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Abstract

In *Les économistes et la fin des énergies fossiles*, Antoine Missemer explores the different ways by which economists have made fossil fuels an object of economic analysis, in the period that runs from *The Coal Question* by William Stanley Jevons to Harold Hotelling's 1931 paper. He is interested in the fear of resource exhaustion and its impact on industrial development, but also reports on the theories that pay attention to the economic activities of fossil fuels producers.

Plan of the article

- The Coal Question as an autonomising work
- Discussion of the autonomisation thesis
- American conservationism
- Nature as an asset
- A retrospective object?



1 Written by a young scholar, *Les économistes et la fin des énergies fossiles*¹ is a rare piece in the history of economic thought that deals with economic theories related to energy and was awarded the 2017 Marcel Boiteux Prize for energy economics. Juan Martínez-Alier² brought to light a fascinating gallery of forerunners of Nicholas Georgescu-Roegen's bio-economics, often marginalised or forgotten thinkers. In his book, Antoine Missemer centres on more traditional figures of economic analysis and tells the story of resources economics from the vantage point of fossil fuels. He covers the period before Hotelling's 1931 paper³, often considered as a starting point of this subfield of economics.

2 Before 1931, how had economists thought about fossil fuels? How was the limited amount of the resources taken into account in economic theories? What were the analytic consequences? How did economists perceive the possible exhaustion of fossil fuels? How can the changing stances and methods regarding fossil fuels be related to broader evolutions of economic

analysis? Antoine Missemer seeks to engage with these questions in his research.

Missemer's book is very valuable because it covers ground to which few works have been devoted. From the point of view of economic analysis, Missemer makes us discover a little known yet rich period, when economic analysis evolves greatly after the seeds of marginalism had been sown. We therefore have the opportunity to see how a paradigm shift pervades applied studies and gradually modifies how their objects are handled. From the point of view of the history of energy, Missemer writes an important chapter on the scientific discourses on energy and the analytic tools that support them. Past reflections on fossil fuels exhaustion and its consequences for economic prosperity echo the concerns of our times. Missemer's account of the birth of economic arguments on fossil fuels connects directly to our current concerns about fossil fuel availability and the way we think about it.

To establish the corpus on which his work is based, Missemer finds texts, speeches, books or articles, mainly by economists, which discuss fossil fuels. Such a corpus constitutes what Missemer calls the economic discourse on fossil fuels. He identifies two trends in this discourse: a macroscopic point of view, which is concerned with the economic system as a whole, and especially the role of fossil fuels on industrial development, and a microscopic point of view, that pays attention to the economic behaviours and constraints of mine owners and operators.

He studies the economic concepts used to analyse fossil fuels, how they evolve through time and under the pressure of broader changes in economic theory. He opens out their analytic interrelations and the ways they are mobilised in arguments. If this internalist perspective is more prominent, it is combined with an externalist perspective that pays attention to the social context of the production of ideas.

¹ Antoine Missemer, *Les économistes et la fin des énergies fossiles (1865-1931)* (Paris: Garnier, 2017).

² Juan Martínez-Alier, *Ecological Economics: energy, environment, and society*, (Oxford: Basil Blackwell, 1987).

³ Harold Hotelling, "The Economics of Exhaustible Resources", *Journal of Political Economy*, vol. 39, n°2, 1931, 137-175.

THE COAL QUESTION AS AN AUTONOMISING WORK

- 6 The starting point is the *Coal Question* (1865)⁴. In it, William Stanley Jevons investigates the role of coal in the development of British industry, examines geological evaluations of coal deposits, in Britain and abroad, anticipates the increase of extraction costs that will impede British industry compared to its competitors, discusses the possible substitutes or the technical solutions to curb consumption, and finally proposes the repayment of national debt as a means of mitigating the adverse consequences for future generations of the complete use of cheap coal deposits. Jevons' book is situated in the context of the period. First, a long-term socio-economic context, that is the growing importance of coal for British industry. Jevons writes after a century of tremendous transformations of the British economy, which creates a break with the conditions experienced by Smith, Malthus or Ricardo, who hardly spoke about the role of coal. Second a short-term political context, the context of the 1860s with worries about the availability of high-quality coal and the possible subsequent end of British industrial supremacy. These worries were vocally expressed by an engineer and powerful British manufacturer, William Armstrong. With *The Coal Question*, Jevons thus enters a lively political debate and his contribution will reverberate throughout the next half-century.
- 7 Missemer starts with the *Coal Question* not only because it is the first work of importance that an economist has devoted to fossil fuels but more importantly because Missemer claims that, with it, Jevons detaches the economic discourse from others. Missemer points to a twofold autonomisation. First, from geologists' evaluations: whereas geologists took the exhaustion of coal deposits as a physical exhaustion, that is the end of the availability of coal, its disappearance as an existing object, Jevons denies the usefulness of this understanding of exhaustion and argues that the

exhaustion should be considered economically. What is relevant is not the end of coal *per se*, but the end of coal at a given cost of extraction. The exhaustibility of coal does not raise a problem of mere availability, rather it is a problem of raising extraction costs. A second autonomisation, from engineers' perspectives, is provided by Jevons. To postpone the exhaustion of cheap coal deposits, engineers promote new techniques or devices that save coal. Jevons points to the fatal drawback of these methods to make coal use more efficient: the economies realised thanks to these new processes make final use of coal less costly and develop the demand for coal instead of reducing it: this is the famous rebound effect. Engineers' reasoning is useless if it is not embedded in proper economic thinking. According to Missemer, these two moves made by Jevons set apart an economic discourse. This autonomisation is important for the coherence of Missemer's project, as it defines the unity and structure of his object, its relative autonomy. If there is something like an economic discourse on fossil fuels, distinct from geological, engineering and political discourse, with its own rules, arguments and arenas, it is justified to study it independently from other fields.

DISCUSSION OF THE AUTONOMISATION THESIS

I will take issue with this autonomisation thesis. Instead of the breaks with the geologists and the engineers, I would rather notice the continuities. Certainly, Jevons makes the abstract argument that exhaustion is a matter of too high costs and not of physical availability. But when he comes to numbers, he relies on geologists' estimates of coal reserves, and these do not depend on cost. Furthermore, one of his main arguments is that the common measure of exhaustion (the ratio reserves on production) is not relevant when production is growing. He emphasises that its rate of growth has a stronger influence on the exhaustion date than the estimates of reserves, a simple argument that does not have a distinctive economic angle but has more in common with geologists' or engineers' contributions to the debate.

⁴ William Stanley Jevons, *The Coal Question* (London: Macmillan, 1865).

- 9 When writing the *Coal Question*, Jevons had no intention of taking a specifically economic stance. His essay is rather a contribution to an ongoing political debate, whose socio-economic context is aptly described by Missemer, a contribution which is embedded in the same knowledge used by other contributions, a knowledge about geology of coal reserves, trade, industry, energy uses, international competitions. What Jevons wrote can be considered today as an economic discourse on fossil fuels, but it was in continuity with discourses that we would assign, from the viewpoint of today, to other realms of knowledge.
- 10 Because Missemer is keen to highlight how Jevons broke with past works, he rightly dismisses the connection with Malthus' fear, yet he does not give a fair hearing to the resemblance between Jevons' depiction of the effects of the raising price of coal and the stationary state of Ricardo-Mill induced by increasing cost of land cultivation. This resemblance is not a coincidence. Jevons wrote his book partly to gain public stature and to be offered a position in academia. That Jevons wanted to be heard and recognised by his fellow citizens explains why he resorted to language close to Mill's *Principles*, the common language of the British elite at the time.⁵ This stresses again that Jevons' book was addressed to a political audience that is not limited to that of economic analysis.
- 11 The innovations made by Jevons, like the rebound-effect, are real but the continuities outweigh the ruptures. The specific economic reasoning spotted by Missemer is so intertwined with different types of arguments that it is not convincing to consider the *Coal Question* as an act of autonomisation of economic analysis. *The Coal Question* is a passionate plea from a learned gentleman about a problem he sincerely fears. I view it more as a remarkable example of how economic analysis can be blended with other types of knowledge to yield an assessment of a policy problem.
- The autonomisation thesis that sets apart an economic discourse legitimises Missemer's point of view, but it is also a product of his focus on economic arguments and economists. Unfortunately, what should be viewed as economic or as an economist is not defined nor thematised, even though the very notion of what an economist is evolves greatly across the period studied, as indicated by the name change from political economy to economics. It seems that Missemer relies on the contemporary conception of what is economic to select his material. To apply this category far back in time, however, when the boundaries between academic disciplines were not established as they are today, raises generic problems. For the analysis of Jevons' work, two risks are involved. First, drawing a sharp boundary between "economists" and those we do not recognise as such severs Jevons from his intellectual associates, because we hail him as a great economist and not them. At the time, however, he contributed to chemistry, spectroscopy, was an ex-gold assayer and was to become professor of logic and moral philosophy. Viewing him as an economist makes his contribution more special than it is. For example, what makes it especially economic, according to Missemer, is the distinction between physical and economic exhaustion. But this had already been made by Thomas Sopwith, an "engineer" and Williams Armstrong, the manufacturer, as Missemer recognised. Why not instead consider Sopwith as an economist? The separation between what today we call an engineer, a geologist, an economist, an industrialist, a moral philosopher or a natural scientist was less sharp than our current categories suggest. Addressing properly this issue would have broadened the scope of the book by making room for non-economic interventions in the debates about fossil fuels in Great-Britain.

AMERICAN CONSERVATIONISM

Fortunately, the detailed account of American conservationism avoids these pitfalls. Here the coherence comes naturally from the fact that a single social and intellectual movement is under the spotlight. The case of Gifford Pinchot,

⁵ Michael V. White, "A Biographical Puzzle: Why Did Jevons Write *The Coal Question*?", *Journal of the History of Economic Thought*, vol. 13, n°2, 1991, 222–242.

forester, civil servant and a leading figure of conservationism, who characterises it in the phrase “the greatest good for the greatest number for the longest time”, an obvious extension of Bentham’s, amply demonstrates that the separation of what is economic and what is not is highly debatable.

14 Missemer presents the context of the end of frontier at the end of 19th century. Conservationism sought to avoid the waste of resources and to develop the natural resources of the country in a rational, ordered manner, in a way that would benefit present and future generations. Fossil fuels were only one topic among others for conservationists and fear of exhaustion was not so influential on their thinking. Contrary to the British who were afraid of the end of their supremacy over other nations, conservationism was self-centred on America, as it seeks to hand natural resources and landscapes on to future generations.

15 Yet, bringing together American conservationism and the British fear of coal exhaustion reinforces the impression that the “economic discourse on fossil fuels” is a questionable object. We really have two different scenes, with different actors, different backgrounds, different temporalities. The arenas in which the texts were produced are separate and Missemer gives no hint that the two are effectively connected, that there had been some transfers of ideas, concepts or texts between the two. It even seems that the *Coal Question* was not known on the other side of the Atlantic, as I found no citation of Jevons in some major works that I checked. Instead of a single strand that develops across countries and evolves through time, we have at least two different strands, each coming from its own context. This does not make less relevant the comparison carried out by Missemer and the contrast he draws between the rather pessimistic British slant and the more optimistic and future-oriented American one, but it certainly puts into perspective the presentation of the *Coal Question* as the opening work of economic discourse on fossil fuels.

NATURE AS AN ASSET

Missemer’s focus on economists is much more convincing in the rest of the book, which deals with two “microscopic” questions, the rent of mines and the intertemporal allocation of resources. Here, the level of technicality of the debates indicates a greater autonomy of the field, and there is certainly a strong overlap between those who venture into these arenas and the economists. 16

In a particularly successful chapter, Missemer focuses on the issue of rent. Starting from Ricardo’s theory of land rent, he describes how a demand grows for an explanation of the rent of mines, as the notion of Ricardian rent is itself called into question with the advent of marginalism. This shows the link between the more specific issues of resource economics and general developments in economic analysis. A firm theoretical ground seems eventually to be found with the notion of compensation: mining rent would thus be a compensation for the reduction in underground value due to extraction. However, this consensual position is completely abandoned and, in a dramatic reversal, economists shift back to Ricardo’s mining rent theory. 17

The fourth and last chapter details the conceptual changes that made Hotelling’s 1931 article possible. It begins with what appears, at first sight, to be a detour, with the theory of capital, one of the places where economic theory evolves rapidly and separately from the repercussions of marginalism. The changes began with the Austrian school and Böhm-Bawerk, which saw capital as a production roundabout. Capital is then very different from raw materials and energy resources. Then comes the Fisherian approach to capital, which opposes it to income: income is a flow of payments, capital is a stock of wealth. Here, the characteristics of the production process no longer matter. Only the flow or stock nature of the payments is decisive in qualifying them as capital or income. From this point on, Missemer describes a fascinating process of extending the meaning of capital, by analogy, contiguity, contamination. With Alvin 18

Johnson, the notion of natural capital is forged: nature is seen as a stock of wealth. A forest, or a mine, for example, is a stock of wealth because it can be sold for money. They are elements of natural capital. Missemmer sees this extension of capital to nature as a critical link in explaining the genesis of Hotelling's article.

19 Hotelling's article indeed deals with the exploitation of exhaustible resources and gives the conditions for its intertemporal equilibrium. But, Hotelling's view is designed to apply to all exhaustible assets, without supplementary specifications. The encompassing category of natural capital explains how a mine can be viewed as an instance of exhaustible assets.

20 Missemmer notices the gaps between Jevons and Hotelling. Hotelling focuses on the micro-economic properties of a mine, in a very abstract way. The consequences of fossil fuels for economic development are out of his scope. The result is a much more optimistic view of the end of fossil fuels. This end is not in fact a problem since resources are assets like any other. This is a remarkable change from Jevons, partly due to the change in context, partly due to the change in perspective.

21 The contrast is also established at the level of the method each uses. Hotelling used sophisticated mathematical tools for the period (the calculus of variations) whereas Jevons' subject was literary. I would like to stress that Hotelling's article contrasts with Jevons' book not only because of its use of mathematics. They differ also in the way they argue and the audience they target. Hotelling took American conservationism as a trigger to investigate whether the restrictions of exploitation favoured by conservationists are warranted. Yet, when reading his article, it is difficult to shrug off the impression that this is only a pretext. Hotelling develops at great length the modelling and the different cases which lend themselves to his mathematical treatment but is far less interested in the conclusion he could draw and feed back into the debate that originally motivated his research. The debate about conservation has inspired Hotelling but he

does not connect his work back to that debate. His paper frames questions in a way that only interests economists. So here, in the paper, we detect the harbinger of the autonomy of economics. It signals that economics can become a self-centred field, strongly detached from practical reality. So, if there is someone who detaches himself from the social context and is not much interested in the effect his writing could produce, it is certainly Harold Hotelling.

A RETROSPECTIVE OBJECT?

To close this review, I would like to make two 22
comments that both originate in the use of current categories of economic knowledge in writing its history.

First, economics now has a category of exhaustible 23
resources, *i.e.* resource that is non-reproducible, of finite stock and of unique use. Missemmer looks at past works through these lenses. He often stresses whether past economists classified resources in a similar way to that which we deem relevant today, and especially whether they have identified the finiteness of the stock of so-called exhaustible resources. Yet, this category is not a matter of fact. Resource economists with a good knowledge of the oil industry, for example Adelman⁶, have challenged whether finite stock is a truly distinguishing and meaningful feature.

The current classification is the very product 24
of the theoretical work recounted by Missemmer. Consider, for example, the distinction that Bruce, an American economist at the turn of the 20th century, made between solid mineral (like coal) and fluid (like oil and gas). That this distinction has not taken roots in economic analysis does not tell us something about the economic nature of exhaustible resources. After all, a provocative essay by Timothy Mitchell⁷ precisely relies on this distinction, deemed irrelevant by economists. Economists have chosen to highlight some

⁶ E.g. Morris A. Adelman, "Modelling World Oil Supply", *The Energy Journal*, vol. 14, n°1, 1993, 1-32.

⁷ Timothy Mitchell, *Carbon Democracy : Political Power in the Age of Oil* (London: Verso, 2011).

characteristics and to downplay others and it would have been very interesting to report and discuss how they justified their choices. Because both the category of “exhaustible resources” and the classification of fossil fuels in it are mostly taken for granted, the opportunity has not been taken to reflect on the process of their construction, although there is the material to service such an exploration.

25 A similar observation can be made about the nature of the exhaustibility of resources. Any question on this subject is settled from the start by hailing Jevons as the great initiator of the economic discourse on fossil fuels. This narrative depicts his economic understanding of exhaustion as the bedrock on which others will build. There are nevertheless variations across authors as far as we can learn from what Missemmer reports. For example, the way Hotelling’s model introduced a finite stock of resources, known *ex ante*, points to a physical understanding of exhaustion. It would have been valuable if this aspect had been monitored more closely throughout the book.

26 Second, Missemmer wants to go farther into the past than the moment often considered as the starting point of exhaustible resources economics. This is a very legitimate endeavour. However, its own starting point, Jevons’ book, is the “act of birth of fossil fuel economics” only in retrospect. Jevons’s book, if it influenced political debates in Britain, was not the onset of a tradition of studies or discourses on the subject of fossil fuels. Until the concerns of the 1960s–70s drew attention to it again, it remained largely ignored or was seen as a work that had no value outside the context in which it had been produced. For example, the *Palgrave dictionary of Political economy* of 1896 only mentions the book in connection with the repayment of national debt. And Keynes⁸, in his bibliographical notice on Jevons, mocks its fear of exhaustion and disparages Jevons’s solution to it. Nor did his book cross easily the Atlantic, as I have noted above.

⁸ John Maynard Keynes, “William Stanley Jevons 1835–1882: A Centenary Allocation on his Life and Work as Economist and Statistician”, *Journal of the Royal Statistical Society*, vol. 99, n°3, 1936, 516–555.

This does not suggest that the current narrative should not be challenged. Hotelling’s 1931 paper is intuitively perceived today as a starting point of exhaustible resources economics because the intense theoretical elaboration of the 1960s and 1970s “is essentially based on Hotelling’s paper” as Arrow⁹ said, and also because some influential papers,¹⁰ presented it as such. But Hotelling’s 1931 paper was rarely cited before that. Early landmark works¹¹ in the area (incidentally, not all made by economists in the current meaning) ignored Hotelling’s paper. If Hotelling’s article is seminal, it has taken more than thirty years for it to stimulate wider research. If we want to date the beginning of exhaustible resource economics, I believe that we should place it in the 1970s when it exists not only intellectually, in the links that can be made across books and articles, but when it also takes the form of a social group, with leaders, rituals, teaching, and its quest for founding fathers.

Taking fossil fuels as a common thread enables Missemmer to provide an overview of economic analysis related to resources during three quarters of a century and to illustrate the important evolutions of the concepts in this period. Placing the material gathered under the umbrella of an “economic discourse on fossil fuels” does a disservice to his impressive work. If we put aside this narrative of a discourse that develops from a single point, we find an exciting story of the birth, evolution and death of several intellectual traditions devoted to questions relevant to fossil fuels’ exploitation. Moreover, what strikes me the most in Missemmer’s depiction is how little fossil fuels are a definite object of economic analysis. In the eyes of the economists of the period, fossil fuels are not viewed as a coherent

⁹ Kenneth Arrow, “Hotelling”, in John Eatwell, Murray Milgate et Peter Newman (eds.), *New Palgrave: a dictionary of Economics* (London: Macmillan, 1987), 67.

¹⁰ E.g. Robert M. Solow, “The Economics of Resources or the Resources of Economics”, *American Economic Review*, vol. 64, n°2, 1974, 1–14.

¹¹ Like the Paley report (1952) or Harold J. Barnett, Chandler Morse, *Scarcity and Growth: the Economics of Natural Resource Availability* (Baltimore: John Hopkins University Press for Resources for the Future, 1963).

object, they are either fragmented or lumped with other resources. For example, Jevons' book deals only with coal. American conservationism is concerned with natural resources in general (including forests). The theory of the rent of mines applies indiscriminately to fossil fuels and minerals. And Hotelling's contribution actually extends to any exhaustible "asset". Fossil fuels were not built as an analytic object of economics in the pre-Hotelling period.

The situation has not changed much in this regard. Theoretical research has dived into the micro-economic characteristics of the production of fossil fuels but has neglected their macroscopic impacts on the economy. What connects the two and what makes fossil fuels specific is their energy content. This fundamental aspect of fossil fuels, fossil fuels as an energy source, was present in Jevons but has been missed since. 29

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