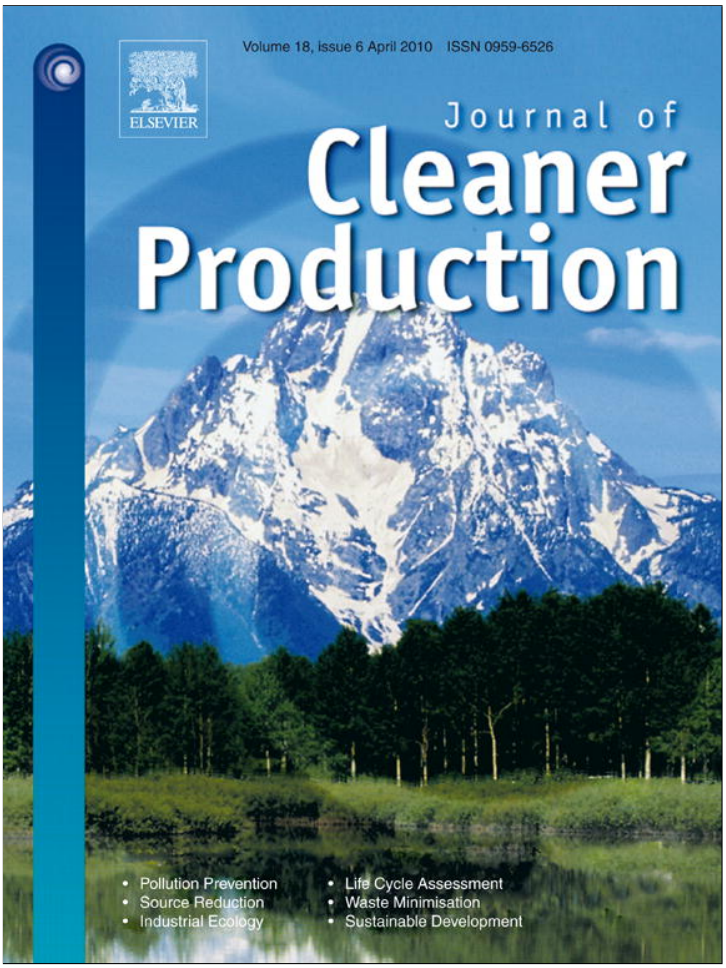

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Book review

John, M. Polimeni, Kozo Mayumi, Mario Giampietro, Blake Alcott, 2008. The Jevons paradox and the myth of resource efficiency improvements, Earthscan Research Editions, London, Sterling VA

Understanding the Jevons paradox is highly relevant for the sustainability of society and continuation of life. The concept is expressed by Jevons in his 1865 "The Coal Question" book, "It is wholly a confusion of ideas to suppose that the economical use of fuel is equivalent to a diminished consumption. The very contrary is the truth" (Jevons, 1866). As the authors of "The Jevons paradox and the myth of resource efficiency improvements" explain, a large majority of experts and politicians take for granted that efficiency would be an effective policy instrument to reach sustainability. Followers of Jevons develop a different view: energy efficiency can actually lead to an increase in energy use, called a backfire.

The book is composed of six parts. In the foreword, Tainter illustrates Jevons phenomenon by describing different situations where outcomes at the macro scale do not reflect what is expected from an action at the micro level. Reducing meat consumption would not lessen environmental damage if the monetary saving are used for plane travel; in ancient Rome, decreasing the cost (or improving the efficiency) of conquests lead to more conquests; improving efficiency in Word processing lead to higher paper use and work load; reducing cost of using high energy weapons lead to an increase of their usage; reduced energy consumption of vending machines leads to their proliferation in more locations; more efficient air travel has generate "low cost" companies and therefore increased the number of people using plane. Tainter questions the existence of a field where the Jevons paradox is not found. Facing the failure of passive reduction of consumption and passive efficiency increase, Tainter calls for preventive governmental policies, such as increasing prices or taxes when implementing efficiency measures.

The next part of the book is an introduction by John Polimeni, Mario Giampietro and Kozo Mayumi. It starts with a description of the skyrocketing growth of both population and affluence in the last fifty years. In face of peak oil and ongoing population growth the book challenges what is called the Hicks hypothesis, which says that price signals would solve all problems with energy efficiency advancement. The authors argue that this blind confidence in the power of progress and better technology provides a justification for refusing to consider an alternative development path.

The chapter by Blake Alcott provides a detailed literature review on the Jevons paradox. It gives an amazing bibliography of early economists which unveils the wide ignorance of today's experts about a phenomenon that seemed pretty well understood by thinkers at the beginning of the Industrial Revolution. This serves as the ground for the definition of the concepts that come throughout the book.

In the fourth part, Mario Giampietro and Kozo Mayumi provide a different perspective on the increase of efficiency for reaching sustainability. They analyze Jevons paradox in economic systems in the light of evolutionary theory and thermodynamics. Economic systems are seen as living metabolic systems, being Complex Adaptive Systems. Firstly, the authors outline the problems with measuring efficiency because economic systems fulfill many tasks across different hierarchical time and space scales. This makes it difficult to measure overall efficiency.

In this context, the researchers analyze several dualities. The first one concerns structure versus function, and asks whether efficiency implies changing the structures of objects or their function. In other words, the duality concerns whether we should go to work by different means of transport (changing structure) or use cars differently (changing function). This double characteristic of economic systems makes evolution possible. Thanks to the apparition of new functions for the same structure, or new structures for the same function, many bifurcations are created. With evolution occurring at different scales of time and space, the authors raise the important point that formal models for describing and predicting the effect of such evolution quickly become obsolete.

A second duality entails extensive versus intensive parameters, or quantity versus quality. This duality separates changes linked to the size of the system (such as number of cars, which the authors call extensive variables) from changes linked to qualities of the system (such as energy use of cars, which the authors call intensive variables). In relation to Jevons, the increase of machines efficiency boosted the exploitation rates of coal reserves. "Economy" understood as an increase of economic efficiency (intensive variable) leads to increase of the "Economy", understood as the system of production and consumption (extensive variable). Between 1950, 2005 in US, the economic energy intensity, which is the energy use per unit of GDP (intensive variable) halves. The US, however has not spared energy because during the same period the total energy use (extensive variable) triples. The idea that we will reduce energy use by simply being more efficient is wrong. Concerning the data used by the authors, it is unclear whether indirect energy use is included, as there has been outsourcing during this time period. In this case the increase of energy consumption would be even higher. Giampietro and Mayumi talk about causality between the decrease of energy intensity and the increase of energy use, even though there are counter-examples. For instance, in the case of Japan during the oil crises there is a decrease of energy use along with an increase of efficiency. This point requires further development as Jevons paradox did not occur in this case.

The third duality concerns the increase versus the decrease of adaptability. When systems become more "efficient" adaptability

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can either increase (by increasing possible choices) or decrease (by discarding obsolete options). As the authors see adaptability as very important for sustainability, they find it simplistic to say that efficiency is good for sustainability. This makes it impossible to predict the final result of efficiency measures. Giampietro and Mayumi analyze this in the light of two thermodynamic principles that seem to conflict with each other: the minimum entropy production, which supports survival in a given context and the maximum energy flux supposed to increase adaptability. The two principles can be seen as two interpretations of efficiency outside equilibrium. Reducing resource use with the first principle has a beneficial effect: we can continue longer with the available resources, but would reduce the options available. For example, according to the authors, decreasing use of horses (or of car?) reduces our options and capacity to adapt. Maximum energy production, which means going faster by car for example, would have a different property. According to Giampietro and Mayumi it increases resource use but has the positive aspect of increasing the available options, supposedly increasing our capacity to adapt.

Continuing with dualities, the chicken and egg problem is another major challenge to reductionism. Chicken and eggs dilemmas require dealing with different scales, with different time representation and horizons. It leads to the idea that there is not one truth as conflicting models might not mean that one is wrong but that they might involve different levels of understanding of a problem. Diversity of opinions is good for adaptability. We need diversity also in terms of levels of action. Single solution will fail. The authors believe that in order to develop good survival strategies loops between increase of efficiency and increase of adaptability are needed.

In the next part of the book, Polimeni looks for evidence on the macro rebound effect. Studying data from the US, Europe, Asia and Brazil, he presents empirical evidence that Jevons paradox exists in many countries and that technological improvement might not be a universal remedy to environmental problems. Technological improvements are only viewed as potential complements to energy and environmental policies. Polimeni also stresses the importance of consumer behaviour.

The concluding chapter associates the Jevons paradox with the concept of Malthusian instability, based on the idea that living systems have a natural tendency to "get in trouble" in favorable conditions. This mechanism is important to support their ability to adapt and become something else (evolve). This is a survival process because growing systems do no live long unless they transform. As an illustration, the fossil fuel-based modern society has been boosting the expansion capacity of industries. Authors unite behind the idea that consumers and policy makers have to develop reflexivity, that is the willingness to change themselves in order to co-evolve with others and the environment. This poses a challenge to the reliance on markets and technological progress.

1. Discussion

The book is one of the most extensive reviews and analysis of the Jevons paradox to date. It nevertheless stirs a number of discussion points.

The book focuses on analysis and remains very prudent concerning the exploration of solutions to Jevons paradox. In the mentioning of solutions, the authors do not unite. Tainter supports governmental action, Polimeni individual action and Giampietro focuses on the unpredictability of actions and the necessity of loops between search for efficiency and search for adaptability.

Malthus comes several times as an important reference. However criticism of Malthusian thinking is largely lacking. Malthus believed that if living conditions improve people are going to increase in numbers. However he is also a fervent defender of privileges. The book overlooks the fact that keeping inequity is another way to avoiding transformation, as fascination for affluence remains when gradient of wealth remains.

Giampietro and Mayumi develop an interesting analysis of efficiency based on an evolutionary framework. The authors defend that efficiency fails because it enables growth through a Jevons paradox. However, the Jevons paradox is in a way also perceived as fundamental to evolution and positive for bringing new options. Evolutionary theories applied to socio-economic systems however have their critics, for example by Juan Salvador (Juan, 2006) and Alain Gras (Gras, 2007), the latter being thinker about techniques and degrowth in France. In light of these critics it is possible that Giampietro and Mayumi do not entirely distance themselves from the growth progressism related to many evolutionary interpretations of technical development. For instance, adaptability is envisioned in the context of increased resource use, while frugality is seen as a limitation to adaptability. Evolutionary theories have shown their relevance in biology, but even though they give a convincing interpretation of the Jevons paradox, nothing proves their relevance when technical/economic developments enter in competition with conviviality (Illich, 1973), human and ecosystems. "Liberating limits" (Ellul, 1983), meaning limits that increase the availability of options, are not considered. As an illustration, a car-free city with an adjustment which changes the functioning and organization of a town can increase the possible options. Instead of having all the space taken by cars and roads, the space becomes available for other activities than car driving: trees, convivial meetings, cycling, sun bath, local production, collective acquisitions, etc. Similarly, a population can increase its adaptability by reducing its consumption of animal products as less land and energy would be required for food production. Adaptability will increase if induced by a combination of individual and political action and accompanied by an adjustment of production and consumption capacity to exploit resources. Adjusting resource availability, institutions and behaviours to leave space for diversity of ecosystems and conviviality in Illich sense, can be done by adequate supportive policies and combinations of frugal actions (Schneider, 2009a,b).

The term "boundary conditions" appears several times throughout the text. The Jevons paradox does not actually create an endless increase of consumption, as biophysical boundaries exist. In some cases these boundary conditions can even prevent the rebound effect/Jevons paradox. For instance, during the two first oil crises in Japan efficiency increased but the total consumption of energy decreased because the crisis affected the capacity to produce and consume. It would be interesting to develop all the implications of these events because in this case the Jevons paradox has been prevented, although involuntarily. The authors have shown that, through the search of efficiency, technical systems tend to transform themselves and grow until reaching a maximum capacity. Firstly, under specific conditions the Jevons paradox can be avoided and a degrowth of production and consumption can take place. Secondly, it is not sure that it is only biophysical constraints that matter (such as the availability of material and energy). Availability of time, money, infrastructures, advertising are other important limiting factors. The maximum energy principle presented in the book, is restricted to energy. It would be interesting to expand it to other aspects. There could be maximum money principle, maximum time principle, maximum materials principle, etc. Thirdly, changing resource availability, institutions and behaviour could be a decision that affects the limiting factors.

At the end of the book, the authors note that reflexivity, meaning thinking and reflecting on the consequences of human choices is required to avoid the Jevons paradox. In principle, reflexivity could alter limiting factors. The system analysis of Giampietro and Mayumi however does not give much room to such a voluntary action. The authors tend to believe that the evolution of systems is constrained by thermodynamics and therefore individual action and policy can only generate results if carried out within a narrow feasibility domain (the options space determined by biophysical constraints). "Frugal innovation" as an action at the micro level and policies are not emphasized. Concerning action at the micro level, Giampietro and Mayumi do not seem to make a distinction between sufficiency and efficiency, grouping them into the category of "efficiency". Yet there are technologies that contain fundamental positive limits in themselves, such as bicycles. With other technologies, the improvement of efficiency suppresses the limit to the expansion of resources consumption. Switching from car to bicycle use (sufficiency) differs from improving efficiency of planes. The type of evolution/transformation that they are going to generate will be completely different. More efficient planes allow larger distance travels and promotes organizing activities far away from each other. Acting on the institutional settings in the book is only mentioned in the context of governmental action of setting taxes and putting money aside.

In sum, the authors develop a convincing interpretation of the Jevons Paradox in the context of evolutionary theories. The next step would be to elaborate an evolutionary interpretation of technological/economic/social transformation towards degrowth. Thinking of economic systems as evolving living systems might be dismissed in this new context. Primarily because technological and economic development is in competition with convivial and life systems themselves.

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François Schneider
Universitat Autonoma de Barcelona (UAB), Facultat de Ciencies, Institut de Ciencia i Tecnologia Ambientals (ICTA), Campus de Bellaterra, Despatx C5/331, Cerdanyola del Valles (Barcelona) 08193, Catalunya, Spain
Tel.: +34 93 5 813 870; fax: +34 93 581 33 31.
E-mail address: francois@degrowth.net

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