the existence of arbitrary numbers started to play an important role in mathematical proofs, for example Bolzano's proof of the result that if a continuous function has a negative image for a given number, and a positive image for another number, and the function is continuous between those two numbers, then its image must have passed through zero at some point, or for some number (notice the mixture between arithmetic and geometry used in the proof through simultaneous references to numbers, and to geometrical points, or to the intuition of a geometrical line crossing the Cartesian axis of the abscissas). These types of existence proofs allow us to proceed by assuming arbitrary numbers or variables (and mixing geometry with arithmetic) without first constructing the actual numbers we would need for the proof.

Before the end of the nineteenth century these ideas were not fully clear. Remember that Leibniz seemed to see his symbols as operations too, rather than actual entities, while nevertheless calling them infinitesimals and treating them as variables. But after Cantor, symbols are already being explicitly used as actual entities, rather than as shorthand for a process of construction. Cantor's set theory is a development enabled by the Cartesian method, which would however be seen as seriously misguided if we adopt the Newtonian strict separation between geometry and arithmetic.

Of course, the mathematicians who followed the Cartesian approach tried to establish foundations for their conclusions which would go beyond the contradictory ideas that emerge when mixing geometry and arithmetic. In the initial approach to set theory adopted by Cantor, sets were treated intuitively as arbitrary collections of elements, which could be defined extensively (in terms of their elements) and according to a given abstract property. But this led to paradoxes, such as the one found by Bertrand Russell, when noting the consequences of defining the set that has the property of having as its elements all the sets that are not a member of themselves. When asking if this set is a member of itself, we reach the contradiction that if it is not a member of itself, then it must be a member of itself, and vice-versa. Russell's paradox led to an abandonment of a more intuitive approach to set theory, which also had implications for the way in which we approach the real line.

The Cartesian procedure presupposes that the Cartesian axis is ordered, and indeed there have been attempts to establish the continuity of the real numbers over the real line without resorting to intuitive geometrical analogies that are foreign to arithmetic and algebra, for example by assuming that the set of real numbers is well-ordered, and thus we can order it to obtain a continuum, hence leaving no "holes" in the middle. Ernst Zermelo, who had also found independently the paradox formulated by Russell, provided a theorem according to which the elements of a set can be well-ordered, and thus the real numbers could be well-ordered too, thus apparently solving the problem of the rigorous definition of a "real line" which arises from the Cartesian methodology, without however having to appeal to geometrical intuition.

Cantor found that the assumption that the elements of a set can be ordered is indeed essential. Julius König, however, argued that it is not possible to order the set of real numbers. König noted that the set of numbers which can be finitely constructed is a subset of the set of real numbers. But if we could order the set of real numbers, there would be a first number which is not finitely definable within this ordering. But the rule "find the first number which is not finitely definable" provides a way to define this very number in a finite way (in a finite number of steps), and thus the number was finitely definable after all, leading to a contradiction.

Besides König, other mathematicians who opposed Cantorian set theory were Henri Poincaré and Émile Borel, but the opposition had started earlier with Kronecker, who famously argued that God created only the natural numbers, and everything else is constructed by human beings. Kronecker's claim entails that real numbers, and indeed all numbers other than natural numbers, are not "already there", and must rather be constructed through algorithmic processes of approximation. L. E. J. Brouwer is usually seen as the founder of the constructivist approach which already underpinned Kronecker's contribution, However, with Brouwer the term "intuitionism" is also often used, due to the fact that the constructivist approach starts from entities which are claimed to exist in our pure intuition (following Kant). These include geometrical figures, (which come from our intuition of space) and natural numbers (which arise through our intuition of time).

Brouwer's approach to mathematics influenced the philosophy of mathematics developed by Ludwig Wittgenstein. Wittgenstein was highly critical of Cantor's set theory precisely because it posits as existing entities what Wittgenstein sees as a rule of indefinite approximation. Mathematics, for Wittgenstein, is characterised by a given rule that we apply. Thus, for Wittgenstein arithmetic is, just like geometry, a process of construction according to a rule. Arithmetic simply operates with whatever is posited at the beginning of the operation. Thus if we start our operations with natural numbers, we will not end up with real numbers, but only with rational approximations to it, because no rule can lead from rational numbers to real numbers.

Cantor's set theory revolutionised mathematics, and provided a development of the Cartesian mixture between geometry and algebra. One way out of the problems raised by the Cartesian methodology would be the one suggested by Newton, which consisted in returning to the ancient mathematical tradition where geometry and arithmetic were fully separated. But another way out, developed first by Dedekind and afterwards by Cantor and Zermelo, consisted in finishing Descartes numbering of the real line, filling in the places that could not be filled by operations on natural numbers. This is what Dedekind, Cantor and Zermelo did. And because their approach simply posited mathematical entities, mathematics was already complete with its own entities which only had to be found (rather than being a permanent process of construction), and had no need to be compared with an external reality.

The term "Platonism" is often used to denote an approach where mathematical entities like those are posited. However, the term is unfortunate, since unlike this contemporary mathematical "Platonism",

Plato and the Platonists did not accept any mathematical entities into the realm of Platonic ideas other than geometrical figures and natural numbers which are, furthermore, kept separated, since Plato and the Platonists accepted a strict separation between geometry and arithmetic.

It is indeed this old Greek tradition that Newton is trying to recover. And in this ancient tradition that Newton recovers, geometry and arithmetic are kept separated, and are also separately applied to the study of Nature. In the Newtonian approach, geometry and arithmetic are two separate methods of construction according to a rule (to use Wittgenstein's term), which remain mere tautologies until they are applied to a given reality, such as the study of Nature.

In the Cartesian approach, in contrast, mathematics is not only a method of (geometrical or arithmetical) construction, as in the Newtonian approach, but it is a study of existing mathematical entities, which are generated by the mixture between geometry and algebra. But since mathematics already possesses its own entities in the Cartesian approach, there is a tendency to feel that there is no need of applying it to further external entities, such as an external reality. Just like Descartes argued that philosophy must proceed through pure reasoning which is not connected to empirical reality, so did Cartesian mathematics develop in a formalist fashion that is separated from empirical reality, in contrast with the Newtonian approach where mathematics was a study of Nature. Indeed, the term "formalism" is often employed to denote mathematical developments of the Cartesian approach.

The Cartesian and Newtonian Approaches within Economics

The Newtonian approach is often misunderstood, and taken to be formalistic too. But as Tony Lawson (2003: 263-264) notes, this happens because the successes of Newton's mathematics were interpreted in France in Cartesian terms, and not as evidence that mathematics can be most useful when it takes into account the nature of the reality under study. The differences between the Scottish Enlightenment, where Newtonianism was interpreted as a study of Nature which is concerned with empirical reality, and the French Enlightenment, where Newtonianism was interpreted as a reduction of Nature to Cartesian mathematics, are symptomatic of this difference. The Cartesian approach to mathematics that prevailed in France shifted the attention towards the mathematical formal structure of Newton's theory, and neglected the way in which the study of Nature, of an external reality, influenced the development of such a theory.

The French Bourbaki school, which Atiyah (2005: 655) identifies as the twentieth century heir of the Cartesian approach, is indeed an example of this type of approach, which inspired central contributions to mainstream economics like Gérard Debreu's (1959), in a context where economics (like Cartesian mathematics), became concerned with possible realities, and not with actual reality itself – see Dow (2003) or Lawson (2003: 271-273). In order to understand the use of mathematics in mainstream economics, it is essential to understand that it was the Cartesian approach to mathematics that became dominant within mainstream economics, leading to a conception where reality is neglected.

This was the Cartesian approach to mathematics towards which Jean-Baptiste Say was hostile. And it was the approach which ultimately accepted the work of Léon Walras and the marginalists. But within this approach, there was no attempt to combine marginalism with classical political economy as Alfred Marshall arguably attempted to do. In fact, classical political economy was rejected, leading to the uncritical use of mathematico-deductivist methods that took place within mainstream economics in the twentieth century, as we shall see.

It is thus no surprise that contributions characterised by a mathematico-deductivist approach, of authors like Debreu (1959), are considered as the more elaborate and admirable achievement of

economic theory within mainstream economics. Within this approach, many theorems rely on the continuity of the "real line" established by Dedekind, Cantor and Zermelo, especially within fixed point theorems where the continuity of the real line is assumed, rather than (algorithmically and arithmetically) constructed (and we find a reliance on the existence of arbitrary numbers, i.e. variables, rather than constructing the actual numbers needed for the proof).

While mainstream economics is best characterised in terms of a mathematico-deductivist methodology (see Lawson, 2003), it is true that most mainstream economics subscribes also to the theoretical principles of marginalism, which pioneered the use of mathematical methods in economics. And marginalism is often identified with what is today called *neoclassical economics*. This identification, together with the fact that there is much overlap between mainstream and marginalism, leads many to refer to "neoclassical economics" as the dominant economic perspective.

However, this use of the term "neoclassical economics" is a misleading one. After the marginalist revolution, Marshall (1890) developed a conception which seemed to many to be a way to make marginalist theory compatible with classical political economy, leading to an approach which was thus termed by Thorstein Veblen (1900) as neo*classical*, in order to distinguish it from the approach of Carl Menger (which inspired Austrian economics). In fact, Keynes (1936) considered Marshall's "neoclassicism" to be a continuation of classical economics. In so doing, Marshall initiated the Cambridge economic tradition, shaped by his contribution (see Harcourt, 2003), while Marshall's (1890) *Principles of Economics* became the canonical economics textbook not only in Cambridge, but in many other economics departments.

The fact that Marshall attempted to establish continuity with Smith, Ricardo and John Stuart Mill does not mean that he succeeded. In fact, as Pierangelo Garegnani (1998, 2005) explains, Smith and Ricardo did not analyse value in terms of the interaction between supply and demand, as Mill and Marshall did. It was Piero Sraffa who, after having criticised Marshall's approach, which had been developed by Pigou – Sraffa (1925, 1926) – recovered the classical theory of value of Smith, Ricardo and Marx, beginning to develop it after the end of 1927, in a project which led to Sraffa's (1960) revival of classical political economy.

Most of Sraffa's work remains unpublished. In fact, as Annalisa Rosselli (2005: 405) notes, Sraffa writes, in a letter to Charles Parrish Blitch (dated October 6, 1975), that "in economic theory the conclusions are sometimes less interesting than the route by which they are reached", which signals how Sraffa was more concerned with the process of discovery rather than with the publication of results. But if we take Smith and Ricardo as the key authors of classical political economy, as Marx did (rather than Stuart Mill's version of it), then it is Sraffa (and not Marshall), who really engages in a continuation of classical political economy.

The Cambridge economic tradition is divided into various streams, including not only the Marshallian stream, but also the Keynesian and Sraffian streams, which emerged with the critique of Marshall undertaken by Keynes and Sraffa. But there is one aspect of Marshall's work which remained throughout the Cambridge economic tradition, namely Marshall's realist approach, which contrasts with Walras's use of mathematics. As Joseph Schumpeter argues:

> "Just as Walras, more than any other of the leaders, was bent on scraping off everything he did not consider essential to his theoretical schema, so Marshall, following the English tradition, was bent on salvaging every bit of real life he could possibly leave in." (Schumpeter 1994: 974)

This difference between Walras and Marshall shows itself in the fact that while Marshall thought that mathematical analysis should be left out of the main text of a book (as he did in his work), mainstream economics, following the Walrasian approach, evolved in a way where mathematical analysis became the central aspect of any mainstream economics textbook.

In fact, the use of mathematics in Marshall, and in the Cambridge tradition, is very different from the mainstream (Cartesian) use of mathematics. Marshall and the Cambridge tradition were much influenced by the Newtonian approach to mathematics. It is true that after 1815 at least, the Cartesian approach was gaining ground in Cambridge too, and Marshall himself uses an approach to differential calculus that is highly influenced by the Leibnizian (Cartesian) approach. But as Simon Cook (2009) explains, the Cambridge Mathematical Tripos that Marshall undertook still contained many elements which remained from the Newtonian approach, such as an emphasis on geometrical and mechanical problems, rather than on symbolic algebra. This is not unrelated to the fact that, for many years, Cambridge and England followed the Newtonian approach, while the Cartesian approach was already dominant in the European continent.

The Search for Certainty

As noted above, Newton was concerned with providing a foundation for science which takes into account the nature of reality, which was also a central concern for Marshall. However, Newton was also very concerned with achieving certainty. As Guicciardini (2006: 1736) explains, "from the early 1670s [Newton] expressed his distaste for the probabilism and hypotheticism that was characteristic of natural philosophy", since mathematics should provide certainty to natural philosophy.

However, as Guicciardini (2006: 1736) also notes, there was a tension in Newton's perspective, for while "Descartes was the champion of an impious mechanistic philosophy (...), Newton conceived himself as a restorer of an ancient, forgotten philosophy according to which nature is always open to the providential intervention of God", and thus, this "led Newton into a condition of strain, since his philosophical values were at odds with his mathematical practice, which was innovative, symbolical, and – pace Newton – deeply Cartesian."

Guicciardini (2006: 1736-1737) continues:

> "Several hitherto unexplained aspects of Newton's mathematical work are related to this condition of stress and strain that characterizes his thoughts on mathematical method. Why did Newton fail to print his method of series and fluxions before the inception of the priority dispute with Leibniz? Why did he hide his competence in quadratures when writing the *Principia*, which are written mostly in geometrical style? Even though there is no single answer to these vexed questions, I believe that Newton's conviction that the analytical symbolical method is only a heuristic tool, not 'worthy of public utterance', can in part explain a policy of publication which was to have momentous consequences in the polemic with Leibniz."

There is an interesting similarity between the explanation that Guicciardini (2006, 2009) gives for Newton's postponement of the publication of his work, and the explanation that Stephen Pratten (1998) provides for Marshall's failure to finish the second volume of his *Principles*. Pratten (1998) argues that it was the tension between Marshall's vision of reality, and his use of a mathematical method which was inappropriate for analysing such reality, that prevented Marshall from achieving a satisfactory second volume, that would reconcile the statical method used in the first volume with the dynamical approach

that was to be developed in the second volume – see also Neil Hart (2004) for an explanation of this tension in terms of the relation between theory and history in Marshall.

The tension in Marshall's approach is often connected to the fact that while Newtonian physics inspired much of the first volume of the *Principles*, Marshall notes that the Mecca of every economist lies in biology. It may however also be the case that for Marshall mathematical physics and biology were not so far apart, for in the mathematical appendix (note XI) of the Principles Marshall writes:

> "There is more than a superficial connection between the advance made by the applications of the differential calculus to physics at the end of the eighteenth century and the beginning of the nineteenth, and the rise of the theory of evolution. In sociology as well as in biology we are learning to watch the accumulated effects of forces which, though weak at first, get greater strength from the growth of their own effects; and the universal form, of which every such fact is a special embodiment, is Taylor's Theorem" (Marshall 1920[1890]: 694)

Taylor's theorem is named after Brook Taylor, who was at Cambridge at the same time as Newton (and in fact was part of the committee that decided Newton's dispute with Leibniz). This cannot be seen however as further evidence of the influence of the Newtonian approach in Marshall, since this theorem is used by mathematicians of both (Newtonian and Cartesian) approaches, and indeed Marshall often uses Leibniz's notation. Marshall follows the broad realist approach that characterises the Newtonian approach, but his mathematics, like his economics, reveal a tension between method and reality.

The reference to the Taylor series again shows how before "burning the maths", as Marshall said one should, mathematics would also drive much of the research. Here there is an interesting parallel with Newton, who believed that algebra was useful to help us reach a conclusion, but should afterwards be discarded. In both cases, of Newton and Marshall, there is a tension between an underlying philosophical vision, and method. This tension led Newton to continuously revise his methods, which were initially much inspired in Descartes, and Marshall to continuously revise the second volume of the *Principles*, which remained unpublished. The attempt to find certainty in an uncertain reality can well be the source of this tension.

Keynes (1936) later criticised the Marshallian framework of the *Principles*, as developed by Arthur Cecil Pigou (1920), initiating the Cambridge Keynesian tradition (on which see Harcourt, 2003, or Pasinetti, 2005). In fact, after Keynes' (1936) contribution, the Cambridge economic tradition became divided between what may be termed as the Cambridge 'welfare' tradition, which followed Marshall and Pigou, and the Cambridge Keynesian tradition, which rejected the neoclassical framework of Marshall and Pigou. But Keynes' overall conception contrasts not only with the Marshallian neoclassical framework, but also with Newton's search for certainty.

In fact, Keynes' tries to transcend the tension generated by the search for certainty by resorting to an original conception of probability – see Lawson (1985b), Carabelli (1985) and Runde (1994, 2003). Keynes (1921) argues that even when we cannot establish an exact law that relates two propositions with certainty, there is still a logical relation between the two propositions, namely the probability relation, wherein a given conclusion is always related to a given premise with a given probability.

But this does not mean that this probability can be quantified through a numerical value. The numerical value of this probability can only be known in the case of exclusive, exhaustive and equi-probable alternatives, as Lawson (1985b) and Anna Carabelli (1985) explain. This led Keynes (1921) to replace certainty for uncertainty, and exactness for probability, leading to a radically new conception –

see Lawson (1985a). Carabelli (1985: 167) writes that "Keynes seemed to see his work on probability as a sort of anti-*Discours de la méthode*, based on probability, ordinary discourse and common sense rather than on certainty and on analytical reason". Thus, Keynes's conception was a definitive rejection of the Cartesian project.

It is important to understand the differences between Keynes' conception of probability, and the mathematical approach to probability of authors like Bernoulli, Pascal and Huyghens. As Carabelli (1985: 159) explains, Keynes was very unhappy with the conception of probability of authors like Bernoulli, Pascal and Huyghens, who assumed the principle of equal probabilities when there was no sufficient reason to think otherwise. This assumption was fundamental to enable the mathematical treatment of probability, but led one to assume a numerical value without any basis for such, an assumption which Keynes found unsatisfactory. Newton was also against this mathematical approach to probability which characterises the work of Bernoulli, Pascal and Huyghens, due to the lack of a basis for such a mathematical treatment. As Guicciardini (2006: 1736) explains, this led Newton to criticise the mathematical theory of probability:

> "… by the help of philosophical geometers and geometrical philosophers, instead of the conjectures and probabilities that are being blazoned about everywhere, we shall finally achieve a science of nature supported by the highest evidence." (Newton translated and cited in Shapiro 1993, 25)

So like Keynes, Newton was very hostile to the mathematical treatment of probability of his time, which can be found in the contributions of Bernoulli, Pascal and Huyghens. Keynes treatment of probabilities, and his rejection of such mathematical treatment of probability, resolves the tension created by the search for mathematical certainty, avoiding a "condition of strain" that characterised the Cambridge mathematical tradition inspired by Newton, and subsequently the Cambridge economic tradition inspired by Marshall.

Keynes achieves this through a conception where probability is grounded on ordinary language and common sense, and not on Cartesian certainty. Keynes' idea of grounding probability on ordinary language was in fact similar to Newton's approach to mathematics in many ways. As Guicciardini (2006) notes, Newton was satisfied only when his conclusions could be supported by geometrical demonstrations which were "worthy of public utterance". This is, indeed, one of the reasons why Newton wants to keep geometry separated from arithmetic, while using geometry for his proofs: the ability to communicate mathematical results using geometrical methods that can be visualised by everyone without resorting to symbols which may not be clearly understood. For example, concerning the squaring of the curves (what today we call integration, following Leibniz), Newton writes:

> "After the area of some curve has thus been found, careful considerations should be given to fabricating a demonstration of the construction which as far as permissible has no algebraic calculation, so that the theorem embellished with it may turn out worthy of public utterance." (Newton, as cited in Guicciardini 2006: 1734-1735).

This neglect of algebraic calculation after using it can be said to be the Newtonian equivalent of Marshall's "burning of the maths" after using it to reach his results. And like Newton, Marshall also wanted to present his economic theory in a language that was "worthy of public utterance", and thus mathematics is left to the appendix of Marshall's *Principles*. The use of ordinary language that is "worthy of public utterance" continued to play a central role in the Cambridge tradition in the twentieth century, in

authors like Moore, Keynes and Wittgenstein, who emphasised the importance of common sense – see John Coates (1996) for a discussion.

The Babylonian Method

As Gay Meeks (2003: 26-28) explains, Keynes was influenced by Hume on this issue. In the Scottish Enlightenment, in which Hume and Smith were central figures, common sense played indeed an important role, as Flavio Comim (2002) explains. Furthermore, unlike the Continental Enlightenment (much influenced by Cartesian pure mathematics), the Scottish Enlightenment interpreted Newton focusing more on his realist approach where common sense played a central role, as Comim (2006) and Leonidas Montes (2006) argue. And thus Keynes' interpretation of Newton can also be seen in light of his reading of Hume, which shows why it is only natural that Keynes was concerned with grounding his work on probability in ordinary language, just like Newton also was concerned with geometrical demonstrations "worthy of public utterance".

This approach ultimately led Keynes to a realist approach to economics, in which he criticised the use of mathematical methods in economics. Keynes argued that economic phenomena are not homogeneous through time, and thus mathematical methods which presuppose the contrary are inappropriate – see Lawson (2003). If we take a Newtonian approach to mathematics to mean a concern with the nature of reality, Keynes can be said to maintain what was termed above as a Newtonian approach to mathematics, in the sense that, for Keynes, mathematics must conform to the analysed reality, in opposition to a Cartesian approach to mathematics where reality (and empirical data) are neglected, which characterises mainstream economics.

In fact, if the Newtonian tradition was already fading away in Marshall's time, vestiges of it remained not only in Marshall's time, but even beyond. After Marshall, we still find Keynes (1936: 297-298) showing a dislike for symbolic mathematics (or as he called it, "symbolic pseudo-mathematical methods") too. Keynes provides the following critique of the use of symbolic mathematics:

> "The object of our analysis is, not to provide a machine, or method of blind manipulation, which will furnish an infallible answer, but to provide ourselves with an organised and orderly method of thinking out particular problems; and, after we have reached a provisional conclusion by isolating the complicating factors one by one, we then have to go back on ourselves and allow, as well as we can, for the probable interactions of the factors amongst themselves. This is the nature of economic thinking. Any other way of applying our formal principles of thought (without which, however, we shall be lost in the wood) will lead us into error. It is a great fault of symbolic pseudo-mathematical methods of formalising a system of economic analysis … that they expressly assume strict independence between the factors involved and lose all their cogency and authority if this hypothesis is disallowed; whereas, in ordinary discourse, where we are not blindly manipulating but know all the time what we are doing and what the words mean, we can keep "at the back of our heads" the necessary reserves and qualifications and the adjustments which we shall have to make later on, in a way in which we cannot keep complicated partial differentials "at the back" of several pages of algebra which assume that they all vanish. Too large a proportion of recent "mathematical" economics are mere concoctions, as imprecise as the initial assumptions they rest on, which allow the author to lose sight of the complexities and

> interdependencies of the real world in a maze of pretentious and unhelpful symbols." (Keynes 1936: 297-298)

Thus, Keynes is explicitly aware of the fact that reality is a interconnected system, and that symbolic mathematics often leads us to use symbols which presuppose that the various components of reality are independent (a closed system characterised by constant conjunctions of the form "if event X then event Y", as Lawson, 2003, notes).

It is not only in Marshall and Keynes, but also in Sraffa, that we find a conception of mathematics in which we must not "lose sight of the complexities and interdependencies of the real world in a maze of pretentious and unhelpful symbols". Sraffa's (1960: vii) insistence on making his argument "easy to follow for the non-mathematical reader", while ignoring the "expert advice" which recommended the use of a different notation (surely one conforming to the symbolic Cartesian approach to mathematics that became dominant), is a consequence of the adoption of a different approach to mathematics by Sraffa too.

Furthermore, even amongst the mathematician who helped Sraffa the most, we find a dislike for purely formal algebra. Amongst the mathematicians mentioned by Sraffa (A. S. Besicovitch, F. P. Ramsey, and Alister Watson), it was Besicovitch who helped Sraffa the most in the writing of his book, as Sraffa (1960: vi) acknowledges. And in the following letter of Besicovitch to Sraffa dated from October 1, 1957, he writes:

> "Dear Sraffa, I have tried to do your problems, but I found myself quite incapable. It is not your fault – you set up the problem quite clearly, but it is just that I could not make myself think on this kind of stuff. *I am at my worst on purely formal algebra*. The problem may by quite easy." (Besicovitch, as cited in Kurz and Salvadori 2007: 188-189, my emphasis-NM)

Thus, the mathematician who helped Sraffa the most is surely not in the formalistic algebraic tradition, and indeed notes that he is at its 'worst' on 'purely formal algebra.' Besicovitch was a student of Andrei A. Markov, who engaged in a separation between geometry and arithmetic, which was to be stressed even more by his son, Andrei A. Markov Jr., who originated the Russian school of constructivist mathematics. We have no evidence, however, at least so far, of whether Besicovitch discussed these issues with Sraffa, or of whether Markov (the father) discussed these issues with Besicovitch.

Furthermore, even Andrei A. Markov Jr. adopted an explicit contructivist approach only later in life (although claiming that he had such an approach in mind for a long time). Wittgenstein, who discussed frequently with Sraffa, was also critical of set theory. Wittgenstein saw both geometry and arithmetic as two different processes of construction according to a rule, where mathematical entities are not simply posited as in set theory, as noted above. This topic could easily have emerged in the discussions between Sraffa and Wittgenstein, but we can never be sure of this, see Davis (1988, 2002) and Sen (2003).

In fact, more convincing evidence of Sraffa's approach to mathematics is provided by Sraffa's (1960) own usage of mathematics. Sraffa's own proofs of the existence of the standard system, the standard commodity, and the reduction to dated quantities of labour, presuppose an algorithm where we find a construction, rather than an appeal to theorems that rely on continuity of a "real line" (such as fixed point theorems) which characterise the Cartesian approach to mathematics.

Many mainstream authors (for example Paul Samuelson) believe that Sraffa's analysis presupposes constant returns to scale, since otherwise the construction of his results consists only in the

indication of a rule or process of approximation, rather than in an exact solution that can be obtained through algebraic manipulation. But if Sraffa did adopt a perspective where geometry and arithmetic are kept separated, even the construction of real numbers can only be a rule or process of approximation, and the indication of a rule or process of approximation is all that is needed from a theoretical standpoint. Going further would require empirical analysis, since pure mathematics is not sufficient.

Thus, there is no need to assume constant returns to scale when developing the standard system, the standard commodity, or when approaching the reduction to dated quantities of labour. We do not need an exact proof. Rather, an indication of the rule of construction is all that is needed (as Wittgenstein would say), especially because only empirical reality can tell us the nature of the returns to scale. And thus we can see why it is not only the classical economic theory developed by Sraffa, but also the mathematical methods employed by Sraffa, that do not necessitate the assumption of constant returns to scale.

Vela Velupillai (2008) argues precisely that Sraffa had a constructivist approach to mathematics, although Velupillai focuses more on Errett Bishop's approach (who was more concerned with showing how the Cartesian approach could be expressed in constructivist terms) than on Brouwer's approach (which influenced Wittgenstein) or on the Russian constructivist school of Markov (the son). The Russian constructivist school developed an algorithmic conception while stressing more the differences to what is termed here as the Cartesian approach.

In this constructivist literature, the Cartesian approach to mathematics, developed to its current stage by Cantor, is often termed "classical" mathematics. Of course, the term "classical" mathematics is misleading in this context, since the label "classical" would be more appropriate for the ancient approach that Newton was trying to recover (curiously, just like the term "neoclassical" economics would be more appropriate for the old theory of value that Sraffa was trying to recover). But this ancient approach that Newton develops does not go back only to classical Greece, but beyond, to the Babylonian and Sumerian mathematicians. Indeed Keynes, who engaged in a study of Newton's works (many of which he bought), famously concluded that:

> "Newton was not the first of the age of reason. He was the last of the magicians, the last of the Babylonians and Sumerians" (Keynes 1963: 310)

If the "age of reason" means an age concerned only with Cartesian pure thought, then Newton was certainly an author who had a broader conception of reality. Based on Feynman's (1965) notion of "Babylonian mathematics", and on Keynes' (1963) writings on Newton, Sheila Dow (1990) uses the term "Babylonian method" to designate the methodology of the Keynesian tradition, arguing that this method, charaterised by the use of multiple strands of argument with different starting points, was also used by classical political economists from Smith to Marx.

Dow (1990) argues that mainstream economics, in contrast, is characterised by Cartesian deductivist methods, which are only a particular case of the Babylonian methodology. This is in fact the key difference between the approach to mathematics that underpins mainstream economics, and the one that underpins other approaches from classical political economy to the Cambridge economic tradition.

The point to note here is not whether any modern mathematician or economist was ever able to return to the ancient separation between geometry and arithmetic that Newton was trying to recover. Arguably even Newton himself was still influenced by the Cartesian mixture between geometry and algebra too. And so were the Cambridge economists, who certainly did not dedicate as much time to think about mathematics as Newton did.

Thus, as noted above, Marshall often used Leibnizian notation in the mathematical appendix of the *Principles*, Keynes also uses Leibnizian notation when defining the marginal propensity to consume, and Sraffa indeed uses Cartesian graphs ocasionally not just to represent his results (as Marshall also does), but also to show that in single product industries, when the rate of profit increases, the rate of fall of prices cannot exceed the rate of fall of wages (Sraffa also uses Cartesian graphs to prove the opposite in multiple product industries).

The point to note is that there is a distinction between those that fully embraced the Cartesian approach (where mathematics becomes self-sufficient with its own entities and realities generated by the mixture between geometry and arithmetic), and those for whom mathematics is only a method, or a rule, that generates results to be applied to an external reality. With all their inconsistencies, the Cambridge economists stood on the realist (Newtonian) side, while mainstream economic theory became dominated by a Cartesian approach where mathematics is detached from reality, for the reasons to be further elaborated in the next section.

The Mathematisation of Economics

In the twentieth century, Keynes and Jan Tinbergen engaged in a debate concerning the merits of econometrics, which was then an emerging field. This was a debate in which Keynes criticised the use of econometrics and the mathematisation of the discipline, noting how symbolic mathematics leads us to treat a complex world as if it were composed of independent parts – see Lawson (1985b, 2003).

It is also in this period that game theory emerged, first with the contribution of John von Neumann and Oskar Morgenstern (1944), and soon after with the contribution of John Nash (1951). This is also the moment where Milton Friedman (1953) argued that realism is not necessary for economic theory. And it is at this time that Kenneth Arrow and Gérard Debreu (1954) developed Walrasian general equilibrium analysis, an endeavour to which Lionel McKenzie will also contribute much.

The approach to mathematics that became dominant in this process was the Cartesian approach, where the mixture between continuous geometrical lines and algebraic coordinates can be readily seen in the assumption of continuity used in Arrow and Debreu's (1954) proof of existence of a general equilibrium, which also resorts to arbitrarily small variables akin to Leibniz's infinitesimals, that are simply taken as existent entities.

Another example is Nash's use of the fixed point theorem (which apparently was an obvious procedure to Von Neumann) which again relies on continuity of a function, and the assumption of the existence of equilibrium at a given point which is not constructed. But in this Cartesian approach the existence of mathematical entities is simply assumed, without a contrast of the methods used with an external reality. Rather, mathematics is concerned only with its own realities, following the tendency initiated with set theory, that can be seen in turn as a natural consequence of the mixture between geometry and arithmetic that emerged with Descartes.

In this Cartesian approach, mathematics becomes divorced from reality, and concerned only with possible realities that can be addressed in a formalistic and deductivist way, as it was the case with the "Bourbaki" school that became a very influential school of mathematics in the twentieth century. As Lawson (2003) explains, it is the later approach to mathematics that characterises mainstream economics. In this approach, mathematics is used in a deductivist way, for it attempts to reduce economics to a formalistic approach that presupposes closed system regularities. If the influence of mathematicians like Von Neumann or Nash was pointing in this direction, the contribution of Debreu, and

his formalisation of general equilibrium theory, is one of the clearest examples of this approach. Thus Lawson writes:

> "Although Debreu's *Theory of Value* was produced after his move to the US Cowles Commission in the 1950s, Debreu was very much a product of the French Bourbaki 'school' (a group of French mathematicians who argued that mathematical systems should be studied as pure structures devoid of any possible interpretations). It was at the Ecole Normale Supérieure in the 1940s that Debreu came into contact with the Bourbaki teaching. And once trained in this maths, but with his interests aroused by economics, Debreu sought a suitable location to pursue an interest in reformulating economics in terms of this mathematics. It is perhaps not insignificant that his move to the Cowles Commission coincided with the latter's effective acceptance of Bourbakism." (Lawson 2003: 273)

And even when attempts are made to apply mathematics to reality within mainstream economics, as in econometrics, we find a wide gap between econometric theory and econometric practice, as Edward Leamer (1983: 37) points out, where "hardly anyone takes anyone else's data analysis seriously" – see Lawson (2003: 11) for a discussion.

The consequences that Marx extracted from classical political economy concerning the distribution of the surplus also contributed to the definite abandonment of classical political economy, as a reaction to Marx, as Sraffa believed (on which see Garegnani, 2005). But it also had consequences for the acceptance of the Bourbaki approach to mathematics:

> "In particular the emergence of McCarthyite witch-hunts in the context of the Cold War significantly affected the developments in which we are interested. In this climate, the nature of the output of economics faculties became a particularly sensitive matter. And in such a context, the project of mathematising economics proved to be especially attractive. For it carried scientific pretensions but (especially when carried out in the spirit of the Bourbaki approach) was significantly devoid of any necessary empirical content." (Lawson 2003: 274)

This approach to mathematics divorced from reality contrasts with the approach of Newton, which was very influential in Cambridge at a time when the Cartesian approach (concerned with abstract symbols, rather than concrete reality) was increasingly dominant in the European continent.

Given the increasing importance attributed to mathematical-deductivist methods in line with the Cartesian approach, Lawson (2003) argues that mainstream economics is indeed now best characterised by the uncritical acceptance of mathematical-deductivist methods. It is important to note that Lawson is not criticising the use of mathematics in general, but only a particular type of use, namely the Cartesian use of mathematics, disconnected from a concern with reality. Thus, Lawson writes:

> "It is not, and has never been, my intention to oppose the use of formalistic methods in themselves. My primary opposition, rather, is to the manner in which they are everywhere imposed, to the insistence on their being almost universally wielded, irrespective of, and prior to, considerations of explanatory relevance, and in the face of repeated failures. (Lawson 2003: xix)"

Concluding Remarks

Mainstream economics has its origins in the mathematical approach of Walras (1874) and Jevons (1871), and in the marginalist revolution which, despite the efforts of Menger and Marshall, ultimately led to the abandonment of a realist approach to economics. The crucial moment occurred in the twentieth century however, with the econometric revolution, the appearance of game theory, and general equilibrium models. The latter, and especially the work of Debreu (1959), contains the more elaborated version of the Walrasian project, which maintains a Cartesian approach to mathematics, and contrasts with the Newtonian approach to mathematics.

The great success of natural sciences like physics led mainstream economists to believe that mathematico-deductivist methods are essential for economics to become a science. But while natural scientists construct closed systems in laboratory experiences so that physical and chemical phenomena may be exactly measured through mathematico-deductivist methods (or address systems that are relatively closed in our lifespan, such as celestial bodies), mainstream economists posit that human agents behave in a rational, exact and predictable way, so that similar mathematico-deductivist methods can similarly be used in a supposedly "scientific" way, while ignoring the nature of the underlying reality.

Central authors of the Cambridge economic tradition, like Marshall, Keynes, and Sraffa, adopted a different approach to mathematics, which is not deductivist, and existed already in Newton. Marshall's method, based on physics, still constrained him from developing consistently his insights regarding evolutionary biology, and the correspondent idea that reality is an organic process. Keynes went further in his elaboration of an economic theory where the economy is an organic whole. And Sraffa's approach certainly takes into account the economy as a whole, while showing the limitations of Marshall's partial equilibrium analysis.

There were, of course, many differences between the specific economic theories of Marshall, Keynes and Sraffa. But if a coherent framework is to be found in the Cambridge economic tradition, it can be found at the level of ontology, within a conception where reality is an organic *process*. Other characteristics, like a Newtonian approach to mathematics, are a consequence of an attempt to analyse this reality, which also leads to the need for diverse methods, and thus to what Dow calls a "Babylonian" approach. This approach contrasts with mainstream economics, where unity is found at the level of the method, a method which consists in Cartesian deductivist mathematics, as Lawson (2003) and Dow (1990, 2003) argue.

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Walter Eucken on Patent Laws: Are Patents Just 'Nonsense upon Stilts'?

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Abstract

As recent newspaper headlines show the topic of patents/patent laws is still heavily disputed. In this paper I will approach this topic from a theoretical-historical and history of economic thought-perspective. In this regard I will link the patent controversy of the nineteenth century with Walter Eucken's Ordoliberalism – a German version of neoliberalism. My paper is structured as follows: The second chapter provides the reader with a historical introduction. At the heart of this paragraph are the controversy and discourse on patent laws in nineteenth century Europe as well as the pro and contra arguments presented by the anti-patent/free-trade movement respectively by the advocates of patent protection. The focus of my paper is on the struggle for the protection of inventions and innovations in nineteenth century Germany, since Walter Eucken, main representative of the Freiburg School of Law and Economics, picks up the counter-arguments presented in the national debate and in particular by the *Kongress deutscher Volkswirthe*. The third chapter deals intensively with the question whether patent laws are just 'nonsense upon stilts' from an ordoliberal perspective. Here, Eucken's arguments against the current patent system are elaborated in great detail. The paper ends with a summary of my main findings.

Keywords: Patents/patent laws, nineteenth century patent controversy, Ordoliberalism, Walter Eucken.

1. Introductory Remarks

'Apple-Samsung patent war', 'Oracle-SAP patent showdown', 'Microsoft-Google copyright infringement' and 'Samsung-Microsoft patent alliance versus Google': these have been some recent headlines in the news all over the world.[1] Within Europe there is currently an ongoing debate about the introduction of European-wide patents, about patents on pharmaceutics and (generic) drugs, groceries (Monsanto) and in particular about patents on genes, so called 'biological patents'. As the headlines as well as the public debates show the topic of patents/patent laws is still heavily disputed. In this paper I will approach this topic from a theoretical-historical and history of economic thought-perspective. In this regard I will link the patent controversy of the nineteenth century with Walter Eucken's Ordoliberalism – a German version of neoliberalism.

My paper is structured as follows: The second chapter provides the reader with a historical introduction. At the heart of this paragraph are the controversy and discourse on patent laws in nineteenth century Europe and the pro and contra arguments presented by the anti-patent/ free-trade

[1] Cp. for more information with regard to the ongoing 'patent arms race': Boldrin/Levine 2012.

movement respectively by the advocates of patent protection. The focus of my paper is on the struggle for the protection of inventions and innovations in nineteenth century Germany, since Walter Eucken – main representative of the Freiburg School of Law and Economics – picks up the counter-arguments presented in the national debate and in particular by the *Kongress deutscher Volkswirthe*. The third chapter deals intensively with the question whether patent laws are 'nonsense upon stilts' from an ordoliberal perspective. Here, Eucken's arguments against the current patent system are elaborated in great detail. The paper ends with a summary of my main findings.

2. Historical Overview: The Discourse on Patent Laws in the Nineteenth Century

A patent is an exclusive right and in some sense a privilege and monopoly of temporary duration granted by a state-run institution to an inventor or someone who has succeeded in the formal application and examination procedure. In recent times, patents are an essential type of intellectual property rights (cp. Agreement on Trade-Related Aspects of Intellectual Property Rights, TRIPS). The word 'patent' itself originates from the Latin verb *patere* which means 'to reveal', 'to expose' or 'to lay open'; usually it is often translated as 'open letters' or 'letters patent' (*litterae patentes*) referring to the openness for public inspection and public availability often granted by a royal decree or document.

Here, it is not the right place to study the different types of patents and to distinguish between patent, copyright, trademarks and utility model/*Gebrauchsmuster* in particular. In addition, it is not the main aim of this paper to review the whole history of patent laws: milestones in the history of patent laws include the Patent Law of the Republic of Venice dating from 1474, the *Statute of Monopolies* (1624) – the '*Magna Charta* of the protection of inventions'[2] –, the 1791/93 patent acts of France and the United States, the so called Prussian *Publikandum* of 1815[3], the first *International Patent Protection Congress* as part of the Vienna World Fair (1873)[4], the *Reichspatentgesetz* of 1877 (German Patent Act) laying the foundation for the German patent system and implementing the German Patent Office[5], and finally, the 1883 *Paris Convention for the Protection of Industrial Property*[6] as the starting point of the still ongoing process of internationalization and harmonization of national laws. Instead, the focus of the following parts of this paper is on the nineteenth century patent controversy[7] which was at its height between 1850 and 1873; the regional focus is on the German discourse on patents in the second half of the nineteenth century. In this regard, it is essential to analyze the international anti-patent movement[8] as well as the free-trade movement in the tradition of Adam Smith (i.e., both groups were loyal followers of the ideas of Smith – although Smith himself was not a direct opponent of patent laws; instead he accepted certain forms of patents (cp. WN Book V, Chapter 1, Part III, 119)).[9] Of particular importance in the present context are the arguments of the patent advocates presented by the *Verein deutscher Ingenieure* (Association of German Engineers) and the *Deutscher Patentschutzverein* (German Patent Protection Association) as well as the counter-arguments of the anti-patent movement presented by the *Kongress*

[2] Machlup/Penrose 1950: p. 2; see Machlup 2000 and Pfaller 2008.
[3] Cp. Pfaller 2008.
[4] Cp. Seckelmann 2006: pp. 155.
[5] Cp. Boch 1999: pp. 71; Kurz 2000: pp. 372.
[6] Cp. Kurz 2000: pp. 469; Pfaller 2008.
[7] Cp. Machlup/Penrose 1950: pp. 3.
[8] Cp. Kurz 2000: pp. 350; Pfaller 2008.
[9] Other important economists justifying patents are for example Friedrich List (*Das nationale System der politischen Ökonomie*), Jeremy Bentham (*Observation on Parts of the Declaration of Rights, as Proposed by Citizen Sieyes*: p. 533), and John Stuart Mill (*Principles of Political Economy*: Book V, chapter X, p. 932). All just mentioned philosopher-economists justify patents by highlighting the differences between patents and monopolies; according to them, patents have nothing in common with monopolies and they are justified as a means of rewarding the inventor's expense and risk (cp. Machlup/Penrose 1950: pp. 7).

deutscher Volkswirthe (Congress of German Economists) and John Prince-Smith, an English-born German economist and politician and one of the outstanding advocates of free-trade in Germany and beyond. As we will see, the patent controversy revolves mainly around the arguments put forward by three German associations and the quarrel between them; one of these institutions was even founded for this particular reason.

Among these alliances was the *Kongress deutscher Volkswirthe*[10] founded in 1858 in Gotha. The main aim of this association of German economists was to promote (economic) liberalism, deregulation and free-trade and to fight protectionism. Inspiring example and role-model was the free-trade and laissez faire Manchester school and especially the Anti-Corn Law League established in 1838 by Richard Cobden, John Bright and George Wilson. The publication organ of the Congress was the *Vierteljahresschrift für Volkswirthschaft und Culturgeschichte.* Important figures of the Congress of German Economists were *Karl Braun*, politician and long-time president of the Congress, *Viktor Böhmert*[11], economist and journalist, *Rudolf Delbrück*, head of the chancellery, *Julius Faucher*, journalist, *Wilhelm Adolf Lette*, social policy maker and jurist, *Otto Michaelis*, political advisor of Delbrück, *Hermann Schulze-Delitzsch*, economist and politician, and especially *John Prince-Smith* (1809-1874), economist, Member of Parliament of the German National Liberal Party (1871-74) and one of the leading figures of the German anti-patent movement.[12] With the advent of the rising international protectionism at the end of the nineteenth century the Congress lost more and more influence – chapter 2.1. will deal with the reasons for this sudden disappearance and for the reversal of opinion in great detail. As a consequence the Congress was soon to be dissolved in 1885. Remarkable is the fact that the Congress of German Economists was *the* central counterinstitution of the German *Verein für Socialpolitik* (Social Policy Association) founded in 1873 and gathering around Gustav Schmoller and Adolf Wagner. Furthermore, the Congress was linked with the (German) free-trade movement and with the anti-patent movement (1850-1873). The opponents of patents were above all supporters of free-trade and vice versa. Characteristic features of the Congress and the anti-patent movement were a far reaching belief in progress and economic growth, the speaking up for Smith's invisible hand theorem, the self-regulation of markets and the harmonious economic society, and moreover, the agitation against any form of state interventionism. The movement's main aim was the entire abolition of the whole patent system including all patent laws and similar forms of monopoly-like privileges.

The pro-patent movement's[13] main associations on the other hand were the *Verein deutscher Ingenieure* and the *Deutscher Patentschutzverein*. The technical association *Verein deutscher Ingenieure* (Association of German Engineers (VDI))[14] was founded in 1856. The main representatives of this association were Rudolf Klostermann, Eugen Langen, Carl Pieper[15] and Franz Wirth. The *Deutscher Patentschutzverein* (German Patent Protection Association)[16] instead was founded in 1874. The main aims of these two organizations were the (state-run) promotion of inventions and innovations, the prevention of the abolition of patent laws and other measures restricting the protection of inventions. Additionally, both institutions were campaigning for overcoming the fragmented and trade-inhibiting patchwork of diverse patent laws in the different German provinces; especially after the foundation of the German Empire in 1871 they were agitating for the unification of German economic laws and in particular

[10] Cp. Boch 1999: pp. 72; Seckelmann 2006: pp. 139.
[11] Böhmert compares patents to 'rotten fruits on the tree of civilization which are ripe to fall' (Böhmert 1869: p. 34).
[12] Cp. Prince-Smith 1843; 1845; 1848; 1863; 1877; 1879 and 1880; see also Hentschel 1975; Boch 1999: p. 73; Kurz 2000: pp. 354; Seckelmann 2006: pp. 140.
[13] Cp. Kurz 2000: pp. 361.
[14] Of special importance in this regard were the VDI memoranda *Zusammenstellung der leitenden Principien eines allgemeinen deutschen Patentgesetzes*, published in 1862, and *Zur Patentfrage* (On the Patent Question) published in 1864; see also Siemens' memorandum *Promemoria*; cp. Boch 1999: pp. 75; Seckelmann 2006: pp. 144.
[15] Cp. Pieper 1873.
[16] Cp. Boch 1999: pp. 71; Seckelmann 2006: pp. 163.

a harmonized, nationwide patent legislation for all of the member states of the German *Zollverein* (German Customs Union). Above all the German Patent Protection Association rendered itself conspicuous when preparing a patent draft bill which provided the basis for the 1877 German Patent Law.

One of the main figures of the VDI and the German Patent Protection Association was *Werner von Siemens*[17], German inventor and industrialist, founder of the electrical and telecommunication corporation Siemens and first chairman of the German Patent Protection Association. Siemens and other German industrialists like Borsig and Krupp embody the primacy of entrepreneurial interests within the pro-patent movement. Moreover, Siemens was one of the key-figures in the run-up to the first uniform nationwide German Patent Act in 1877. Due to his eminent influence on (patent) legislation, the German 1877 patent law for the entire Reich is often referred to as the *Charta Siemens*.[18]

2.1 Patents: Arguments and Counter-Arguments

What were the main arguments put forward in the nineteenth century patent controversy? First of all, we have to consider the *pro-arguments*: Four types of arguments justifying and legitimizing patent rights may be separated: the (natural) property right in ideas argument, the just reward for the inventor argument, the best incentive to invent argument and the (social) contract theory argument.[19]

1. According to the (natural) *property right in ideas argument*, each invention is an intellectual property of the inventor comparable to a physical entity owned by a person; intellectual property is similar in its logical nature to material property. Or to put it differently: "A man has a natural property right in his own ideas. Their appropriation by others must be condemned as stealing. Society is morally obligated to recognize and protect this property right. Property is in essence exclusive. Hence enforcement of exclusivity in the use of a patented invention is the only appropriate way for society to recognize this property right."[20]
2. The *just reward for the inventor argument* highlights the necessity of an appropriate (pecuniary) reward and a sufficient compensation and recompense for the inventor's (time-consuming and costly) efforts[21], for the useful services rendered to society as a whole and as a return for the assumed increase in social welfare. In addition, these kind of moral arguments refer to a common sense of fairness and 'justice as fairness' (Rawls) by pointing at the importance of a fair equivalent between give and take, between service and return service.
3. A major pre-condition for economic growth and the overall prosperity of a society is the innovation ability of a country. In order to foster and stimulate inventions, innovations and technical progress and as a consequence the 'wealth of nations', it is advisable to promote

[17] Cp. Gispen 1999: pp. 7; Häusser 1999: p. 16; Boch 1999: pp. 71 and pp. 77; Kurz 2000: pp. 368.
[18] Cp. Kurz 2000: p. 382.
[19] "The four types of argument are independent of one another. Any one of them may be upheld if the other three should be rejected. The first two are based on ethical norms, the last two on political expediency. The first is anchored in conceptions of natural law, giving the inventor a natural right to protection; the second calls for protection in the name of fairness to secure the inventor his just reward. The third, resting on the assumption that not enough inventions would be made and utilized without adequate inducements, recommends patent protection as the best inducement. The fourth, fearing the loss of inventions through secrecy, recommends patent protection as a means of inducing disclosure and publicity" (Machlup/Penrose 1950: p. 11); see also Ammermüller 1846; Emminghaus 1858 and Machlup 1964.
[20] Machlup/Penrose 1950: p. 10. This jusnaturalistic justification of intellectual property rights which are in this sense similar to human rights is in a way problematic: How can we justify (intellectual) property rights or generally speaking human rights which are only conditional and limited to a certain period of time? As we all know, patents are awarded for a limited period of time.
[21] Smith for example justifies patents on that basis. He argues that temporary monopolies granted to an inventor by the state may be justified as a means of rewarding expense and risk (cp. WN Book V, Chapter 1, Part III, 119).

ingenuity, entrepreneurial spirit, inventive talent and in general the innovative skills of the individuals. One way of promoting the economy in such a way is via education and science policy; another one contains the granting of patents (i.e., *best incentive to invent argument*).[22]

4. The (social) *contract theory argument* which is linked with transparency and disclosure arguments (i.e., *best incentive to disclose secrets*) reads as follows: Inventors and innovators enter into a hypothetical social contract: society as whole grants exclusive rights and security against (commercial) imitation and plagiarism while the inventor agrees to disclose the secrets behind the innovation. The argument is based on the assumption that without patent laws the secrets would be kept and not revealed (i.e., secret-mongering). With the help of patent laws innovations are now released and the public gains access to most recent technological knowledge. As a consequence, knowledge will be widely dispersed (i.e., diffusion of know how) and the technological gap will be overcome respectively the lead through technology will extend.[23]

These kinds of reasons coupled with commercial motives and monetary interests were alleged by the *Verein deutscher Ingenieure* (Association of German Engineers), the *Deutsche Chemische Gesellschaft* (German Chemical Association) and the *Deutscher Patentschutzverein* (German Patent Protection Association) during the patent controversy in the nineteenth century.

The *arguments* presented by the free-trade movement[24] *against patent protection* on the contrary comprise the following ones:[25] the free-trade argument, the re-feudalization argument, the 'patents as obstacle to progress argument', and the 'invention as an intellectual common property argument'.

Free-trade argument (1.): According to the anti-patent advocates, patents promote the monopolization of the economy due to the fact that they enhance the granting of exclusive privileges; patent laws are linked with monopoly privileges. To put it differently: patent privileges equal monopoly privileges! From that perspective patents as exclusive rights or 'intellectual monopolies' restrict the freedom of trade. The focus of the free-trade movement lies on self-regulation and, as the name implies, on free commerce; they are supporting the removal of all regulations on the free movement of capital, goods and labour and they are questioning all forms of exclusive rights to monopolize. Patents in this regard are regulations on the free movement of goods, they are tariffs and in the end they are barriers to free-trade.

Linked with the free-trade argument are two other arguments favouring the abolition of patent laws: a) patents are an institution of protectionism; b) patents are a means of enforcing market power. According to the protective tariff or *infant industry argument* picked up by Alexander Hamilton, Daniel

[22] "Industrial progress is desirable to society. Inventions and their exploitation are necessary to secure industrial progress. Neither invention nor exploitation of invention will be obtained to any adequate extent unless inventors and capitalists have hopes that successful ventures will yield profits which make it worth their while to make their efforts and risk their money. The simplest, cheapest, and most effective way for society to hold out these incentives is to grant exclusive patent rights in inventions" (Machlup/Penrose 1950: p. 10)." Continental writers were prone to take the rapid industrialization of England and the United States plus the fact that these nations had patent systems as sufficient grounds from which to infer a causal relation between patents and progress. On the other hand, there were some German and Swiss economists who attributed industrial progress in their countries to the absence of effective patent protection. […] The main thesis demonstrating the beneficial effects of patents rested on the following assertions: (1) industrial progress is desirable, (2) invention is a necessary condition of industrial progress, (3) not enough inventions will be made or used unless effective incentives are provided, (4) patents are the cheapest and most effective means of providing these incentives" (Machlup/Penrose 1950: p. 21).

[23] "Industrial progress is desirable to society. To secure it at a sustained rate it is necessary that new inventions become generally known as parts of the technology of society. In the absence of protection against immediate imitation of novel technological ideas, an inventor will keep his invention secret. The secret will die with him, and society will thereby lose the new art. Hence it is in the interest of society to induce the inventor to disclose his secret for the use of future generations. This can best be done by granting exclusive patent rights to the inventor in return for public disclosure of his invention" (Machlup/Penrose 1950: p. 10).

[24] Cp. Kurz 2000: pp. 315 and pp. 350.

[25] Cp. e.g. Emminghaus 1858; Machlup/Penrose 1950; Machlup 1964.

Raymond, Friedrich List and others, new or infant industries which in their early stage are not able to compete with their older and well-established competitors need protectionist help by the state in order to develop. One way of granting such help is via patents. In this sense, patents enhance protectionism and the relapse into a mercantilist era: patents are holdovers from an old regime and they are a relic of pre-modern times such as mercantilism and feudalism.

Moreover, and most severe, patents in fostering the monopolization of the economy are also maximizing market powers and the re-feudalization (*Vermachtung*) of the economy. As such, the (politico) economic consequences have to be taken seriously. The social costs of granting patents include the costs of bureaucracy administering the patent system, the costs of hampering technological progress via so called blocking patents (i.e., this implies a delayed (further) development of patented products as well), but also the costs of monopoly rents and of enhancing market power. All these economic disadvantages connected with the granting of privileges and monopoly power have to be taken into account. According to the anti-patent movement the costs outweigh the alleged benefits (i.e., increase in productivity due to patent protection, support of knowledge- and science-based high-tech industries, etc.[26]) by far; from an economic perspective they are simply not acceptable. This *re-feudalization argument* (2.) is at the core of Walter Eucken's analysis of patent laws. Later on I will elaborate this argument in more detail.

In addition, the proponents of the anti-patent law-movement were convinced that patents hamper industrial progress: patents form an obstacle to technological progress and innovation. This '*patents as obstacle to progress argument*' (3.) is highly related with the first one, namely the free-trade argument: in fostering protectionism and the monopolization of the economy, patents increase the price of certain products and, worst of all, they are blocking further experimenting and the further advancement and development of products. Thus, they are jointly responsible for the gridlock of the (nineteenth century German) economy.

The next argument refers to the question whether inventions are a private property of the innovator or whether they are a common good. The nineteenth century free-trade movement stated that all kind of inventions and innovations are an intellectual property owned by the whole society. Prince-Smith for example was arguing against 'intellectual monopolies' and envisioned a world in which all inventions and innovations would be part of the public domain (*inventions as an intellectual common property argument* (4.)). Later on this argument was denounced as being part of the 'intellectual communism' and the socialist view of property of the free-trade school. Yet, the free-trade movement felt confident that inventions and innovations are sufficiently rewarded by the market: pioneering enterprises gain profits due to the temporal advantage through technology; they are able to promote their invention ahead of their competitors and thus can obtain an (additional) financial return resulting from their invention (i.e., (Schumpeter's) first mover advantage or innovator's head-start profits). Moreover, the free-trade movement declared that individual achievements were not the decisive factor; they were not as much as important as societal achievements and in particular the general framework conditions: without politico-economic and legal parameters inventions would hardly be possible, so the argument goes. As a consequence an individual and privately owned intellectual property right is a *contradictio in adiecto*: each inventor is standing on the shoulders of his predecessors profiting from the overall institutional framework.

To sum up the arguments against patent laws we can refer to the resolution adopted by the *Kongress deutscher Volkswirthe* in 1863:

[26] According to Boldrin/Levine (2012), there is no empirical evidence that patents foster innovation and productivity; to the contrary, since patents are nothing else than rent-seeking tools and monopoly rights (opposed to property rights), they are decreasing social welfare rather than promoting the common good.

> "Considering that patents hinder rather than further the progress of invention; that they hamper the prompt general utilization of useful inventions; that on balance they cause more harm than benefit to the inventors themselves and, thus, are a highly deceptive form of compensation; the Congress of German Economists resolves: that patents of invention are injurious to common welfare" (quoted in Machlup/Penrose 1950: p. 4).

These kinds of arguments were presented by the London *Economist* and Robert Andrew Macfie[27] in Great Britain, by the *Kongress deutscher Volkswirthe* and by the Prussian ministerial bureaucracy. Almost half a century later Walter Eucken, main representative of the Freiburg School of Law and Economics, adopted a similar attitude, yet with slightly different reasons. The arguments put forward by Eucken are the subject of the following paragraphs.

Excursus: The Decline of Nineteenth Century Anti-Patent Movement

Before moving on to this section it is important to note, that the abolitionists of patents were not able to get their demands – the complete abolition of the whole patent system – accepted. Instead they had to resign in the 1870s and acknowledge their defeat by the friends of the patent system gathering around the *Verein Deutscher Ingenieure* and the *Patentschutzverein* (i.e. victory of the allied forces of patent advocates in the so called 'German Patent Dispute'). But what were the reasons for the sudden disappearance of the anti-patent movement in the 1870s? How is it possible to explain the reversal of public opinion? The aim of the following paragraph is thus to reconstruct and understand why the free-trade and anti-patent movement lost its influence in the years following the foundation of the German Reich.

Until the 1870s it looked as though the free-trade movement was able to win the battle over patent laws. Since the 1850s patent protection experienced a crisis of legitimation in Germany and other European countries. But then many unforeseen events occurred which may help clarifying the change of mood at the cost of the anti-patent movement and in favor of patent protection. In 1873, after the glorious founder's years, a financial crisis broke out; it was soon to be followed by a great depression, the so called Gründerkrach. As a consequence of the panic of 1873 the free-trade and anti-patent movement in Europe and especially in Germany were deeply shaken and sustainably weakened; the financial crisis and the following depression were successfully presented as a failed test of the logics of free-trade liberalism by their protectionist rivals.[28] "The idea of patent protection regained its public appeal when, after the crisis of 1873, protectionists won out over the free-traders" (Machlup/Penrose 1950: p. 6). The 1873 economic crisis can thus be seen as a trigger of departing from economic liberalism and as a trigger of the reinvigoration of protectionism. While the free-trade movement was tremendously shaken, protectionist measures and instruments such as protection tariffs and other trade barriers as well as patent laws grew in popularity in the following years after the severe depression. The resistance against the patent system as well as the combat readiness on the other side ebbed away. The increased acceptance and popularity of protectionism was accompanied by the upcoming rise of nationalism in the course of the foundation of the German Reich in 1871: the strengthening of the German industry via

[27] Cp. Macfie 1863/1964 and 1869.
[28] Cp. Lang 2010: p. 13 and p. 19; ""thanks to the bad crisis" the public opinion had turned away from the "intellectual communism" of the free-trade school" (Ackermann quoted in Lang 2010: p. 15).

patent laws among others (i.e., advancement of the quality of products as well as fostering technological progress) was seen as the basis of a strong and powerful German nation.

Furthermore, the ever-increasing internationalization of the (globalized) world economy (i.e. first wave of globalization) and the increasing numbers of (world) fairs demanded a sufficient patent protection (i.e., exhibitors' fear of imitation[29]). In Germany a transformation of the industrial structure took place: at around 1840 Germany was an industrially underdeveloped country; it heavily relied on the unrestricted import of ideas and inventions and the theft of foreign inventions; Germany was regarded as a nation of imitators and German products as cheap and low-quality imitation and plagiarism of foreign high quality products; as a consequence, German goods with its bad reputation on global markets experienced significant export losses. In this situation of a technological gap of German industries the introduction of a nation-wide patent system would have been counter-productive. But then the transition and catching up-process started: three decades later, in the 1870s, the protection of inventions and innovations and the protection against plagiarism was reasonable since many high-tech products were introduced for the first time and so the industry and in particular the *Verein deutscher Ingenieure* demanded patent protection.

The reversal of public opinion in favor of the pro-patent movement and the more or less sudden disappearance of the free-trade movement in the 1870s were also promoted by a shift in attitudes of the most prominent economists in Germany. They were no longer hostile to the state; instead they were advocates of state interventionism especially in the field of social policy and in order to solve the social question; thus, they favored a more active role of government and the state. According to these kinds of economists – the main representatives were the adherents of the Historical School and the so called *Kathedersozialisten* which played a major role within the 1873 founded *Verein für Socialpolitik* – a new type of economic policy was required. Furthermore, many German economists in that era were more and more skeptical with regard to unlimited and unrestricted free-trade.[30]

The last and probably most influential reason for this turnaround and political *Umschwung*[31] leading to the victory of the allied forces of patent proponents was the political agitation and in some sense propaganda of the patent advocates catching the attention of the media and the public. The debate was carried on in newspapers, journals, pamphlets, books, and of course in the daily press, in various societies, associations, chambers of commerce and in the legislatures.

> "The advocates of the patent system organized a mighty counteroffensive. The techniques of propaganda employed in the years between 1867 and 1877 were quite remarkable for the time. New societies for patent protection were formed, resolutions were drafted and distributed to the daily press, speakers were delegated to professional and trade association meetings, floods of pamphlets and leaflets were

[29] One reason behind the initiative of the first International Patent Protection Congress in 1873 was the fact that many foreign and oversees manufacturers had refused to present their products at the World Fair in Vienna. They feared the imitation by other exhibitors, especially German ones, due to the insufficient patent protection in many European countries. What was needed was an international harmonization of regulations as well as the need for (national) patent protection

[30] Cp. Eucken's criticism of the Historical School in: e.g. Eucken 2001.

[31] Interestingly, there is also a remarkable turnaround in the public opinion as well as in the academic sphere in another sense. Nadal is absolutely right in pointing to this politico-economic *Umschwung* when he writes: "In the nineteenth century the opposition to the patent system came from free traders, while protectionists favored the establishment of the patent system. Today the terms of this equation have been reversed. Today's free traders (in the extreme version, neoliberals) are entirely in favor of very strong patent protection (wide coverage of patents and long patent life), while economists favoring protectionism reject strong patent systems and favor, instead, industrial and technological policies in order to acquire technological capabilities" (cp. Nadal's comment on the WEA website). Here, we can even speak of a shift of economic norms (turning away from an anti-patent towards a pro-patent view). The following reasons – among others – might have had an influence in causing this (paradigm?) shift: 1. Transformation of the industrial structure, 2. Influence of lobbying and pressure groups, 3. Legitimization of patents by the founding fathers of economics. For more information on the potential reasons, please refer to my reply to Nadal's comments attached to this paper.

> released, articles were planted in trade journals and reproduced in daily papers, public competitions were announced with prizes for the best papers in defense of the patent system, petitions were submitted to governments and legislatures, international meetings were arranged, and compromises were made with groups inclined to endorse liberal patent reforms" (Machlup/Penrose 1950: pp. 5:). In this regard "[i]t was strategically essential for the [defenders of the patent system] to separate as far as possible the idea of patent protection from the monopoly issue and from the free-trade issue. This was attempted by presenting the case of patent protection as one of natural law and private property, of man's right to live by his work and society's duty to secure him his fair share, and of society's interest in achieving swift industrial progress at the smallest possible cost" (Machlup/Penrose 1950: p. 9).

The patent dispute as such is an early example of the influence of lobbying pressure groups causing a reversal of opinion in politics and the public.

So far I have just presented the points of conflict, the different conflicting parties and the alleged arguments: Engineers, inventors, industrialists and other groups profiting from the patent laws (e.g. patent lawyers and jurists, etc.) were among the advocates of the patent system, a system of inventor's protection, while free-trade economists and other adherents of the free-trade and anti-patent movement were among the opponents of the patent system. The *Kongress deutscher Volkswirthe* aimed at the abolition of the whole patent system, while the *Verein deutscher Ingenieure* and the *Patentschutzverein* were agitating for the implementation of a nation-wide patent law. The patent dispute ended with the victory of the allied forces of patent proponents due to different reasons (see above). In 1877 the German Patent Act became effective. This law is often considered as the 'corporative turning point' (*korporative Wende*) since it ends the era of free-trade liberalism (at least for the moment) and heralds the start of an epoch of state interventionism.

3. Eucken on Patents: Are they just 'Nonsense upon Stilts'?

Walter Eucken's main anti-patent law argument rests upon the (alleged) linkage between patents, monopolies, exclusive privileges and protectionism. In this sense, Eucken is highly critical of the intrinsic monopolistic momentum of patents. From an (ordo-)liberal perspective patents are fostering the monopolization and re-feudalization of the economy; moreover they enhance the foundation and strengthening of cartels, trusts and syndicates. As a consequence Eucken demands the reduction of patent protection as well as a reform of the current patent system. Although Eucken is not as much as radical as the proponents of the nineteenth century anti-patent movement he makes use of the arguments of the patent controversy in the previous century. What should become clear in the next paragraphs is that Eucken is one of the leading figures of the twentieth century movement against privileges, monopolies, and protectionism. As such he speaks up against patent laws in its present form; however, he does not provide the reader with necessary reform measures (like the anti-patent movement).

The following paragraph is structured as follows: the next subsection outlines the central axioms of Eucken's Ordoliberalism. Based on Eucken's politico-economic principles I will then take a closer look at Eucken's primary writings with special emphasis on his arguments against patent protection. In this regard I will deal with the topic of the necessary framework conditions for releasing and implementing creativity, inventiveness and originality. The pro-patent advocates state that patent laws are quite

essential in order to enhance inventions and innovations; on the contrary, the patent opponents à la Eucken claim that only the ordoliberal competitive order and its inherent fight against any form of market power has the ability to foster creativity and in the end the overall wealth of a society.

3.1 The Freiburg School of Law and Economics and its Central Axioms[32]

The ordoliberal Freiburg School of Law and Economics, often referred to as German Neoliberalism, was an interdisciplinary research community at the University of Freiburg in the 1930s-1940s. The main representatives, including Walter Eucken, Franz Böhm, Hans Großmann-Doerth and Leonhard Miksch, to name just a few, were convinced, that the market economy mechanism can neither develop spontaneously nor survive unaided (i.e. Freiburg Imperative). Hence, the institutionalization of constituent and regulative principles is necessary to establish and maintain a new permanent socio-economic order – 'Ordo' simply means order – which is capable of solving the New Social Question (i.e. dependencies and exploitation of socioeconomic powers as a threat to individual liberty (Eucken 1948b)). The main characteristics of German Ordoliberalism as among the central pillars of Social Market economy are the following ones: differentiation between *Ordnungs-* and *Prozesspolitik* (rules of order vs. rules of the game), 'Interdependency of Orders', notion of 'Leistungs-' instead of 'Behinderungswettbewerb' (competition on the merits and in terms of better services to consumers (consumer sovereignty)), market conformity of economic policy measures (Röpke 1942: pp. 258)) rather than arbitrary, isolated and case-by-case interventions, and the liberal ideals: freedom of privileges, non-discrimination and equality before the law.

One of the main distinctions drawn by the ordoliberal Freiburg School is in relation to regulatory and process policy (rules of the game (choices of rules) vs. plays of the game within these rules (choices within rules) (see Eucken 1999)). The state must limit itself to the formation of regulation, or frameworks; state intervention in the economic plays of the game must be on the grounds of market conformity (Röpke 1942: pp. 252), i.e. it must not impair the functioning of market and price mechanisms. Process policy-oriented intervention which does not conform to the market must be avoided. In this instance, state regulation must take into account the "Interdependency of Orders"[33] (Eucken), i.e. the fact that economic intervention can also have an impact on the remaining social structures. (Interdisciplinary) "Thinking in Orders" (Eucken), which takes account of these interdependencies, is, therefore, of great importance. It is incumbent upon the "strong state" (Rüstow[34]), as an "ordering power" and "defender of the competitive order" (*Hüter der Wettbewerbsordnung*) (Eucken 1952/2004: pp. 325), to use regulation to establish an economic system, which allows competitive performance to flourish, as this promotes innovation (i.e. competition on the merits and in terms of better service to consumers) (Eucken 1952/2004: p. 247, p. 267 and p. 297), and in which perfect competition ensures that socio-economic interest groups are stripped of power ("competition as an instrument of disempowerment" (Böhm 1971/2008: p. 306)). The liberal ideals, which are at the basis of Ordoliberalism, include freedom of privileges and non-discrimination (see Vanberg 2008). The 'strong', 'powerful' state – governed by the rule of law – must be, constitutionally speaking, in a position to ward off particular interests; it should ideally be above interest groups, seek to remain neutral and serve the common good. In this respect, it is particularly important that the role of the state, but also the boundaries for state activity, are clearly

[32] Cp. Klump/Wörsdörfer 2010; Wörsdörfer 2010.
[33] For more information about the ordoliberal slogans *Denken in Ordnungen* and *Interdependenz der Ordnungen*, see Eucken: 1950/1965: pp. 50 and p. 62; Eucken 1940 and 1952/2004: pp. 13, pp. 19 and p. 183.
[34] The term 'strong state' was introduced into the ordoliberal debate by Rüstow in 1932 at a conference of the Verein für Socialpolitik. His lecture was entitled "Free Market - Strong State".

defined, so as to prevent abuses of power and particular interest groups from exerting influence. To put it differently: According to Eucken (1952/2004: p. 177), companies, associations and the state pose several, socio-economic threats to liberty. These threat scenarios must be prevented using the rule of law, the competitive order (*Wettbewerbsordnung*) and the control mechanisms invested in them. Eucken's Fundamentals of Economic Policy and the Constituent and Regulatory Principles – fundamentals and principles form a coherent entity – serve as a means to an end; they enable competition, which, in turn, minimizes the abuse of power and facilitates the exercising of civil liberties. The Kantian moments relate to the prevention of power (i.e. socio-economic limitation of power and limitation of the state's authority) and the facilitation of liberty (cp. Kant's Metaphysics of Morals).

3.2. Eucken's Main Arguments against Patent Protection

But what are Eucken's main arguments against the current patent system? In this regard we have to take a closer look at the ordoliberal primary literature. Interestingly, Eucken refers to patent laws only in five of his writings – namely in the *Staatliche Strukturwandlungen und die Krisis des Kapitalismus* (1932), in the *Grundlagen*-book (1939), in the essay *Industrielle Konzentration* (1946), in one of his speeches at the London School of Economics and Political Science (LSE) entitled *Zwangsläufigkeit der wirtschaftspolitischen Entwicklung?* (1950), and finally and most importantly in the *Grundsätze*-book published posthumously in 1952. Four of these writings contain rather minor paragraphs devoted to patent laws; only the Grundsätze book contains a detailed and elaborated analysis of the current patent system and its failure. Moreover, we are aware of an unpublished letter written by Eucken to Friedrich August von Hayek dating from 1946 in which he critically assesses patent laws.

In *Staatliche Strukturwandlungen und die Krisis des Kapitalismus* (1932) Eucken blames patents for being responsible for an increasing inflexibility and rigidity of the German economy. In cases where the 'whip of competition' ("*Peitsche der Konkurrenz*" (p. 298)) is missing, the economic system lacks a sufficient degree of adaptability and elasticity; the feudalization spreads and a fundamental change in the entrepreneurs' attitude takes place which is not suitable for an ordoliberal competitive order and which deviates from a Schumpeterian entrepreneur model ("*Unternehmertyp des Wettbewerbs*" (p. 299)). In this regard, Eucken implicitly picks up one of the arguments of the patent controversy of the nineteenth century, namely the '*patents as obstacle to progress argument'.* In the same paper Eucken laments on the paradoxical situation of an increasing politization of the economy, the emergence of the total economic state and state interventionism. At the same time the state is paradoxically weakened and the danger of a decomposition of the state comes up. The eroding state becomes captivated and fettered by special interest groups and the decision-making procedure depends on particularistic rent seekers. In the end the state is entirely in the hands of lobbying groups abusing state authorities as a tool in order to realize their particularistic goals. This kind of a weak state hampers the technological progress and the private initiatives of businessmen. Although Eucken does not make this point abundantly clear, his argument immediately suggests that patents as well as special interests groups play a decisive role: the influence of special (patent) interest groups on the (reform of the) patent legislation process contribute to the erosion and disintegration of the state and the re-feudalization of the economy. Moreover, patents indeed hamper the innovative process as they prevent the advancement of technology.

Eucken's *Grundlagen der Nationalökonomie* (Foundations of Economics) is remarkable in two ways: first of all it is remarkable that Eucken's *opus magnum* contains only two quotations concerning patent laws (p. 107 and p. 157); secondly, it is noteworthy that Eucken criticizes and defends patents at the same time. Critically he notes that patents are able to close the market in the sense that they restrict

the number of producers. The market entry barriers are artificially raised and they are much higher than they would be in the case of an ordoliberal competitive order (cp. Eucken 1950/1965: p. 107[35]). A few pages later (p. 157) Eucken on the contrary praises patents as an instrument of fostering inventions due to the fact that they protect inventions from imitation.[36] In the *Grundlagen*, Eucken's judgment is ambivalent incorporating a positive as well as a negative evaluation.

In the essay *Industrielle Konzentration* which may be translated as 'industrial concentration', Eucken highlights the *non*-technical causes which played a decisive role within the industrial concentration process. In this regard he refers to the role patent laws played within this process (see also Eucken's letter to von Hayek dating from 12 March 1946). The main topics of Eucken's essay are the entanglement and interwovenness of enterprises (i.e., trusts, big business corporations, and concerns), and the market arrangements and agreements between these institutions, in everyday language: cartels and syndicates. The question comes up: what are the reasons of this issue of concentration and monopoly and how is it possible to prevent it (p. 27)? Following Eucken the main reasons for the industrial concentration process in Germany are not the technical ones; rather non-technical aspects such as fiscal law, state-run trade policy, wartime economy, law on stock companies as well as patent legislation(!) and trademark law(!) (pp. 30). All these factors lead to the disequilibrium and imbalance of markets, re-feudalization (*Vermachtung*), monopoly fights and economic concentration; even more important, they are endangering the competitive order and they are in a way the forerunners of the centrally planned economy – unless they are combated in a sufficient (i.e., ordoliberal) manner. Patents – in combination with other factors threatening the functioning of a market economy – cause oligopolies and monopolies. The following required countermeasures should be adopted from an ordoliberal perspective: reform of corporate law, fiscal law and patent legislation with the aim of strengthening personal viability and accountability; moreover a prophylactic economic policy is needed and in particular a monopoly commission and a cartel office are required in order to supervise and monitor corporations and in order to break up cartels, trusts and syndicates (p. 36). In sum, Eucken does not plea for an entire abolition of all patent protection; instead he campaigns for a fundamental reform of patent legislation. Yet, he gives no answer on the specific measures which should be adopted in order to reform the patent legislation.

The major argument offered in Eucken's speech at the LSE in 1950 (*Zwangsläufigkeit der wirtschaftspolitischen Entwicklung?*) is that patents foster the concentration process (p. 32) and hinder competition at the same time. According to Eucken, modern technology has intensified and accentuated competition (i.e., improvement of logistics, reduction of transport costs, market extension right up to a global/world economy, variety of substitution goods, increase in adaptability and flexibility via technical know-how (pp. 24)). Nevertheless many attempts were made in order to restrict or block competition. This subversive fight against competition was lead – among others – by patent and licensing advocates (p. 27). Patents in this regard enhance the inherent tendency towards monopolies, cartels and the re-feudalization of the economy (*Hang zur Monopolbildung*) via a containment and suppression of competition.[37] They are nothing else than instruments on behalf of special interest groups combating the competitive market economy (pp. 29).

As said before, the most detailed and elaborated analysis of the current patent system and its failure by Eucken can be found in his *Grundsätze der Wirtschaftspolitk* (Principles of Economic Policy)

[35] "Schließen *Patente* das Angebot auf dem Markt? – Sicher nicht, wenn sie sich nur auf einen kleineren Teil des Produktionsprozesses beziehen, was oft der Fall ist. Wenn es sich aber um Patente handelt, ohne welche eine Produktion unmöglich ist, so ist das Angebot in der Tat für die Laufzeit der Patente geschlossen."

[36] "Darüber hinaus hat die Schaffung der modernen Patentgesetze, die einen gewissen, wenn auch befristeten Schutz vor Nachahmungen boten, den Strom der Erfindungen wahrscheinlich vermehrt."

[37] Cp. Eucken 1914/1990; 1921.

which were published posthumously in 1952. Here, Eucken repeats his main arguments and pleads for a radical reform of the present patent legislation; however, he does not demand a complete abolition of patent laws.

As we already know, patents foster the formation and consolidation of monopolies (p. 9); especially *Sperr-* or blocking patents are of great evil (Eucken 1952/2004: p. 41). What is decisive in Eucken's argument is that he blames the state authorities for provoking the foundation of monopolies, cartels and the like and for being responsible to encourage the emergence and growth of private power. One reason for such a development is state-made patent legislation. Via patent laws and other economic policy measures the state initiates and triggers the re-feudalization, monopolization and cartelization of the economy and afterwards the state authorities and especially the government will totally depend on such private economic power. The state authorities are digging their own graves; private interest groups and rent seekers behave just like undertakers. Eucken himself notes: "The formation of monopolies may be provoked and prompted by the state itself, e.g. via its patent policy […]. First, the state encourages and fosters the emergence of private economic (market) power, then the state becomes partially dependent on it"[38] (Eucken 1952/2004: p. 183). In addition, Eucken states that the modern patent law and the ordoliberal competitive order are mutually incompatible! To the contrary, patent legislation (often) leads to the emergence of economic orders which are alien to the system (i.e., "systemfremde Wirtschaftsformen" (p. 268)). Eucken admits that the negative consequences of patent laws – namely the inherent tendency towards monopolies as well as the fostering of the concentration process within the German industry (p. 268) – were not the intention of the lawmaker; the original intention was to foster inventions and the technical progress and to protect the inventor from imitation and plagiarism. However, what was not taken into consideration was that patents grant exclusive and monopolistic privileges, that they clothe private interest groups with power and that they therefore close markets, cause and corroborate the politico-economic concentration process and enhance the emergence of cartels and concerns (p. 268). Eucken speaks in this regard of patent cartels and patent trusts (*Patentkartelle* respectively *Patenttrusts* (p. 268)). He goes on to state that: "The interchange of licenses facilitates the emergence of cartels; the danger that one member [of the cartel] faces in case of abandoning the cartel, i.e., the loss of certain patent rights, cements a cartel. Furthermore, cartels are essentially important when it comes to the setup of modern [multinational] corporations and concerns, namely for their expansion [strategies] as well as their fight against outsiders" (p. 268).[39]

In sum, patents as well as trademark protection and its inherent (resale) price maintenance determined the development of the 'modern' economic system mainly characterized by market-dominating monopolies and cartels. This concentration process was additionally promoted by the jurisdiction: In 1897, for example, the German Supreme Court legalized cartels (cp. Eucken 2001: p. 14); in 1923 a new cartel regulation was passed which again legalized cartels and which proclaimed the state-run supervision of cartels, yet in an totally insufficient manner (cp. Böhm's criticism in: Böhm 1933/1964; 1937: pp. 98 and pp. 138). This formal-juridical *legalization* of the cartelization and concentration process led to a steady increase in the number of trusts, cartels and syndicates. Germany at that time was commonly known as a 'nation of cartels'. Moreover, this legalization was accompanied by a far reaching *legitimization* of cartels and monopolies – most notably by the German Historical School and one of its main representatives, Gustav Schmoller (cp. e.g. Schmoller 1901: pp. 448; 1920:

[38] "Die Monopolbildung kann durch den Staat selbst provoziert werden, etwa durch seine Patentpolitik […]. Erst begünstigt der Staat die Entstehung privater wirtschaftlicher Macht und wird dann von ihr teilweise abhängig" (Eucken 1952/2004: p. 183).
[39] "Der Austausch von Lizenzen erleichtert die Kartellbildung; die Gefahr, die ein Mitglied im Falle des Ausscheidens läuft, das Recht an gewissen Patenten zu verlieren, kittet viele Kartelle zusammen. Auch beim Aufbau der modernen Konzerne sind Patente geradezu entscheidend geworden, und zwar für ihre Ausdehnung und für den Kampf gegen Außenseiter" (Eucken 1952/2004: p. 268).

pp. 470 and p. 560). Due to the outstanding importance of Schmoller and the Historical School especially within the (in the meantime[40]) cartel-friendly attitude of many economists of the *Verein für Socialpolitik* (cp. Eucken 1914/1990: p. 221 and Eucken's letter to von Hayek dating from 29 June 1948) an intellectual climate arose which abetted the upcoming total cartelization of the German economy. Eucken himself was one of the outstanding critics both of the legalization by the jurisdiction and the legitimization of cartels and monopolies by the Verein and the Historical School. Both aspects – the legalization as well as the legitimization – paved the way for the accelerating concentration process; hence the market and competitive forces were extremely limited (Eucken 1952/2004: p. 269).

As a consequence, Eucken pleads for a radical reform of patent policy and the implementation of a radically new patent legislation. The aim must be to overcome the closing and compartmentalization of markets. Concretely, Eucken brings up for discussion the shortening of the period of patent protection and the extension of licensing. Eucken's model of licensing includes a system which obliges the patent owner to 'grant licenses to each and every(!) eagerly interested person' (p. 269).[41] The reform of patent legislation has to be accompanied by a severe fight against market power concentration and the monopolization and cartelization of the economy. This implies the dissolution of monopolies, cartels and the like and an efficient state-run monopoly control including a monopolies and mergers commission and a cartel office. The aim is to open markets and to lower the entry barriers to markets (p. 290).

4. Concluding Remarks

As my review of patent laws from a theoretical-historical and history of economic thought perspective has shown, Eucken picks up the arguments of the nineteenth century anti-patent movement (cp. especially Eucken 1932: p. 298; 1946/1999: p. 36; 1950/1965: p. 107; 1952/2004; 2001: pp. 27) – although his conclusions and implications are less radical compared to those of the anti-patent advocates. Nevertheless, Eucken draws on the arguments presented by the *Kongress deutscher Volkswirthe* and others – namely the free-trade argument and the 'patents as obstacle to progress argument'. Only one major argument of the patent controversy is missing: the 'inventions as an intellectual common property argument'.

At the heart of Eucken's argument are of course the free-trade argument and the (assumed) linkage between patents, privileges and monopolies (i.e., patent privileges/patent monopolies). This kind of argument may be relabeled as the *(anti-)protectionism* and *(anti-) re-feudalization argument*. But what is the reason for criticizing patents as monopolies and the inherent monopolistic character of patents? The great drawback of market-dominating, engrossing and forestalling monopolies and cartels – Eucken (1947/2008: p. 139 and pp. 145; 1952/2004: pp. 265; 1999: pp. 25; 2001: pp. 13, pp. 79 and pp. 85) speaks of *Marktmacht*, *Marktbeherrschung*, *Machtkonzentration* or *Vermachtung*, which are the German translations for the just mentioned terminology – is the rising of commodity prices while at the same time the quality of goods and services decreases. Moreover, monopolies tend to diminish the division of labour, they tend to increase poverty and decrease the wealth of a nation, and they discourage industry and improvements in the form of technological innovations (i.e., patents among others as an obstacle to progress). They are mutually incompatible with a liberal economic policy. Furthermore and even more

[40] As we have seen, a change in the attitudes of German economists occurred in the nineteenth century. Until around 1870 many German economists were advocates of the free-trade and anti-patent movement; since the 1870s and especially with the foundation of the *Verein für Socialpolitik* and the growing influence of the German Historical School however, more and more economists were in favor of patent protection, cartels and state interventionism especially in the field of social policy.

[41] "… System einzuführen, nach dem der Patentinhaber verpflichtet ist, die Benutzung der Erfindung gegen eine angemessene Lizenzgebühr jedem ernsthaften Interessenten zu gestatten."

important is the fact that monopolies, cartels, etc. threaten personal liberty, a value which is at the heart of Ordoliberalism.

According to Eucken (1948a: pp. 73; 1949: p. 27), individual liberty consists of the Kantian notion of autonomy, self-legislation and self-determination highlighting the importance of the Kantian philosophy in general and the Categorical Imperative in particular. Liberty is constitutive for humanity (cp. Eucken 1948a: p. 73; 1952/2004: p. 176 and pp. 369) and it is strongly related to human dignity: Each person is an end in itself and no instrumental means to an end (cp. Böhm 1950: p. XXXV; Eucken 1948a: pp. 75).[42] Furthermore, freedom is necessary in order to overcome tutelage, dependency and immaturity (Eucken 1948a: p. 74). Eucken abhors the stereotyping process (*Vermassung*), the mental uniformity, nihilistic soullessness, and the mental vacuity and void resulting from the at that time societal crisis (*Gesellschaftskrisis*) (cp. Eucken 1926; 1932). Freedom has to be protected by the law-giving bodies of the state, pointing at the interrelatedness of freedom and the rule of law (cp. Eucken 1949: p. 27; 1952/2004: p. 48 and p. 176). The jurisdiction – together with ordoliberal *Ordnungs*- and *Wettbewerbspolitik* and a clear-cut definition of the state's tasks – is responsible for averting the threefold dangers threatening liberty: private powers of producers, semi-public and corporatist powers of societal collectives and the powers of the state (cp. Eucken 1952/2004: p. 177). Eucken clearly criticizes the totalitarian interventionist state of the industrialised age and its unification of economic and political powers (cp. Eucken 1948a:p. 75). It is the aim of all ordoliberal representatives to implement a constitutional design with adequate restrictions and sanctions that maximizes individual liberty and the freedom of external (legal) compulsion and disposal, while at the same time protecting privacy and minimizing the abuse of socio-economic power.[43]

In this regard Eucken abhors the combination of (patent) monopolies, exclusive privileges (of inventors), the re-feudalization of the economy and the growing market-dominating power of market actors. The risk of abuse which accompanies the granting of exclusive patent privileges is by far too high. Additionally, patents are an instrument of protectionism. So here we can detect the linkage between patents, monopolies, exclusive privileges and protectionism. Eucken as one of the leading figures of the twentieth century movement against privileges, monopolies and protectionism speaks up against patent laws in its present form; in this regard, he implicitly draws on the argument of the opponents of patent laws in the nineteenth century. The aims of the nineteenth century anti-patent movement – namely the abolition of the patent system as a system of inventor's protection, the reduction of patent protection and free-trade in inventions (i.e., transfer of the free-trade argument to intellectual property rights) – are quite similar to Eucken's ones, although he is less radical compared to John Prince-Smith and other advocates of the free-trade school (e.g. Eucken does not plea for the entire abolition of patent legislation; instead he proclaims a radical and encompassing reform of the patent jurisdiction). In sum, Eucken implicitly joins the anti-patent movement in presenting similar (free-trade and anti-feudalization) arguments; however, he does not provide the reader with necessary reform measures.[44] This is a further parallel to the anti-patent movement and probably one of the major reasons for the sudden disappearance of the free-trade movement in the 1870s.

[42] As a consequence, Eucken would have probably adopted a negative standpoint with regard to biological patents and patenting of genes, since they incorporate a violation of the Kantian Categorical Imperative as well as major commandments of Protestant social ethics. As Wörsdörfer (2011) has shown, Eucken's economic ethics rests fundamentally on Kantian philosophy and Christian social ethics. As such, he would have refused the instrumentalization and commercialization of humans (i.e., bioethical concerns include the following ones: exclusive property rights, exclusive rights of use, marketing/commercialization, danger of abuse, etc.). Moreover, he would have rejected them for economic reasons such as monopolization, granting of exclusive privileges and re-feudalization of the economy.

[43] Cp. Klump/Wörsdörfer 2010.

[44] A further question concerning German neoliberalism is the issue whether Eucken's Ordoliberalism is compatible with the modern capitalistic system since it contains some anti-capitalistic momentums, e.g. the plea against patents and the protection of intellectual property as well as the plea against multinational corporations, stock companies, limited liability companies, etc.?

Remarkably, most of the here presented arguments defending or opposing patents are still used today whenever the meaning and significance of patent laws is debated. Thus, the patent controversy of the nineteenth century and the (counter-)arguments presented by Eucken are still relevant in the present context.[45] Thus, we can close this paper on patent laws with quoting again Machlup and Penrose (1950: p. 10): "Indeed, little, if anything, has been said for or against the patent system in the twentieth century that was not said equally well in the nineteenth."

5. Acknowledgements

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[45] Contemporary and topical questions involve the following ones: Is the modern patent system with its patent arms races and the problem of 'ever-greening' (i.e., extending patent monopolies by minor modifications) fostering the monopolization and concentration of the economy – at the cost of small and medium sized enterprises? Are Apple, Facebook, Google, Microsoft and other patents-pegged corporations facilitating the re-feudalization of the world economy and fuelling the cartelization process? Are patents adequate instruments of promoting the intended economic goals or is it possible to reach these goals in a less expensive way? Are patents the cheapest and most effective instrument to stimulate industrial progress? Are there any alternatives to patents to protect inventions and innovations? Are there any mechanisms other than patent laws protecting intellectual property (cp. Moser 2005)? Are patents directing research and development into the economically most productive areas? Finally, are they promoting the transformation towards a knowledge-based economy – from an imitation-based industry towards a highly innovative society? These questions are nowadays even more important than at the time of Eucken, since today we face a globalized and supranantional patent system (including a strengthened and extended regulatory (WTO-) regime (e.g. TRIPS); see also Nadal's comments and the author's reply).

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Forecasting, Prediction and Precision: A Commentary

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Abstract

Forecasting involves an underlying conceptualization of probability. It is this that gives sense to the notion of precision in number that makes us think of economic forecasting as more than simply complicated guesswork. We think of it as well-founded statement, a science and not an art of numbers. However, this understanding is at odds with the nature of social reality and the attributes of the forecaster. We should think differently about how we both anticipate and make the future and what this means. Foresight is perhaps a more appropriate term.

This paper addresses two issues that rarely receive attention in the field of economics. First, why is there a continued high demand for economic forecasts despite their lack of success in anticipating significant turning points in any given system? Second, what are forecasts actually assuming about the nature of a system and the future state of the world? In the paper I approach these issues indirectly. My intention is to highlight their significance by setting out a series of arguments that encapsulate the characteristics of a forecaster required to match a common understanding of what forecasting is intended to do.

The structure of this paper is unusual for a contribution in the field of economics. It follows a format more commonly used in analytical philosophy when the author wants to focus on a problem and where the intention is to provoke further questioning, rather than supply ready answers. As such, it should not be read as a comprehensive account of all possible approaches to methods or philosophies of forecasting and attendant issues of probability. Three points are worth stating at the outset as a guide to what follows:

1. Forecasting tends to forget that it is conjecture and what that really means. Its scientism overburdens how it is articulated and how it is perceived.
2. We tend to think of forecasting as degrees of precision in prediction and of successful prediction as successful description of phenomena at some future point.
3. There is, as the following discussion demonstrates, something basically inconsistent within the implications of this minimalism.

Since the greater part of the credibility of, and authority of, economics resides in its claims to effective forecasting these points are highly relevant to the state of the discipline.

1 Inhuman Characteristics: Sherlock or Sheer Luck?

In the latest BBC Sherlock Holmes television series Holmes would seem to have the following attributes:

1. In situ eidetic memory – he remembers for recollection the whole picture of his immediate experience as a real time movie.
2. Hyper observation – he is able to focus in on specific details as points of relevance in minute detail within the whole (hems, spots, stains, calendars in the background)

3. He has instant recall of all aspects of further information; his immediate experience at some point has included the absorption of street maps, timetables, texts, newsfeeds etc.
4. He is able to integrate 1, 2 and 3 based on some undefined but additional synthesis of relevance to the case.
5. Predicate perfection – he immediately reconstructs the whole as a deductive model that flows from True predicates to True conclusions [there are no lemmas, but there can sometimes be mistakes – because predicate perfection is not the guarantor of the correct predicates – there can be external shocks].

Sherlock's interior world is not our own. It is recognizable yet alien. But not as alien to economists as it would be to most people. To economists, Sherlock's interior world immediately evokes that of the Walrasian auctioneer, the implicit conditions of Arrow & Debreu's complete contracts, and the similarly weird world of many ideal models.

But is the set of characteristics 1-5 also implicit in any form of probability calculations about the future? Do they bear on the background issues for forecasting and the conditions of successful description?

2 When Naming is not Numbers but Numbers are Named?

We are accustomed to thinking of statements of likelihood being equivalent to numerical statements of the same thing. But are they simply that?

If we think about the future, to state 'it is likely that' is to indicate some proposition concerning that future. In terms of events/outcomes it can indicate:

'The occurrence of outcome A is more likely than the absence of A'

'The occurrence of outcome A is more likely than B'

At a minimum this can be translated into:

'There is a greater than 50% likelihood of A'

This, of course, can be adjusted by the conditions of the initial statements. If there is some other possibility than A or B then it does not necessarily follow that there is a greater than 50% likelihood of A in fact. The possibility of C or D complicates the transition from 'more likely than' to a 'likelihood of'. For example:

'The occurrence of outcome A is more likely than B, but neither A nor B is the norm or dominant situation.'

Here one might state:

'There is a greater than 50% likelihood of A occurring rather than B, but not of A in fact.'

But the point remains that the translation gives the impression that not only can the meaning of likelihood be translated into number, but that the attribution of number *adds something additional to the statement*. Yet in this case the number is simply a translation of the statement of likelihood. It has not become more precise by the restatement.

The equivalence here is not between a statement of likelihood and the precision of number but the statement of likelihood and the imprecision of number. The semantic equivalence between the two is not about precision. However, we look to number to give us precision – even if that precision is specified

as a range. This is an important point in regard of probability, social reality and the expectations of forecasting.

A probability is a statement (typically today founded in calculation) of likelihood of some future phenomena. It is not itself a statement of the event. [1]

- One can state that GDP for 2012 will be 3%.
- One can state that one is predicting or forecasting this outcome; one can then state the terms on which the prediction is made – statistical inputs x, y and z were of particular levels, the relations of x, y and z over time have led us to expect an outcome of GDP 3% based on previous occurrences and some stated assumptions, and this has held on, say, 90% of previous occasions.
- One might then state that there is a 90% likelihood of a 3% outcome (though one might then hedge this).
- One might adjust the claim by the likelihood of error in the initial statistics for x, y and z, and thus of error in the modeled outcomes of the presumed relations.
- One might adjust for likely deviation in the precision of the presumed relations of x, y and z as they pertain to GDP, and thus of deviation in the modeled outcomes of the presumed relations.
- One might then state a range of possible outcomes for GDP for 2012 – a forecast range of 2.5% to 3.5%.
- One might then state a further probability of the range based on the previous relations of x, y, and z coinciding with that range of outcomes.
- One might then run a series of further 'scenarios' allowing for additional changes in x, y, and z over the period in which they are deemed to impact on GDP for 2012.
- One might then also adjust one's forecast during the period up to the completion of the forecast as and when data could be used to replace the anticipated/interpolated numbers.

Several features are worth noting here:

1. The statement of the future outcome or event is linked to a statement of probability but the probability of the event is rarely what we focus on in public discourse.
2. Both the probability of the outcome or event and the series of statements regarding the outcome or event that are the forecast are a curious mix of precision and imprecision.
3. The received understanding, however, is that there is something in the underlying calculation that is being done in a precise way and that this gives credibility to the forecasting process.

In the end, however, what one has is a series of outcomes or events, which either did or did not coincide with the forecasts.

In a truistic sense these common features of forecasting render it no more or less than successful *description* of some future phenomena. This does not account, however, for the full range of intentions that may motivate forecasting:

- A forecast may be knowingly of an impossible outcome as a cautionary statement – often used when trends are extrapolated ad absurdum to indicate the need for current change.
- A forecast may be intentionally an act of construction in a variety of other senses of shaping the future (see later).

[1] The following is not a claim that this separated series is what actually occurs in any programmatic sense in any given instance of modeling for forecasting. The list is just that – a list of what can be stated.

More immediately for our purposes, one can state a number of possibilities regarding the circumstances under which successful description is occurring in the forecasting process:

1. Successful description can be simply coincidence.
2. Successful description can be approximately successful and the approximation may be highly conditional – creating a great deal of leeway in claims of successful description.
3. Successful description can actually be a basic illusion, trading on the perpetual adjustment to the modeled process of forecasting as and when new data emerges that confounds the initial basis of the initial forecast.[2]
4. Successful description may actually also be because the forecasting process had (in sum or parts and to different degrees based on power, position, and institutional location and remit) inadvertent constituting influences on the outcomes or events.
5. Successful description may be no more or less than a special case of coincidence – the conditions that allowed for outcomes to be of a particular kind were captured for some brief period *because they were stable* – it is the stability that is being captured and not the complexity of relations that are sometimes stable; the forecasting, therefore, is descriptively successful in an approximating way for some period; in so far as it is successful it is 'right' for the wrong reasons and thus forecasting works reasonably well right up to the point where you actually really need it to work – when things fundamentally change. *Then it doesn't work*. At such points one might then get more of 2 and 3.

Elements of 3, 4 and 5 are most recognizable in modern forecasting. They are, for example, fundamental issues for the methodology and philosophy of dynamic stochastic equilibrium (DSGE) models and for econometrics. Both have become more sophisticated, but within limits. The driving question remains whether the mathematical complexity matches the complexity of the world - *not* whether the mathematics *is* complex but whether its complexity captures the complexity of the world (e.g. Hendry 2000; Pratten, 2005).

The possibilities 1-5 ought to make us consider carefully the way we think about the link between the success or failure of forecasting as description. They also raise issues in regard of the role of precision and of our understanding of probability in forecasting for social reality. All forecasting involves an underlying conceptualization of probability. There is a formal division between a cardinal statement of probability with its precise statements of likelihood, and ordinal or relative probability with its more explicitly comparative statements of likelihood. But this formal division is blurred by the actual practice of forecasting (what is specified in quantity) and by the way forecasting is expressed and received.[3] It is the notion of precision in number that makes us think of economic forecasting as more than simply complicated guesswork.[4] We think of it as well-founded statement, a science and not an art of numbers –

[2] This has been a particular feature of IMF forecasting over the last 4 years. Each new significant publication (World Economic Outlook etc.) updates prior forecasts for growth; the use of the term 'update' masks the basic fact that the models have been consistently wildly inaccurate. All too often the curious defense has been that the unexpected occurred! 'Illusion' also has a different register; a given country may issue headline data that is simply unreliable (China's GDP bears little resemblance to the disaggregated components of the economy) but forecasters apply the same methods and models as the government in order to be able to accurately forecast that essentially spurious indicator.

[3] A forecaster's claim may well be intended to be weaker as a statement of probability than it is subsequently taken to be by others. But it is important to note that much of this weakness can be strategic rather than a direct output of any given method – 'weak' can be more an expression of lack of confidence that the claims will be realized than it is a product of the approaches relied upon to do the forecasting. For example, the forecasters may be aware that radical changes are occurring that undermine the assumptions that went into the calculations; or they may be aware that they ran a variety of simulations producing many different outcomes and are unsure how to choose between them… They can then choose to provide an intuitive probability or likelihood of an outcome; but this is different than the probability built into something like the Gaussian basis of a model… see above

[4] For the early development of concepts of probability and their implications see Hacking (1984).

we are encouraged to think of it as something like Sherlock's predicate perfection, subject to shocks. The issues are most easily illustrated using pattern recognition.

What are the Grounds of Precision in Probability: Probability and Pattern Recognition

Ultimately, probability is a particularized numeric statement linking conditions to outcomes, trading on, and thus expressing, a determinate statement of a relation. It is determinant by range, since to state a probability of 35% is to also state the range – that other occurrences fall within the other 65%. There is, at minimum, a tacit completeness, even if the statement of some portion of the rest is a statement of the range of ignorance (the indeterminacy is itself a determinate range within the whole).

But:
It is an error to conflate a probability with a pattern.

1. One can identify a pattern and state the pattern, as is, so far.
2. One can quantify elements of some kinds of patterns.
3. One can state that the pattern under some description of that 'pattern' that is quantified has shown no deviation, specific deviation, repeated deviations of specific forms…

Yet:

1. It is the *grounds* of the pattern that account for the fact that elements of the pattern can be quantified and that it may show no deviation, specific deviation, repeated deviations of some form…

Therefore:

2. It is *the nature of the grounds of the pattern that are significant* to the pattern's form and continuation.
3. It is the grounds of the pattern that provide the basis for any possibility of probability statement and for such probability statements to be precise.

Further:

1. Though social/economic reality has elements that can be 'patterned' the further identification of any pattern is, truistically, a human construct about human constructs. The expression of patterns is a provisional representation. For example, one can look at a housing market and observe for circumscribed statement:
   a. A house has been sold, a house has been sold, a house has been sold…
   b. Some houses have been sold. Houses are being sold.
   c. Three houses have been sold – imposing a break in time and a quantifier.
   d. Again, a house has been sold, a house has been sold, a house has been sold, 3 houses have been sold, and a total of 6 houses have been sold since a given point in time.

Here, a frequency is being formulated. The numbers are real object references but also interventions in flows based on categories that are used to state patterns. What has been observed is not an irrelevance but nor is *the act* of observing i.e. the nature of the intervention. The patterns are constructs and they are not the grounds of the real referents that the constructs are constructed about. Since the grounds are significant to the pattern and the observer is significant to the act of observing (its forms of construction) then the possibility of probability statement requires further characteristics of the

identifier of the pattern in order for s/he to formulate a probability in a descriptively real sense. They must be able to orient on and gather the relevant information as an act of construction and to do so in a way that addresses grounds.

One can now ask:

2. What grounds are conducive to the production of a probability statement?
3. What attributes must the probability stater exhibit in order to make probability statements?

For probability statement to be possible one might expect:

1. Given patterns of outcomes to be stable
2. Given patterns of stability to be observable
3. Given patterns of observable stability to be translatable into quantifiable forms.

But, any sophisticated approach recognizes that stability is a relative term. As such, probability would seem also to require that the relative stability conform to the expectation that:

1. Possible patterns of outcomes form a totality – the range; where that range is complete
2. Possible patterns of outcomes – the range – will be stable
3. Possible patterns of outcomes – the range – will be inferable-observable-deducible
4. Possible patterns of outcomes – the range – will be translatable into quantifiable forms.

The implication would seem to be:

1. A fixed, complete, social/economic reality, exhibiting in its parts and its whole a system that is a stasis of some form expressed variously in regular outcomes, in a range of possible outcomes, and/or in the grounds that gives rise to its outcomes and possible outcomes.
2. The stasis is temporal, extending from the manifest outcomes to the possibilities of outcomes that have not been but can be – to the determining relations or grounds.
3. For the *probability range* of any acknowledged complexity to be consistently descriptively true that description must be of a complete pre-conditioned possible patterning of complexity.
4. As such, the grounds necessary for the precision of probability are both closed and complete.
5. This closure and completeness would appear to extend from the actual pattern manifest to the range that might be.

Two things follow. First, the more complexity one affords to this stasis the more the problem of probability is generalized beyond simple pattern recognition. *Any* approach to probability must address the problem of grounds. *Any* approach must acknowledge the problem that the precision of number blurs the problem of what it means to state a cardinal likelihood, and what it means to state an ordinal 'more likely than'. Second, the more challenging an investigation becomes, whilst presuming that a probability can be stated, then the more the forecaster must take on the guise of Sherlock.

Forecasting, in so far as it gains its credibility from an underlying probability, therefore, runs up against a problem of the real world. Social/economic reality is, in its entirety, simply not complete in the necessary sense and we, as economists exhibit few and at best transient Sherlock characteristics (often tending more towards Frank Spencer).

4 Forwards and Backwards

If there is a way forward here, then it involves a decision: is the problem a mathematical one to be solved by mathematical means – Steve Keen's approach – or is the problem a problem of mathematics to be solved by a turn to non-mathematical means – Tony Lawson's approach (Lawson, 2003). The answer hinges on how far one can make mathematics compatible with social reality. Keen (e.g. 2011) would have it that there is a way to make the internalities of models capture genuine change and contingency, as such, forecasting may still be useful when you need it most…

The major challenge for innovative approaches that take Keen's route is posed by what Morin terms their 'restricted complexity' (e.g. 2008). Many complex systems approaches are rooted in difference equation models. These typically borrow methods from physics to construct simulations. The system oscillates but has points of tendency – 'attractors', which emerge based on the behavior encoded in the initial difference equation. Some see a great deal of scope in this approach (e.g. Ormerod, 2001). It may be, however, that it provides no more than a more sophisticated approach to relative stability for some period; in this sense, the more information encoded into the model the better the scenario will be. This is particularly so if the information extends to the institutional means by which actors proceed. The rules are… But it is the existence of rules that raises a question mark against the adequacy of simulations for forecasting. There is a clear difference in what degrees of latitude in relations or interactions means when one considers a human system rather than any other non-sentient-based system. There is a great gulf between contingent rule following and a contingent physical relation.[5] As such a meteorological model and, say, a financial system model, are in some basic sense different.

This is not to suggest it would then be impossible to anticipate a financial typhoon (or epidemic). It may be that complex systems models will be able to highlight thresholds and breakpoints, which are indicative of phase shifts in human activity. The question would then become, whether in fact the model enabled a degree of insight that a focus on raw data and the application of common sense based on well-known principles (herd activity, feedback loops etc) could not provide – was it in some sense providing an early warning or a counter-intuitive red flag? One might also wonder how many simulations are run based on different scenarios and how does one rank the simulations prior to the events? There may be something analogous here in the scientistic mode to an econometrician running numerous applications but subsequently publishing only one.

It may also be germane that applications of complex system models are not new. Hedge funds and various other financial organizations have been employing physicists and mathematicians to construct such models for quite some time; there is no evidence that their use gave hedge funds in general any advantage in forecasting the global financial crisis or in generating consistent returns (though there are hedge funds that use undisclosed proprietary trading models in fabulously profitable ways, such as Renaissance Technologies' Medallion Fund). Those hedge funds that did profit from the crisis (such as Paulson & Co), did so based on simple scepticism regarding an ever-expanding housing market and a timely introduction to a new innovation in credit default swaps, which allowed them to short the market based on AIGs naivety as a counterparty (Morgan & Negru, 2012). Moreover, those economists who were most accurate in anticipating the crisis did not share a common mathematical model for forecasting

[5] This is by no means to suggest that a quasi-Platonic reality in which numbers are real referents is automatically rejected (Benacerraf, 1965 & 1973, provides the two main contributions that have defined the problem in philosophy of mathematics). Material reality may well be written in the language of mathematics. But we also live in a world of emergent complexity. Causation may be central to social reality. However, determined does not imply determinism. The former acknowledges significant antecedents. The latter is usually associated with the inference that an outcome could not have been otherwise.

– they too shared an interest in the same raw data (the descriptive statistics) of rising debt levels and asset prices.

Conclusion

The conclusion I want to draw here is not that forecasting has failed to have some traction within social/economic reality. The implication is that the relative success or failure of forecasting cannot be based on:

1. A *consistent* isomorphism between probability calculation and reality as is in its complexity
2. The necessary attributes of a person calculating probabilities in regard of that reality, in a Sherlock sense.

The failures of forecasting flow from the lack of isomorphism and the impossibility of the necessary attributes. But, the lack of isomorphism does not mean that there cannot be brief points of tangency – stabilities in reality that seem to conform to the completeness and overall stasis that seems to be needed. The lack of the necessary attributes does not mean that our real attributes are not sometimes sufficient to express probabilities for some time in some place within social reality. The problem is that we may be right for the wrong reasons and come to place faith in methods that are not genuinely adequate. The faith itself is an unintended consequence of an underlying social demand for security and control.

Ultimately, we should think again about the nature of forecasting. We should think carefully about the nature of social reality that it is seeking to 'describe'.

This is not a new message. It is central to Keynes' work on probability. It is, for example, an important element in the distinction between probability as a numerical expression from relative frequency and the imprecise statement of likelihood based on an understanding of context (take an umbrella it might rain). It is at the heart of the problem of uncertainty and what we mean by that. The potential problems here are more than a matter of theoretical interest. The message is one that needs to be reinserted into how economists proceed on a practical level. Concepts of probability, forecasting models, and so forth are also resources for agency. As many have noted, the over-reliance on DSGE models that presumed relative stability to be the norm, and which were used by central banks in conjunction with a price stability policy focus, helped to render those central banks blind to the rise of financial instability (Morgan, 2009 & 2013). Similarly, the development of risk management mathematics by financial organizations encouraged them to think of the financial landscape of profit and loss as probabilistic, in a precise sense, enabling more not less risk to be taken.

Many points might be made here in regard of forecasting. One important one is that we should think again about its institutional role i.e. its ideological function and also its role in construction. We ought, for example, to be thinking far more in terms of the issue of foresight rather than an ideological precision in forecasting.

Foresight and forecasting are not the same things.

Forecasting is about stating the future that will be, foresight is about anticipating possible futures and shaping them – perhaps avoiding what may otherwise be, and where one considers a possible state of affairs to be adverse. Foresight involves the negative in the sense of what may now never be and also why one would not want the outcome that may now never be. Foresight recognizes that the issue of possible futures begins from alternative possible presents.[6] This is also what forecasting is about, though

[6] The political economist Heikki Patomaki has many interesting things to say about the issue of possible futures and alternative presents (e.g. 2011 & 2012).

in the case of forecasting the relation is not emphasized. Forecasting is about possible presents in two senses:

1. In many institutional contexts forecasting is also an expectations shaping exercise. The highlighted future shapes a present behaviour. This is implicit in the expectations theorizations and practices of central bank policy. More broadly, a forecast can justify a present policy. There is a credibility compromise at play that is well understood. For example, forecasting in conjunction with predictive models played a key role in the stress tests of banks in the EU and the US over the last 4 years. The stress tests were positioned precisely as damage limitation exercises. Possible futures were constructed that minimized the degree of statement of the current undercapitalization (if any) of the banks. Possible futures were being constructed in order to stabilize the present i.e. in order to form a possible present that (hopefully) prevented some possible futures.[7]
2. Forecasting typically shares an imaginary world with general equilibrium and with the efficient market hypothesis (EMH). It shares a paradox of implicit understanding of the flow of time. Both the EMH and general equilibrium are essentially timeless as models in any real sense. However, the EMH, for example, assumes that all information is commonly available, commonly processed and well used. The present is in effect an assimilation of the relevant elements of the future. The present performs the future but the future dictates the present. Since the basis of doing so is descriptive completeness, then effectively every point of the present becomes fixed by an accurately anticipated future. One is effectively living backwards from the future to the present and living the future twice – both as a perfect simulacrum and as an actual event. Since each point in the past is an instance of this (in order for the model to be confirmed) then one is permanently living backwards from the future to the present as a series of moments that become future pasts. The problem here is the basis of description shared by forecasting; i.e. completeness and closure that then become the basis of the possibility of prediction as calculative precision for forecasting.

The future may be in the present and expressed through the tentative relation between possible presents and likely futures, but this is not a situation that can be encompassed by a simple notion of description. Forecasting, as currently practiced, has a disjoint between its actual significance and its manifold of justifications and expressions. It thus occurs within an ideological frame. It is partial description in three senses. It is partial in the sense of being incomplete because social reality is incomplete. It is partial in the sense that it is incomplete because no forecasting system and forecaster can fully capture what is not complete. And it is partial in the sense of partiality – it is part of the multiform manner in which social reality is shaped.[8]

I'll finish here with a quote from Geoffrey Dicks, chief economist at Novus Capital Markets:

> "Forecasters tend to hunt in packs. At one time they are all downgrading; at others they will be revising their forecasts higher. It may sound a contradiction, but typically forecasts will lag rather than anticipate trends in the real economy. In the financial crisis

[7] This is not to suggest the shaping exercise is necessarily realised as anticipated: the process may have unintended consequences or fail to produce its intended outcomes. For example, a stress test may be passed by a bank but the bank may suffer losses irrespective – undermining the credibility of the stress test. This may be considered an acceptable risk by the authority since it allows a problem to be at least temporarily mitigated

[8] These are issues addressed in various ways by Donald Mackenzie (e.g. 2008) in the sociology of finance, as well as by the CRESC group at Manchester University (Karel Williams, Julie Froud, Ismail Eerturk, Adam Leaver etc. e.g. 2006)

and the recession that followed in 2008-9 the forecasters were in perpetual catch-up mode." (Dicks, 2012)

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