Altered States: Cartesian and Ricardian dreams

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Altered States: Cartesian and Ricardian dreams

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Abstract

Economics and science are both experiencing crises. These crises have more in common than it might seem, apart from the banal - albeit contested fact - that economics itself is a science.

Among the various readings of the crisis of science, behind a dystopian system of incentives and bad practices leading to the so-called reproducibility crisis, one can see the unravelling of the Cartesian dream of power, prediction and control of man over nature made possible by natural philosophy. Economics has its share of irreproducible results, and economists suffer under the same publish-or-perish culture as other scientists. Yet, in the reading of the specific features of the crisis in economics, the element of ideology is more prevalent: economics would no longer get it right, as its lenses would be those of a neo-liberal ideology and of an associated simplified vision of what economics is about. The role of markets in this vision is of paramount importance, so it would not be inappropriate to call this the crisis of the Ricardian dream.

In this paper, we investigate what the Cartesian and the Ricardian dreams have in common and discuss what this would imply for our understanding of present day science and economics.

Keywords: Economics, history of economics, econometrics, sociology, technological change

JEL codes: A12, A14, B1, B16, B2, B23, B52, 014

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Introduction

'Everyone seems to agree that the economics profession had a near death experience in 2008' (Wilsdon 2016). As examples, the 'death of [economic] theory' was hypothesised by Noah Smith (Smith 2013); conferences were held entitled 'What's Wrong with Economics?'; Queen Elizabeth questioned the predictive capacity of British economists (Pierce 2008); a similar moment occurred among US economists in a senate hearing (Mirowski 2013, pp. 275-286); Paul Romer denounced the use of ideologically laden mathematical models (Romer 2015); 33 theses were nailed to the door of the London School of Economics (Macfarlane 2017; Reinert 2018); and new curricula were developed to 'fix' the teaching of the craft (Cassidy 2017). The list could go on, making the case that economics lives a moment of crisis, where some of the prevalent core assumptions of the discipline are being disputed. Has this ever happened before?

There was a time in the recent past where Ricardian economics was declared dead. This occurred after the economic crises of 1848, with the critique reaching maturity early in the 20th century. Herbert Foxwell (1899), a Cambridge economist, warned his contemporaries of the 'extreme dangers' of Ricardian economics, arising 'from the unscientific use of hypothesis and social speculations, from the failure to appreciate the limited application to actual affairs of highly artificial and arbitrary analysis.' In the US the same critique took to the extreme of sarcasm in the famous line from Thorstein Veblen when he criticised English 19th century economic and political philosophy:

> 'A gang of Aleutian Islanders slashing about in the wrack and surf with rakes and magical incantations for the capture of shell-fish are held, in point of taxonomic reality, to be engaged in a feat of hedonistic equilibration in rent, wages, and interest.' (Veblen 1919a, p.193)

Today, as then, a subject of criticism was the level of abstraction of economic theorising, what we would today associate with mathematical modelling in the famous assertion by Milton Friedman that:

> 'Truly important and significant hypotheses will be found to have "assumptions" that are wildly inaccurate descriptive representations of reality, and, in general, the more significant the theory, the more unrealistic the assumptions (in this sense).' (Friedman 1953, p.14)

Against this vision, Wolfgang Drechsler was quoted in Hudson (2010) as saying that mathematics has helped enthrone 'irrelevance as methodology'.

The background to Friedman's assertion enables an even stronger assessment. Among other issues, the 'marginalist controversy' included a debate between Richard Lester, a labour

economist at Princeton, and the eminent Fritz Machlup on the marginalist Theory of the Firm. Lester conducted an empirical survey of cotton-spinning firms, to see whether, as the theory predicted (and as every student of economics was taught) they stopped increasing production when increasing marginal costs equalled the decreasing marginal returns. He found that they had no idea at all about marginal entities, and in any case their internal accounting systems could not trace them. He concluded that the Marginalist Theory of the Firm had no basis in the real world of practice. Machlup defended the theory, with his arguments eventually becoming similar to the classic formulation of Friedman (Ravetz 1994).

History tells us that economics became quantitative in the first place - in the second half of the 18th century - only to fall periodically back into scholasticism (Reinert 2000). Thus, economics emerged from the sterile pursuits of medieval scholasticism. Francis Bacon (1561-1626), who attempted to create experience-based science, describes how scholasticism makes science degenerate:

> 'Surely, like as many substances in nature which are solid, do putrefy and corrupt into worms; so it is the propriety of good and solid knowledge to putrefy and dissolve into a number of subtle, idle, unwholesome and, as I may term them, vermiculite questions, which have indeed a kind of quickness, and life of spirit, but no soundness of matter, or goodness of quality. This kind of degenerate learning did chiefly reign amongst the schoolmen [i.e. the scholastics], who, having sharp and strong wits, and abundance of leisure, and small variety of reading, but their wits being shut up in the cells of a few authors…, as their persons were shut up in the cells of monasteries and colleges, and knowing little history, either of nature or time, did, out of no great quantity of matter, and infinite agitation of wit, spin out unto us those laborious webs of learning which are extant in their books.' (Bacon 1605, quoted in Reinert 2000)

Mathematics was an important ingredient of the quantitative programme, but a fanatical commitment to formal models ended up pushing economics back into scholasticism - into 'working upon itself' - thus closing the circle. When mathematics was first introduced in economics in the 18th century, accusations of scholasticism re-appeared (Sophus A. Reinert 2007).

The ideological elements of the economic theory are very much at the core of the present moment of economic angst, although different readings have been put forward. For Rajan and Zingales (2004), 'Capitalism's biggest political enemies are [...] the executives in pin-striped suits extolling the virtues of competitive markets with every breath while attempting to extinguish them with every action'.

History shows that developed countries, having achieved their level of wealth by protecting their industrial sectors at birth, needed to maintain now the postulation of perfect competition and efficient markets as an expedient to prevent developing countries from creating an industrial sector

of their own (Reinert 2007).

In reality, an economic theory modelling international trade as the barter of qualitatively identical labour hours, whether in Silicon Valley or in a tribe of hunter-gatherers in the Amazon, will fail to realise that 'free trade' may benefit some types of economic activities more than others. This analysis of *'cui prodest',* to whom all this benefits follows a long intellectual tradition and can be found in England with Josiah Tucker (1713-1799), Tucker (1782), who was in the habit of directly or indirectly asking *'cui bono'*, in relation to economic theorising. In the United States this tradition was followed up by Thorstein Veblen (1857-1929). Veblen analysed the power of 'vested interests', which he defined as 'a legitimate right to get something for nothing, usually a prescriptive right to an income which is secured by controlling the traffic at one point or another' (Veblen 1919b, pp.161-162).

It might be pointed out that we present a caricature of economics here; after all, there is a lot of literature on imperfect competition. However, it is important to note that key policy decisions on the global level, whether they are from the World Trade Organisation, The World Bank or the International Monetary Fund, tend to revert back to Ricardianism in its crude forms. We saw this, for example, in 1997 when WTO Director-General Renato Ruggiero declared that we should unleash 'the borderless economy's potential to equalise relations among countries and regions' (Ruggiero 1997). This illusion - that trade under all circumstances would tend to even out economic differences among nations - is the main mechanism that has created increasing inequality crisis between nations (Reinert 2007). The World Bank's Doing Business Report gives us an example of the indirect damage of using a frictionless Ricardian framework as an implicit ideal: cutting welfare to the poor would boost a country's score on this index. Implicitly admitting to the problem, in August 2020 the World Bank announced that the publication of this report was to be suspended 'until it conducts a review and audit'. An ongoing controversy inside the World Bank, related to Paul Romer leaving his post as chief economist, focused on India's rating under the autocratic regime of Prime Minister Narendra Modi rising by 67 slots in this survey, while the rating of more 'social democratic' Chile fell.

In this work we discuss the present status of health of economics moving from a somewhat different perspective, starting from the considerations that economics presents itself as a science, all the more so when economics' ambition is of paralleling physics in its reliance on equilibrium-based mathematics as a key to the reading of the world. As part and parcel of the house of science, economics participates in the vicissitudes of science.

Thus, we shall first discuss how science qua science is currently undergoing a serious moment of crisis, mostly impacting its governance and quality assurance system; then we shall investigate the extent to which the crisis of economics is different from the crisis in science.

Our thesis is that the two crises have more in common than is acknowledged at present, and that a useful reading of the present crises can be provided by the crafts of history and philosophy of science and of economics. Only once this is done will the peculiarities and idiosyncrasies of economics need to be called to the fore.

1. A crisis in the house of science

The year 2016 saw the first example of artificial intelligence (AI) beating the best Go player, and the confirmation of the existence of gravitation waves. The previous year was the year of Homo Naledi and the penta-quark. In 2014 a probe was positioned on the surface of a comet. In 2013 a fast and precise new method for editing snippets of the genetic code, the so-called CRISPR technology, was developed. In 2012 the Higgs boson was experimentally detected. In 2011 another AI program beat humans at Jeopardy, a quiz show.

Talking about a crisis in science in this situation might seem unwarranted, and some readers of the crisis add that the 'crisis of science' narrative is irresponsible (Fanelli 2018; Jamieson 2018). The situation is complicated by instrumental use of the 'irreproducible science' narrative to advance anti-regulation agendas (Wood and Randall 2018), especially in the United States (Oreskes 2018; Saltelli 2018).

Indeed, the crisis is a poorly kept secret. Much is played in public spaces and the media, even beyond academic fora. As early as 2013, The Economist devoted its cover to 'Bad Science' ('How science goes wrong' 2013; 'Trouble at the lab' 2013), reporting an unprecedented crisis of reproducibility in several disciplines, from psychology to cancer research.

Journals such as Nature (2015) and The Lancet (Horton 2015) have run concerned editorials, and six international conferences were held between 2007 and 2019 on Research Integrity.[1] The issue is debated in academia and think tanks (Horton 2015). In social science an important experiment was led by Brian Nosek, a psychologist at the University of Virginia, co-founder of the Center for Open Science and leader of the 'Reproducibility Project: Psychology'. The experiment zoomed in on 100 major studies, and could only replicate 35 per cent of the total. Further, the size of the effects was systematically smaller in the replica than in the original (Open Science Collaboration (OSC) 2015). Several scholars, including John P. A. Ioannidis, have investigated the extent to which different disciplines are diseased, from medicine (Ioannidis 2016) to economics (Ioannidis et al. 2017) to nutrition (Magni et al. 2017) to social sciences in general (Hardwicke et al. 2019), while Fanelli compared the seriousness of the problem with Auguste Compte's hierarchy of science (Fanelli 2010), with, for example, psychology faring worse than space science, and social sciences being more vulnerable than natural ones.

The crisis should also be seen in the context of our symbiotic relation with technology and innovation (Arthur 2009). Recent years have seen unprecedented progresses of automation in what is now called the second machine age (Brynjolfsson and McAfee 2016), while concepts such as crowd and platform continue to acquire new meaning (McAfee and Brynjolfsson 2017). Concerned eyes (Lanier 2006; Lanier 2018; Zuboff 2019) have looked at the impact of platform (or surveillance) capitalism on society and democratic representation. While most analyses have set the reproducibility crisis aside from the crisis in our relation to technology, we consider them here as related, following Benessia et al. (2016), Ravetz (2016), Ravetz and Saltelli (2015) and Saltelli and Funtowicz (2017).

[1] http://www.wcri2019.org/

In this reading, the crisis has ethical, epistemological, methodological and even metaphysical dimensions. Its root causes were diagnosed long ago by philosopher Jerome R. Ravetz (1971), whose predictions have found abundant verification in present-day historical critique of commodified science (Mirowski 2011, 2018). The crisis of science *qua science* impacts science as used for policy. Identified points of friction are the paradigm of evidence-based policy (Saltelli and Giampietro 2017), the use of science to produce implausibly precise numbers and reassuring techno-scientific imaginaries (Benessia and Funtowicz 2015; Porter 2012; Scoones and Stirling 2020), and the pretended use of science to 'compel' decision by the sheer strength of 'facts' (Muller 2018).

Writing of the crisis of science is complicated by the rapid unfolding of events, with the discipline of statistics at the forefront of the storm. The saga of the p-value - revolving around the use or abuse of this particular statistic for the identification of effects in various types of experiments - is still ongoing, with the issuing of recommendations on its use by the American Statistical Association (Wasserstein and Lazar 2016) and lively discussion among practitioners (Gigerenzer and Marewski 2015; Leek et al. 2017; Leek and Peng 2015; Saltelli and Stark 2018). The latest convulsion of the crisis of statistics involves a petition to abolish the concept of significance altogether (Amrhein, Greenland, and McShane 2019). Like other disciplines, economics has also been a victim of the reproducibility crisis (Ioannidis, et al. 2017).

In summary, the different readings of the crisis in science (Benessia et al. 2016) include:

- Poor training, poor statistical design, hubris of data mining, perverse incentives, use of counterproductive metrics to appraise science and scientists.
- Science victim of its own success; senility by exponential growth and hyper-specialisation. A prediction in this direction was made by Derek de Solla Price (de Solla Price 1963, pp.1-32), the father of scientometrics. This reading is today brought to an extreme conclusion by (Millgram 2015, pp. 21-53) for whom science has contributed to the undoing of the Enlightenment - creating a world of serial hyper specialisers, where man's capacity to make sense of reality is compromised.
- Science as another victim of the neoliberal ideology. This is the thesis upheld by Philip Mirowski (Mirowski 2011, 2018). According to Mirowski, since the 1980s neoliberal ideologies have established that the market is the best answer to the question of how best to fund research. At present, much research is performed by contract research organisations (CROs) that operate under significant budget and time pressures; that this may impact on reproducibility is unsurprising.
- Science is a social enterprise. Its quality control apparatus suffers under the mutated conditions of techno-science. This reading is mostly due to Ravetz (1971, 2011), who predicted in 1971 that, in the passage from small science to big science, the form of commitment necessary for the performance of good quality scientific work would come under increasing strain. Recent analytic work (Smaldino and McElreath 2016) accurately confirmed that prediction, going so far as to identify a Darwinian superior fitness in bad science.

2. The house of economics

A recent study of the 80 most important economics books – measured as number of editions – before 1850 showed an important discrepancy compared with what is presently taught in most courses in the history of economic thought (Reinert et al. 2017). The origin of modern economics is normally seen as the 18th century French *Physiocrats* who – based on the logic that ultimately food was the key commodity of man – decided that agriculture was the only 'productive' branch of the economy. The historical records of economic bestsellers show that the Physiocrats were outnumbered by works *against* Physiocracy by a factor of about four to one.[2] The theories that dominated economic policy were based on empirical studies, not the highly abstract theories of the Physiocrats. Recent works have re-evaluated the importance of Physiocracy by analysing its limited influence on economic policy at the time, comparing this to its overwhelming presence in today's history of economic thought (Klotz et al. 2017; Kaplan 2015).

In their book *The Invisible Hand. Economic Equilibrium in the History of Science*, Ingrao and Israel (1990) traced the use and misuse of equilibrium in the history of economics. In economics, vested interests shine through more clearly than in the hard sciences. It was obvious that the Physiocrats' emphasis on agriculture represented political support to the feudal landowning class. However, a direct result of this policy was that more money was to be made not by bringing grain into Paris but rather by storing it and waiting for prices to rise. In fact, this early belief in 'the magic of the market' was responsible for the shortage of bread that was the main cause of the French Revolution (Kaplan 2015). The Storming of the Bastille happened when news reached Paris that the ardent anti-Physiocrat Jacques Necker had lost his job as minister of finance. Necker, who is virtually unknown as an economist, is the only author with four different works in the bestseller list mentioned above.

Thus, economics has been a tool of political vested interest from its very conception. At a time when England was the only industrialised country, and clearly had an interest in continuing to hold that position, David Ricardo (1817) constructed his theory of international trade, visualising the world economy as a system of bartering labour hours, all of identical quality. Here is a context-free world, with no capital, no skills, and no knowledge. David Ricardo 'proved' that the world would be richer if every country stuck to its 'comparative advantage', whether it was in the Stone Age or the Machine Age. By the end of the 19th century, Ricardo was completely out of fashion. In his 1897 inaugural address as Rektor of the University of Berlin, Gustav Schmoller criticised the two political extremes – Communism and the Manchester School (today's neoliberalism) – as *twins of an ahistorical rationalism*. In a sense, Ricardo was father of both 'twins': of communism with his labour theory of value and of Manchester Liberalism with his theory of international trade.

> 'The simplistic optimism of 'laissez-faire' and the childish and frivolous appeal to revolution, the naive hope that the tyranny of the proletariat would lead to world

[2] It should be added that the Physiocrats mainly published in journals, not in books. However, the books came in very few editions.

> happiness, increasingly showed their real nature, they were twins of an ahistorical rationalism … The old doctrines of individualistic natural law were transformed from the humanistic idealism of an Adam Smith to the hard mammonism of the Manchester School and (were useless for the present situation) … The period 1870–1890 led to the theoretical and practical bankruptcy of both the old schools.'
>
> (Schmoller 1897)

Unfortunately, what Schmoller referred to as the two bankrupt schools came to be at the centre of what we can call Cold War Economics. Early in the Cold War, US economist Paul Samuelson (1949/50; 1983), using the usual assumptions, employed Ricardo's trade theory to 'prove' that, under the standard assumptions, international trade would tend to equalise the prices for the factors of production: capital and labour. At approximately the same time, also in the US, the Cowles Commission started sponsoring influential economic research based on market equilibrium models, producing more than 10 Nobel Laureates in economics. With the benefit of hindsight it is reasonably clear that the extremely high level of abstraction employed in both Ricardian trade theory and equilibrium models ideologically underpinned the perfection of the capitalist model during the Cold War. The utopian free trade model appears to be collapsing only now as it hits the United States like a boomerang. No longer the world economic hegemon - as England was when David Ricardo wrote - free trade is no longer in the interest of the United States.

Relevant to the issue of the Cartesian dream treated here, the great Physiocrat Quesnay wrote a few pages on economics and hundreds of pages on bloodletting (salasso/sangría) as a cure-all (his 1770 work on the subject has 734 pages). It is believed that bloodletting contributed to the death of Descartes at the Stockholm Castle (Clarke 2006). Quesnay was perhaps as wrong on bloodletting as he was on economics.

3. Is the crisis just one?

The word crisis originates from a Greek verb (krī́nein) for 'to decide, separate, judge'. We should clarify what we mean by crisis by separating its different elements, and by judging upon their seriousness and relevance. Already, some voices have wondered whether there is not perhaps a 'crisis of the crisis?' (Ortmann 2016), and different claims have been put forward regarding the status of health of the various disciplines.

3.1 Cartesian dream and science hubris

For some scholars, the last four centuries have been those of *scientific hubris*, of rationality becoming a substitute for reason; to use the words of Stephen Toulmin (2001), of a 'Cartesian dream' (Pereira and Funtowicz 2015). A vivid illustration of the dream is Francis Bacon's *Magnalia Naturae*, in the *New Atlantis* (Bacon 1627), Wonders of nature, in particular with respect to human use. This ancient work contains one full-page listing - four centuries ago - of all future conquests

of science, from the retardation of age to the mitigation of pain, to the creation of new materials and so on. Thanks to science, with the exception of the long-distance transfer of smells (which he once mentions), no item in Bacon's list has been left unachieved.

The same dream was shared by Descartes and was later enriched by Condorcet (1975), although in his prediction of the future progress of humanity Condorcet made the assumption that scientific and moral progress would go hand in hand.

The scientific revolution, with Galileo and Descartes, opened the path to dominant faith that the truth would only be achieved through science; with the Cartesian dream, the mission of science 'to knowledge highly useful in life' coincides with 'knowing the force and action of fire, water, air, the stars, the heavens, and all the other bodies that surround us' (Descartes 1637); that is, objective facts, not on understanding of personal ignorance (Ravetz 1993). The vision of science as 'the art of the soluble' (Medawar 1968) entails the removal of what is not soluble because it is not scientific; therefore, it does not exist. Descartes's positive dream of a certain truth and absolute power has resulted in the systematic suppression of any understanding of the Platonic and Socratic ignorance (Ravetz 1993), what we would today call a refutation of Knightian ignorance (Knight 1921). Science is about certainty. Uncertainty is to be evicted. It exists only in the form of 'soluble' scientific inquiry, at the edge of scientific knowledge, and ignorance must be pushed beyond the research problems boundaries (Ravetz 1994).

Since then, human reason and the use of mathematics, as opposed to the use of wisdom and self-knowledge (that is, humanistic learning), are the positive elements of the European of understanding of science (Ravetz 1993). Mathematics can vanquish uncertainty, 'studying the world in simplified, isolated bits, with only moderate uncertainty' (Ravetz 2015). This 'reductionism' set a partial view of the world against its complexity, dismissing the importance of complementary perspectives (Ravetz 2019).

Condorcet's insight, in his 1785 essay *Outlines of an historical view of the progress of the human mind* (Condorcet 1975), was to add to the Baconian list of achievements that science would have tamed social problems as well, thanks to the power of mathematics. Condorcet was one of the fathers of modern decision theory. It is curious to note that the unique possibly non-realised item on Bacon's list of wonder is something he called 'Natural Divinations', possibly the capacity to predict the future. However, here we might find modellers advocating that this has been mastered as well. The promise of control and prediction rooted in the Cartesian dream of rigorous technical models and precise scientific metrics in handling the uncertainties did not survive the test of a radically uncertain world (Scoones and Stirling 2020).

It was the extraordinary success of science - continuing to the present day - that ensured the persistence and vitality of the dream. If science makes airplanes fly, skyscrapers stand, metro and cars run without human intervention, surely science can tame human problems, inform policies, and resolve disputes by the sheer accumulation of facts. Indeed, artificial intelligence does beat human intelligence in a growing set of contexts.

Without much success, philosophers, scholars, and ecologists have taken issue with this dream.

This critique has often addressed innovation as a source of never-ending growth, for bringing about as many new problems as those which are solved. The same conversation today pits technooptimists (Nijhuis 2015; Rifkin 2015) against the more prudent reading of Brynjolfsson and McAfee (2016), and of Pope Francis' own *Laudato Si* (Pope Francis 2015); for example, on the effect of automatisation on the labour market. An underlying problem here is that economics - from Ancient Greece to the more recent historical and institutional schools - have traditionally had ethics as a built-in element. Only with its methodological individualism and physics-envy has modern neo-classical economics externalised this part of the analysis.

3.2 Ricardian and Cartesian dreams and their vices

Economics might be considered part of the implementation of the Cartesian dream. The earlier successes of that programme were always mixed with failures. After all, it was Descartes' disciple Huygens who summed up a lifetime of attempts to prove the system with the phrase 'un beau roman de physique'.

Such a Ricardian dream within a Cartesian dream appears to have pushed aside more ancient sources of economic thought originating centuries ago in Italy, and kept alive by generations of economists, especially in Germany, until well into the 20th century (Reinert 2007). In brief:

> 'The mainstream canon is a product of the Enlightenment, in opposition to Renaissance values and outlook. Rationality and individuality during the Renaissance were based on an image of man as a spiritual being: creative and productive. The Enlightenment had a more materialistic understanding of human rationality and individuality: mechanical and consuming.'
>
> (Reinert and Daastøl 2004).

This quote recalls the theses of Toulmin's works *Cosmopolis* (Toulmin 1992) and *Return to Reason* (Toulmin 2001), as well as Harold Innis' theories of cycles, to which we shall return later.

In the Ricardian system (especially as it developed), 'the market' becomes the 'pineal gland' that explains everything and nothing.

Criticism of an overly formalistic economics would converge on three key aspects of the Ricardian economy which, if applied to policy, would turn out to be distortive. Reinert (2012a) identified these as 'Ricardo's three vices':

1. 'Ricardo's assumption-based rather than empirically based theory'. Joseph Schumpeter originally described it as the original Ricardian Vice. He referred to the use of unrealistic assumptions, producing elegant but often practically useless

theories.

2. 'Ricardo's built-in defence of colonialism'. Removing any qualitative features from the theory of international trade on the barter of labour hours, the Ricardian economic theory considered all economic activities equally generative of economic welfare, making colonialism legitimate.

3. 'Ricardo's failure to distinguish the financial sector from the real economy'; in other words, 'between the monetary (financial) sphere of the economy and the real economy of goods and services' (Reinert 2012a).

A curious aspect of David Ricardo is that his labour theory of value is, simultaneously, both the foundation for communism (Marx made this concept the core of his economic theory, as it gave primacy to the industrial working class) and for the neoliberal theory of international trade with its 'comparative advantage'.

As per the role of economics, Ravetz (1994) advances the provocative hypothesis that it has remained an elite folk science, one where the production of stable 'facts' is less important than its ideological functions of providing justification and guidance for policies. Most economists would likely disagree, but if natural and social scientists can be said to be the heirs of the Cartesian dream, it should be acceptable to say that mainstream economists are today the heirs of the Ricardian dream.

While Ricardian vices may be so to an economist's sensibility, Cartesian vices may appear more evident to an ecologist, or to a sociologist:

- 'Man as master and possessor of nature' is, by design, entitled to exploit the same nature as much as needed or wished. The most conspicuous examples of the rape of the earth come to mind, from the poison cups left by mining to shale gar and tar sands extractions of fossil fuels, and from collapsing fisheries to the burning of Amazonian forests.

- In the Cartesian world, environmental and social affairs can be predicted and controlled, ignorance can be tamed, and even climate can eventually be regulated with the right amount of 'negative emissions' (Curvelo 2015). The ecosystem becomes an occasion for 'services' whose functioning can be evaluated and optimally allocated.

- Finally, to a sociologist's sensitivity, there is in the predominant status assigned to geometry and mathematics as an element of education and regimentation (Ernest 2018). Descartes' denunciation of humanities and philosophy as castles built on sands starts a long historical process that leads eventually to the modern emphasis on STEM and the disciplined learning of mathematics as a contribution to the making of modern citizens, apt subjects of a knowledge economy. Unsurprisingly, this is reflected in current measures of education (Araujo et al. 2017).

3.3 Economics and the scholasticism wave

As mentioned in the introduction, the crisis of economics can be framed in the context of recurring cycles of economic thought (Reinert 2000), with economics first out then back again into scholasticism. When did economics become scholastic and lose touch with reality?

A rich strand of literature, which has Philip Mirowski as its champion, argues that economics is a recurring victim of its physics envy (Mirowski 1991; Morus 2013). In late-Victorian times, a surge of popularity and prestige for physics might have been the birth of physics-envy.

There was a general background in the late19th century when, at an accelerating pace, 'disciplines' were being formed and *'scholasticised'.* This could be seen in connection with history, psychology and anthropology: practitioners taught their craft and reflected on its foundations; they wanted to make it a science, also by using quantification as 'guarantee of truth'. Mathematisation 'becomes more than a tool, it becomes a safety-foundation of an almost mythical nature' (Drechsler 2004).

Cambridge University was crucial here, given the high prestige of its physics, Alfred Marshall establishing economics, and the added local feature of the 'Tripos' examination in mathematics, which had all the features of a scholastic enterprise (Warwick 2003).

All that could have been the context for the creation of a mathematical-scholastic science of economics, whose content was arcane puzzles where the variables had real-sounding names.

Economist Paul Romer (2015) coined the term 'mathiness' to denote an improper use of mathematics to veil or obfuscate normative or ideological stances.

The roots of the problem of 'mathiness' were born within Alfred Marshall's 1890 *Principles of Economics.* In Marshall's text, the Law of Increasing Returns and the Law of Diminishing Returns led Marshall to recommend, in line with John Stuart Mill, subsidising manufacturing, which obeyed the Law of Increasing Returns. However, this is not included in the models in the appendices nor in the further development of formal economics: the increasing/diminishing returns dichotomy, which is the main determinant of the wealth and poverty of nations, was thrown out of the models because it was not compatible with equilibrium. Instead, they should have thrown out equilibrium because it was not compatible with reality. This problem was analysed extensively by Ingrao and Israel (1990).

In a sense, the rot started with a theory that provided the extremely simplifying assumptions that made the *mathiness* possible. Herbert Foxwell, a Cambridge economist, clearly saw the problems with Ricardo: in an introduction to an 1899 book by Anton Menger, Foxwell pointed to the key problems with Ricardo:

> 'Ricardo, and still more those who popularised him, may stand as an example at all time of the extreme danger which may arise from the unscientific use of hypothesis

> in social speculations, from the failure to appreciate the limited applications to actual affairs of a highly artificial and arbitrary analysis. His ingenious, though perhaps over-elaborated reasonings became positively mischievous and misleading when they were unhesitatingly applied to determine grave practical issues without the smallest sense of the thoroughly abstract and unreal character of the assumptions on which they were founded.' (Foxwell 1900)

3.4 Mathiness: the Cartesian and Ricardian legacy

As just mentioned, economist Paul Romer (2015), with his use of the term 'mathiness', has led a courageous debate against 'freshwater economists' (an allusion to Chicago and the Great Lakes region, distinct from the 'saltwater' economics of institutions on the East and West coasts) or 'sympathisers' for their use of mathematics as Latin, in the sense that mathematics would be used to scare off debate and veil ideological stances.

In a later blog entry, Paul Romer rested his plea to fellow economists for the importance of intellectual honesty on a famous speech by Richard Feynman, perhaps the most beloved US physicist ever. Feynman's speech, entitled 'Cargo Cult Science' (Feynman et al. 1985), famously argued for a distinctive feature of science: that of being falsifiable, and for the moral commitment of scientists to go out of their way to try to falsify their own work. Hence, in the moment in which economics performs its ethical self-examination, it is to physics (again) that Romer turns.

Economics' moment of truth has coincided with the inability of mathematical modelling - in the form of dynamic stochastic general equilibrium (DSGE) models - to forewarn of the oncoming crisis, with the ensuing inquiries involving the US senate as well as the British crown (Mirowski 2013, pp. 275-286). The use of mathematics to obfuscate rather than illuminate would correspond to the use of 'Latin' of a decaying science, according to Harold Innis (1991), for whom periodical crises of the 'core' speaking in Latin[3] are resolved by injections from the periphery speaking vernacular. Innis' description of links among economic fashion, quantification and power relations can be summarised as follows:

> 'Canadian economist Harold Innis (1894-1952) suggests that scientific fashions of what Veblen called esoteric and exoteric knowledge follow a pattern, and in his scheme it becomes clear that scientific fashions may be driven by what Veblen dubbed "vested interests". I shall argue that sectors of the economies may actually be collecting rents from irrelevant economic theories. Without reference to Veblen, Innis sees that abstract science, communicated in Latin, gets more and more abstract, monopolises knowledge and enters into alliances with the political elites (with Veblen's vested interests). [Innis, 1951] Today's Latin would be mathematics, and today a de facto alliance exists between mainstream (neo-classical) economics

[3] Models as Latin are also discussed in Saltelli et al. (2013).

and the financial sector.' (Reinert 2012b)

Economics is presently a master discipline as far as policy advice is concerned. Almost by definition, cost-benefit analyses, promoted by engineers and economists (Porter 1995), are the method of choice to adjudicate the feasibility of policy options.

In the academic world, economists command the highest salaries (Fourcade et al. 2014) and make decisions about the desirability of austerity policies. In the case of Harvard professors Kenneth Rogoff and Carmen Reinhart, this decision was based on flawed spreadsheet computation (Cassidy 2013). Rogoff and Reinhart calculated that a public debt to gross domestic product ratio above 90 per cent would be bad for countries. This calculation was used worldwide to justify austerity policies in the middle of the present recession, but a later reanalysis by researchers from the University of Massachusetts at Amherst disproved their finding, tracing it to a coding error in the authors' original software (coded in MS Excel). It is significant that the policies based on that error remained in force after its exposure.

The Rogoff and Reinhart model made an even more fundamental mistake: they analysed only the liability side of the balance sheets of nations. England's sovereign debt after winning very long wars with France during the late 1700s was huge, and so was the debt of the United States in the years following its independence in 1776. We can trace bookkeeping - separating assets and liabilities to find net worth - back to 13th century Venice and the very origins of capitalism, but today's macroeconomists fail to see the world from this angle. Already from Hammurabi as the ruler of Mesopotamia (around 1750 BC) through the Bible, to the economics of Marx and Schumpeter, we find the separation of the financial economy (money) and the real economy (the production of goods and services) (Reinert 2012c).

From this also follows the separation between *unproductive hoarding* and *savings productively invested.* The gradual loss of these distinctions has led us to an economy where the financial sector is growing at the expense of the real economy.

Economists have recently attempted to extend their reach to adjudicate disputes such as climate change. In particular, Nicholas Stern called for more and better modelling (using the contested DSGE) to show how serious the consequences of climate change will be (Stern 2015).

Scholars of the study of science and technology (Collingridge and Reeve 1986; Funtowicz and Ravetz 1994), as well as fathers of the ecologist movement (Ernest Friedrich Schumacher, Lewis Mumford, Langdon Winner), have long argued that the enrolment of quantification in support of environmental policy, in the form of risk or cost-benefit analysis, should be resisted, lest one remains trapped in 'tar' (Winner 1989, p.151). For Ernest Friedrich Schumacher:

> '[...] quality is much more difficult to "handle" than quantity, just as the exercise of judgment is a higher function than the ability to count and calculate. Quantitative differences can be more easily grasped and certainly more easily defined than qualitative differences: their concreteness is beguiling and gives them the appearance

> of scientific precision, even when this precision has been purchased by the suppression of vital differences of quality.' (Schumacher 1973)

The movement known as Post-Normal Science or PNS (Funtowicz and Ravetz 1993) can be seen as a reaction to the hyper-precision of cost-benefit and risk analysis as applied to solve ecological problems. *How much is a songbird worth?* was another title in the same style (Funtowicz and Ravetz 1994). It is interesting to note that, even then, in order to show the vacuity of a certain style of quantification, Funtowicz and Ravetz (1994) selected the economics of climate change as their target - again a cost-benefit analysis.

One could argue that the issue is not with statistics, or cost-benefit analysis, but more in general with an improper use of quantification, so that books apparently treating different endeavours such as algorithms (O'Neil 2016), metrics (Muller 2018) and mathematical models (Pilkey and Pilkey-Jarvis 2009) and many others are in fact wrestling with very similar pathologies, including the neglect of the non-neutrality of the technique (Saltelli et al. 2020; Scoones and Stirling 2020)

There is currently resurgent interest on issues of ethics of quantification, first proposed by Espeland and Stevens (Espeland and Stevens 2008), both in relation to mathematical modelling (Saltelli et al. 2020) and to other forms of quantification (Bruno et al. 2014; Didier 2020; Saltelli 2020; Saltelli and Di Fiore 2020).

4. The Cartesian and Ricardian dreams: common thread, same ethos?

Thus, it would seem that the Cartesian and Ricardian dreams share more than one thread. Both can be seen in an historical perspective as the following cycles: that between the Renaissance's reasonableness and qualitative understanding vs the Enlightenment's rationality and increasing quantification, that between the power of the centre and its periphery, and that between Latin and vernacular.

In both dreams, mathematics appears to contribute cyclically to relevance and irrelevance, when its adoption as the language needed to read the book of nature (and of man) is taken too far.

Asking if science suffers more under the stupor of the Cartesian dream or the Ricardian one recalls the dialogue of Italian poet Giacomo Leopardi about whether Death or Fashion kills the most, where the poet adjudicates in favour of Fashion.

One can say that while the Cartesian dream served science well in many of the excellent things science did and does for us - with the key idea that many problems can indeed be subdivided into simple ones and solved one at a time until the entire edifice is built- the same cannot be said for the Ricardian one. In this sense Ricardo would win the Leopardian context against Descartes- for lack of countervailing goods to balance its vices.

Reawakened today, Leopardi would probably note that present-day economics has reversed its relation with science: science is now part of the economy more than economy is a part of science.

Another common thread linking the Cartesian and Ricardian dreams is a common origin that both, through the use of implicit and explicit assumptions, bring theory up to a level of abstraction where the conclusions suffer from a *reductio ad absurdum,* while an increasing number of observers, both inside and outside of the economics profession, argue that the use of mathematics in economics in some areas has reached a point of diminishing or even negative returns (Muller 2018; Porter 2012; Stirling 2019).

Following Ravetz (1971), we would like primarily to note that both economics and science are social activities, and their ethos (and its changes) determines their function, quality and outcome. The perceived collapse of quality assurance, most visible in statistics, is an indication of the decline of that dream (Amrhein et al. 2019; Gelman 2019).

Nevertheless, a legitimate question is whether science at large and economics share the same ethos.

According to a lively strand of literature, economics exhibits some distinctive features when it comes to the prevailing norms of the craft. Clearly the moral progress of Enlightenment economics was a result of a century-long effort to sort out the ethics of the market, a process that started with Bernard Mandeville's *Fable of the Bees* (Mandeville 1723). Mandeville recognised that 'private vices' are at the core of the growth into a liberal economic system, replacing the role of virtue of Renaissance civic humanism. Later, Count Pietro Verri of Milan discovered the limits of Mandeville's theory and counterbalanced its main revolutionary claim, that any private interest is good greed. Instead, Verri's Rule stated that the coincidence of private with public interest is the boundary between good greed and bad (or predatory) greed (Reinert 2012a).

For Ruske (2015), politicians with a past as economists are more likely to be corrupted. That claim was extended by Frank and Schulze (2000) from politicians to the entire citizenry. Those who have watched Charles Ferguson's movie *Inside Job* will recall an interview with Frederic Mishkin, a banking professor at Columbia University, praising Iceland's 'strong' banking regulation system two years before it went bust. Mishkin had been paid US$124,000 by the Icelandic Chamber of Commerce to write the paper. The episode suggests 'a troubling possibility: that prominent academic financial economists, such as those portrayed in the movie, had lucrative connections with private financial firms that they did not disclose to the public even when they were proffering public policy advice on financial matters that could affect the financial fortunes of those financial firms' (Carrick-Hagenbarth and Epstein 2012).

The investigation by Carrick-Hagenbarth and Epstein (2012) focused on the financial affiliations of 19 prominent academic financial economists active in proposing reforms in the wake of the 2008 Global Financial Crisis, and found that 'private affiliations were common but that these academic economists disclosed these affiliations infrequently and inconsistently.'

In 2015, Campaign for Accountability, an advocacy group, revealed how a payday lending

industry trade association paid for and edited a controversial academic paper claiming that payday loans do not leave consumers trapped in cycles of debt.

All of the above are anecdotes. Natural scientists are also corruptible, and it is possibly a caricature to describe natural scientists as 'Mertonian', meaning by this committed to a higher standard of moral behaviour,[4] and attribute to economists a more profit-seeking (or utility-maximising) attitude - like that of Frederic Mishkin in real life or the fictional Gordon Gekko, immortalised by Michael Douglas in Oliver Stone's movie *Wall Street.* As anticipated by Ravetz (1971), and discussed by Benessia et al. (2016), Mertonian principles were more plausible in describing pre-war 'little science' than modern techno-science and more for amateur gentlemen scientists than for young researchers on the verge of a precarious profession.

What one can observe is that today's economics is much closer to the exercise of power than any other discipline at possibly any point in the history of mankind - only churches have historically enjoyed as much leverage. Notwithstanding the existence of a healthy level of disagreement within the craft of economics, mainstream economics plays an important role in the maintenance of existing economic order - inclusive of its distortion of the balance between the real and the financial economy, which we now all take as a fact of life but which would have terrified 'Old Canon' economists.

Perhaps the most telling difference between today's economics and science's other disciplines is in the mismatch between status (and ambition) of economics and the quality of its achievements.

The inability of economists to predict or explain the Credit Crunch, and 'spot on the mark' predictions have tended to elude the craft. In a three-page letter to Queen Elizabeth II, 10 economists explained the failure to forecast the extent and harshness of the Credit Crunch, writing that 'in recent years economics has turned virtually into a branch of applied mathematics, and has become detached from real world institutions and events' (Hodgson 2009). The spirit of the letter goes in the direction of escaping from Cartesian and Ricardian legacy and enabling economics to embrace a diversity of approaches.

[4] 'In his essay 'The normative structure of science', Thomas Merton attributed to modern science a unique ability to provide 'certified' knowledge, thanks to the institutionalization of distinctive social norms in the scientific community, in the form of a specific ethos that drove progress […]. The ethical and epistemic value of science ensured by the Mertonian norms of communalism, universalism, disinterestedness and organized scepticism helped to delimit a 'republic of science'—an autonomous community of peers, self-governed through shared knowledge and under no form of authority other than knowledge itself […]' (Benessia et al., 2016, p. 76.)

5. Concluding Remarks

A recent book on science's crisis (Benessia et al. 2016) advanced a number of hypotheses about what could, or would, need to be done to achieve progress:

Ongoing initiatives from inside the house of science - to overhaul the peer review system, to ease retractions, to increase reproducibility and transparency, to revise the use of perverse metrics, and overall to change the existing system of perverse incentives - are useful, but at the same time insufficient. As noted on a blog at the London School of Economics, it is difficult to detach oneself from old habits (Moriarty 2015). For example, one cannot ask young researchers, caught in the struggle to secure an insecure job - and requested to publish to achieve their PhD - to do this while fighting existing metrics and bad practices. Along the same lines, we have already mentioned the Darwinian 'fitness' of bad science (Smaldino and McElreath 2016). Things are likely to become worse before they get better (Saltelli 2017; Gillis 2019).

In a paper exposing the abuse and misuse of statistical tools, Gigerenzer and Marewski (2015) noted that, in 'Bacon's view, it is better to have no beliefs than to embrace falsehoods, because false idols block the way toward enlightenment'. Benessia et al. (2016) called this the need to 'unlearn' before progress can be achieved, and the list of unlearning extends from blind reliance on quantitative tools to the aspects of the Cartesian Dream already discussed.

Ravetz (2018) called for a resistance movement against bad and corrupt practices and against the proletarianisation of research. Statistics, one step ahead as usual, already has a movement of statistical resistance, named French Stat-activisme (Bruno et al. 2014), and one of its missions is the fight against 'Funny Numbers' (Porter 2012).

History and philosophy of science, science and technology studies and similar sociological tools to understand the crisis are important and should be heard. In the experience of the authors, if there is one thing that both conservatives and progressive scientists agree upon, it is their disdain of philosophers. Scientists might have difficulty living through their structural contradictions - for example, between science's public image and its role (Ravetz 2011). Scientists' responsibilities have been defined as 'the elephant in the room we can't ignore' (Macilwain 2016). Criticism should not become a pretext for yet another round of science wars between the two cultures.

What conclusions can one draw by revisiting the above list with economics in mind?

Economics shares science predicaments as to the hyper-reliance of perverse metrics and incentives, and must therefore give serious consideration to the ongoing activities to fight perverse incentives. Economics could also consider strengthening its quality control mechanisms and tools. This would involve reintroducing craft skills in handling numbers. Education would play an important role in this, as well as better strategies for the screening of mathematical evidence, such as the use of pedigrees for quantitative information (Funtowicz and Ravetz 1990) or of testing the quality of the narrative supported by numbers (Saltelli et al. 2013; Saltelli and Giampietro 2017). Finally, the work of historians of economic thought - such

as Philip Mirowski and others quoted in the present work - shows that, even in economics, a useful critique can emerge from the history of the discipline. This should be more visible in present economics curricula.

Paul Romer's discussion of 'mathiness', cited previously, shows that the level of debate in economics on what should be unlearned is advanced. However, Romer's very brief tenure as chief economist of the World Bank (October 2016 - January 2018) and the conditions under which he left point to a structure that was unwilling to tolerate his view of the problems with economics.

Even in economics, one should abandon the belief that nothing can go wrong when there are quantitative data and mathematical techniques. As we have discussed in the present paper, the Ricardian dream would need to be revisited, as per the Cartesian one.

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