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Thermodynamics and Economics

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Since Georgescu-Roegen's statement on entropy, there has grown a vast literature on the implications of the laws of thermodynamics for economics. Most of this literature is related to the environmental consequences of the 2nd law, i.e. that any economic activity unavoidably causes pollution¹. This important insight could, at least to some extent, be integrated into (environmental) economic theory. Other implications of thermodynamics will probably be more difficult to be incorporated into the prevailing neoclassical framework, if this is possible at all. An example is the notion of irreversibility, which implies at least some sort of non-equilibrium. A corresponding micro-economic modelling approach was proposed recently in this journal [1]. Another example is discussed in the following. We address the issue of appropriately including the indispensable

production factor energy into macro-economic theories of production and growth, and try to draw some conclusions.

In conventional neoclassical theory the production factor energy is either neglected altogether, which is inconsistent with thermodynamics, or attributed only marginal importance. The argument is that energy's share in total factor cost is small compared to the cost shares of labor and capital. However, the recessions after the oil price crises in 1973/74 and 1979/81 have posed the question how a production factor of monetarily minor importance can have such grave economic consequences.

The conventional view of the low economic importance of energy dates back to the first stages in the development of neoclassical economic theory. Initially, the focus was not so much on the generation of wealth, but on its distribution and the efficiency of markets. Consequently, the early thinkers in economics started with a model of pure exchange of goods, without considering their production. With a set of assumptions on rational consumer behavior it was shown that through the exchange of goods in markets an equilibrium results in which all consumers maximize their utility in the sense that it is not possible to improve the situation of a single consumer without worsening the situation of at least one other consumer (Pareto optimum). This benefit of (perfect) markets is generally considered as the foundation of free-market economics. It shows why markets, where "greedy" individuals meet, work at all. But later, when the model was extended to include production, the problem of the physical generation of wealth was coupled inseparably to the problem of the distribution of wealth, as a consequence of the model structure: Since the neoclassical equilibrium is characterized by a (profit-maximizing) optimum in the interior –and not on the boundary– of the region in factor space accessible to the production system according to its state of technology, factor productivities had to equal factor prices. In the resulting production model the weights with which the production factors contribute to the physical generation of wealth, i.e. the elasticities of production, have to equal the factor cost shares. These cost shares, in the industrialized countries, are typically 0.7 (labor), 0.25 (capital) and 0.05 (energy).

Consequently, according to the neoclassical model, the elasticities of production of the factors, which –roughly speaking– measure the percentage of output growth if a factor input increases by one percent, would have to have these values: labor 0.7, capital 0.25, and energy 0.05. With these input weights a decrease of energy utilisation of up to 7%, as observed during the first oil crisis between 1973 and 1975, could explain a decrease of value added of only $0.05 \times 7\% = 0.35\%$. The actually observed decreases of economic output, however, were roughly ten times larger.

Furthermore, a substantial part of observed long-term economic growth cannot be explained by the growth of the factor inputs, if these are weighted by their cost shares. Large residuals remain. In most cases the residuals play a more important role than the explanatory factors, which, according to Gahlen, makes the neoclassical theory of production tautological [2]. Solow, after noting "...it is true that the notion of time-shifts in the [production] function is a confession of ignorance rather than a claim of knowledge" [3], comments: "This ... has led to a criticism of the neoclassical model: it is a theory of growth that leaves the main factor in economic growth unexplained" [4].

As it has been shown recently, the residuals of neoclassical growth theory can mostly be removed by taking into account the production factor energy appropriately [5-11]. It turns out that the crucial point is to drop the neoclassical equilibrium assumption, and to determine the elasticities of production of the factors by purely technological and empirical considerations instead. Thereby, the previously unexplained technological progress reveals its two principal elements: The first one is the activation of the increasingly automated capital stock by energy; and, of course, the people who handle capital have to be qualified appropriately. The second one consists of improvements of organizational and energetic efficiencies of the capital stock. The short-term impact of the first element is much bigger than that of the second element, but the reverse may be true for the long-term impact, if efficiency improvements fundamentally change the course of economic evolution [11]. The efficiency improvements are identified by shifts of the

corresponding technology parameters in the production functions, whereas energy's high productive power in increasingly automated production processes is revealed by its high elasticity of production: Energy's elasticity, in industrial sectors of the economy, is typically of the order 0.5, i.e. as large as those of capital and labor together. In service sectors it still exceeds energy's low cost share significantly [7]. Both in industrial and service sectors, labor's elasticity is far below its cost share. Only in the case of capital, do elasticities of production and cost shares turn out to be roughly in equilibrium, as neoclassical theory presupposes.²

What are the consequences of these findings? Let us frame one selected point as follows. If wealth had been distributed according to the "marginal productivity theory", labor would have received only a share of national income much smaller than the observed 70%. But apparently, in the past most of the value added by energy was attributed to labor. The underlying mechanism of distribution was that of wage-negotiations in which free labor unions, powerful during times of high employment, regularly succeeded in winning wage increases according to the growth of productivity, i.e. increased production due to increased and more efficient energy utilization. This way most of the population in the industrialized countries benefited from the wealth generated by the production factors capital, labor, and energy.

With increasing automation in production, however, human routine labor becomes more and more dispensable. A possible consequence is the increasing inequality in the distribution of income, as can be observed in the US, where, due to flexible labor markets, the hours worked per year have increased, but the problem of the "working poor" remains unsolved. Consequently, if society wishes to organize labor markets more competitively, while socially unacceptable distributional effects are to be avoided, the question arises how the institutional settings within market-economies have to be adapted to the changing technological conditions.

Certainly, increased investments in education and the design of appropriate labor market and social policies are crucial issues. Here, let us address the issue of how such policies may be financed in a sustainable way. In the past the financial burden resulting from social policies was mainly put on the production factor labor. This is one of the causes of the identified disequilibrium between the cost shares and productive powers of labor and energy, which, in turn, accelerates technical progress towards increasing automation. If this disequilibrium is sufficiently steep, the newly emerging and expanding sectors of the economy will no longer be able to compensate for the losses of jobs due to increased automation in the existing industries, thus destabilizing the system as a whole. Therefore, in view of social and fiscal stability, it might be worthwhile to consider a shift of taxes and levies in the industrial countries in such a way that the production factors labor and energy are burdened more according to their productive contributions to value added.

Notes

1. I.e., the emission of heat and substances into the environment due to entropy production.
2. The production systems are operating in *boundary* cost minima in factor space, where the boundaries, at a given point in time, are established by the state of technology in information processing and automation and prevent the system from sliding at once into the absolute cost minimum of nearly vanishing labor input.

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Assessing economic potential: what the physical sciences have to offer

Jane King (Resource Use Institute, UK)

Perhaps one of the gaps in traditional economics teaching has been the failure to incorporate physical science into economic analysis. Economists have traditionally been wary of intervention by outsiders. Scientists, for their part, have tended to leave analysis of the economy to those trained in economic techniques. Economics and Science rest on different paradigms. However co-ordination between the two can offer new insights in a situation where economic development is increasingly coming up against physical constraints whether in terms of limited resources, such as oil, water or fish, or of the amounts and nature of pollutants we exude.¹ I am one of a growing number of people who believe that economics urgently needs to find a way of dealing with these physical realities. But to do so, it will have to innovate in a fundamental way: it will have to use, in addition to monetary evaluation, a system of physical evaluation.

Money and energy: two units of account

In an unconstrained world the appropriate unit of account for economic analysis would undoubtedly remain that superb concept already devised to assign values and preferences within a given range of economic possibilities - namely money. The drawback is that in looking into the future, and in particular the long-term future, estimates have to be made of the evolution of monetary value; and as we all know in the case of projected oil prices, such estimates can be notoriously misleading. Indeed they can in certain cases even lead one beyond the range of theoretical physical possibility. Monetary evaluation is admirably suited to analysing past economic behaviour or to evaluating short-term trends, but it cannot be relied on for exploring economic potential with a longer time horizon.

An alternative numeraire is offered through Natural Capital Accounting (NCA), an approach based on physical principles.² NCA reflects the fact that production or delivery of a service, is a process of reducing the entropy of the set of components that go to produce the final product; an inevitable conclusion from the second law of thermodynamics.

It follows that in order to reduce the entropy of a system, somewhere else there has to be a sacrifice of negative entropy of at least equal magnitude. In practical terms that sacrifice is the effort involved in terms of the energy required to create the inputs well as the fuel needed to operate the economy. In other words the dissipation of a non-renewable resource. Output is thus quantitatively linked to input as a causal relationship. Production can only occur if the necessary inputs are physically available. Significantly the different linkages do not vary over time, give or take a certain amount of technological improvement.

Modeling the economy in physical terms

Natural Capital Accounting can be articulated through the generic model known as ECCO (Evaluation of Capital Creation Options) and can be applied with appropriate modifications to different regions or countries (a world ECCO model also exists). It should be made clear that rather than conflicting with established economic approaches ECCO in fact complements them. Its purpose is not to explore the collective economic behaviour of individuals in a somewhat different manner from the traditional, but to determine the *physical* potential for growth of the economic system as a whole. That potential will depend on the policies imposed on the model by the user which might, for example be the outcome of an econometric forecast. It cannot be denied that what is not physically possible can never be economically possible.

This is not the place to give an exhaustive description of the structure and application of ECCO, for which refer to www.eccosim.org.uk. Briefly, it is a holistic dynamic simulation model of an economic system. The potential supply of human-made capital is set against the demands implicit in the user's policies. All transformations (such as the formation of physical capital) require a reduction in entropy. That reduction is measured in terms of the consumption of depletable natural capital expressed in energy units of standard quality. It follows that a unit of human-made capital produced may then be quantified in terms of the energy embodied in it.

A useful aspect of Natural Capital Accounting models is that assumptions do not have to be made about economic growth rates. Potential growth rates evolve from the models themselves according to the policies imposed on them by the model user. If sufficient human-made capital cannot be created to meet demands, then something within the system will ultimately give.

By way of example the following sectors are included in a current European model.

- Manufacturing
- Construction
- Market services to industry
- Market Services to people
- Non-market services (government - health - education)
- Non-energy physical resource extraction
- Fossil-energy extraction by type - coal, lignite, natural gas, oil
- Electricity generation by type - nuclear, coal, natural gas, hydro, other
- Domestic housing
- Transport - roads, rail, air & infrastructure
- Consumption - consumer goods, services, transport, fuels
- Agriculture, forestry and fishing
- Water
- Capital transfers (external to EU), balance of international payments
- Internal and external debt
- Income re-distribution (pensions, benefits), average (EU-wide) taxation
- Environmental significant outputs - CO₂, SO₂
- Employment - by different sectors.

The application of Natural Capital Accounting

The purpose of Ecco models is not to forecast the behaviour of the economy but rather to determine whether the economic objectives set by decision makers can lead to the desired results, and what trade-offs may thereby ensue. Given that ECCO is not an optimisation model, there is never any unique solution. The model provides many indicators which may be selected as criteria of success. It is up to the user to decide which. Seeking an acceptable outcome is an iterative procedure.

Many of the policies explored by ECCO models relate to the environment, but by no means all. A few are given by way of example.

- How fast is it possible to develop an alternative energy regime in view of declining supplies of fossil-based fuels? To what extent would the material quality of life be affected?
- Is it possible to sustain the economy in the future without nuclear energy?
- What is the effect, in terms of resource use, of different modifications to the transport system
- What are the implications for the economy of attempting to meet the Kyoto and subsequent agreements on limiting CO2 emissions?
- How fast and for how long can the material standard of living be increased
- What is the effect on the economy of demographic growth rates

There is much talk today about the over-compartmentalisation of knowledge and the need for "interdisciplinarity". How different the world was two centuries ago. In the Edinburgh of that time Adam Smith, David Hume the philosopher and James Hutton the geologist, met in the street, dined and argued together. In Paris Voltaire, de Bourgainville, the explorer, Fourier, the mathematician and Lavoisier the chemist all lived in a Paris that was then a compact city. They shared each other's knowledge and wisdom. Today not one of us can absorb the huge body of skills and understanding that has been built up in these last centuries. However what we can do, indeed must do, is to link up the relevant parts of economics and science within a single system including both the economy and the biosphere within which it operates.

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What is worth keeping in standard microeconomics?

For background to this debate, see *post-autistic economics review*, issues no. 12, March 15, 2002, http://www.btinternet.com/~pae_news/review/issue12.htm and no. 13, May 2, 2002, http://www.btinternet.com/~pae_news/review/issue13.htm

Doctrine-centered versus problem-centered economics

Peter Dorman (The Evergreen State College, USA)

Bruce Caldwell's response to Bernard Guardian illustrates exactly what is wrong with mainstream economics as it is taught and applied: it is doctrinaire. He believes that he has made an advance over more typical teaching approaches by scaling down the math, but I can see no change in the overall project of imposing a dogma in the name of an academic discipline. It is sad to have to conclude this, given Caldwell's large contributions to economic methodology, but there it is.

His examples of "economic reasoning" for the improvement of undergraduate minds are worth a closer look. I could take up all of them, but I will confine myself to the two that are given the most attention, the role of price supports in agriculture and the advantages of free trade over protection.

Agriculture

Agricultural policy has many dimensions. It is a social policy that can support, change or weaken rural culture. It is certainly an ecological policy, whether by intent or not. It influences food

security in the face of ineradicable uncertainties in supply. It is competition policy, favoring either centralized or decentralized market structures. And, of course, it has a political economic dimension, responding to the various interest groups that have a stake in the choices made by government.

What do Caldwell's price ceiling diagrams tell us? If they are like all the other price ceiling diagrams I have seen, they announce that, as a first-round effect, price supports are economically inefficient, sending false signals to the marketplace and incurring deadweight loss. The second-round effect, alluded to by Caldwell, is political: there is rent-seeking that further absorbs resources and distorts policy.

It seems obvious to me that the price ceiling analysis, while it has some value, is hopelessly inadequate as a primary guide to what to do about agriculture. The role of uncertainty and time, of environmental externalities and public goods (such as a healthy rural culture) ought to be central to any serious analysis of this topic, and to short-circuit the process in the way Caldwell describes is to abandon higher-order for lower-order thinking. In practical terms, it also silences students, because their common-sense intuitions about agriculture (many of my own students have rural backgrounds) often have no standing amid the supply and demand curves.

Trade

Caldwell would have students learn the theory of comparative advantage as a guide to making sense of globalization and combating the naive belief that interference with trade can ever be a good idea. He talks in precise dollar terms about the cost per job saved by tariffs on steel, as though the complex effects of such a policy can be perfectly known and calculated. Yet trade policy is complex, and it is fair to say that economists have not yet put together a convincing model of how the system works. In particular, comparative advantage depends on the assumption of balanced trade at the margin - that every extra dollar or euro of imports will be automatically and simultaneously balanced by an equivalent additional value of exports. If this were true in the real world, of course, we would have a simpler, more pleasant life: no country would experience balance of payments crises, there would be no pressure on countries to be "competitive", and one policy alone - free trade - would be all we would need to follow. (For a more extended critique of this sort of cost-of-protectionism analysis, see Dorman, 2001.)

Unfortunately, life is not like that. Laid off steel workers will not automatically find jobs in exporting sectors, and not only because they have the wrong skills or live in the wrong cities, but also because the effect of more steel imports may simply be that the trade deficit increases. (Yes, I know, there is also a theory that says that this can't happen because it would require investors to change their already-perfect international allocation of asset positions. No comment!) This doesn't mean that protective tariffs are a desirable policy response, just that an a priori dismissal of them contradicts the creative, disciplined thinking that teachers ought to encourage in their students - and that denying the legitimacy of reasonable ideas that might occur to students pushes them into passivity or out the door altogether.

Conclusions

I have two concluding thoughts. First, the level of math is not the issue. One can be dogmatic with blackboard diagrams and open-minded with reams of equations. In general, less math is generally better, because it lowers the barrier to critical thinking, but simply getting rid of math is not the point. Second, the solution is not to replace one dogma by another or even by a menu of competing dogmas, but to redefine, for our students and ourselves, economics from being a doctrine-centered to a problem-centered enterprise. Instead of agreed-upon theories dictating simplified or completely fictitious examples (with their widgets, perfectly behaved functions, etc.), real-life cases in all their messiness should be the measure of any theories we throw at them. Such an economics would not only be post-autistic, but also a lot more fun.

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High priests and run-of-the-mill practitioners

Joseph Halevi (University of Sidney, Australia)

Geoff Harcourt and Bernard Guerrien are speaking about two different sentences in the same paragraph, as it were. Harcourt points out that textbooks usually treated the microeconomic theory of perfect competition as approximating some immanent tendencies of actual economic behaviour. Guerrien notes that the perfectly competitive model has got nothing to do with a market economy, it rather requires a centralised system. Both statements are correct. Many textbooks still present the competitive model as a first approximation and they are wrong of course precisely on the account of Guerrien's observations. I tend to agree with Guerrien's view that Stiglitz's asymmetric information stories do not represent novel findings or new theoretical developments but they simply introduce imperfections in an otherwise standard approach. In other words, Stiglitz's reasoning would not exist without having at its foundations traditional micro-theories. I think that this is true also for macroeconomic models which once were flagged as most innovative such as those pertaining to rationed equilibria. They all postulate the existence, somewhere, of a Walrasian equilibrium.

Thus the substantive issue is whether or not there is something to be retained from micro-theory. My own answer is in the negative. The existing body of microeconomics has no cognitive content in relation to its object of inquiry. In this respect Bernard Guerrien, a mathematician who has brought out before any English speaking economist the significance of the Sonnenschein-Mantel-Debreu theorems, has done extremely valuable work in pointing out the lack of interpretative value in the standard approach.¹ I do not agree with the view that bits and pieces may be salvaged and retained on the account of their practicality. If the demand curve can be of any shape, that is if there is no compelling reason to assume that the demand curve should be downward sloping then there is no point to retain the theories built upon that premise just for practical matters. Practicality is in itself a constructed process and if it is based on particular premises which have no reason to be selected as the more relevant ones, it becomes a trivial ex-post rationalization as well as justification of the theory. These sort of things belong more to the domain of the sociology and politics of research and of ideas in general, yet they have nothing to do with the cognitive dimension of a particular theoretical construction. I would extend my negative conclusions also to macroeconomic theory as taught in most textbooks. The latter is even in a worse shape than micro-theory since it is heavily biased towards representative agent's models and flawed aggregate notions such as capital as a factor of production. Micro-macro theory as it stands today in textbooks provides neither a form of basic reasoning in practical terms, nor does it help to apprehend economic concepts. Just consider the most crucial of them: price. No price is determined the way traditional theory would like us to believe. If anything, prices are likely to be determined in a monetary manner and they are connected to the process of production and the formation of multiple profit margins and rates of profit. Furthermore a classification of price behaviour would show many different forms of adjustments hardly having anything to do with the fairy tale taught in standard lectures.

While micro-macro textbooks may easily be disregarded with no loss of knowledge as to the functioning of contemporary societies, the teaching of traditional economics, and indeed all of economics, should be linked to Joan Robinson's principle of critically knowing a subject in order not to be fooled by its high priests and run of the mill practitioners. This is especially true when in today's polity economics performs the same role of theology in the past as the conduit for the expression of social, economic and political interests.

Note

1. Bernard Guerrien, *Concurrence, flexibilité et stabilité*, Paris: Economica, 1989.

Joseph Halevi is the editor (with Jean_Marc Fontaine) of *Restoring Demand in the World Economy: Trade, Finance and Technology*.

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Theoretical substance should take priority over technique

Geoffrey M. Hodgson (University of Hertfordshire, UK)

Essentially, neoclassical theory involves actors who are rational in that their behaviour is consistent with the maximisation of utility with a given preference function. Two other features follow. The concept of maximisation points towards equilibrium outcomes and a disposition towards equilibrium conceptions and solutions. Furthermore, the concept of capable preference involves a more-or-less well-defined choice set, involving either certainties or calculable probabilities. As a result, chronic information problems such as radical uncertainty, ignorance or interpretative ambiguity are excluded.

I would prefer to define neoclassical economics in this way, and not in terms of any ideology or predisposition towards competition or markets. I agree entirely with Bernard Guerrien on this point. Theorists have attempted to apply the neoclassical approach to socialist planning and capitalist monopoly, as well as to competitive markets. Just as we have individualistic, pro-market neoclassical economists (such as Milton Friedman) we have liberal or social-democratic neoclassical economists (such as Kenneth Arrow and Paul Samuelson) and also 'Marxist' neoclassical economists (such as Oskar Lange, John Roemer and Jon Elster). The essential core of neoclassical theory involves rationality, equilibrium and adequate information. This theoretical core is quite adaptable, and has served a variety of ideological positions, from left and right.

Having defined neoclassical theory, we can now attempt to answer Guerrien's question. What is 'worth keeping'? Many mainstream economists today, especially in the last 20 years, accept some of the limitations of the neoclassical core theory. For example, Herbert Simon's concept of bounded rationality is now acknowledged. Many experimental economists are sceptical of the neoclassical axioms. Yet still the core neoclassical assumptions still dominate the journals and textbooks.

When we ask 'what is worth keeping?' there are really two questions here. One concerns what should be taught on the economics curriculum. The second concerns the adoption, application or development of a theory by a researcher. I'll deal mainly with the first question and touch briefly on the second.

There are several reasons why the curriculum is still dominated by the neoclassical approach. Among these, economics has almost turned into a branch of applied mathematics, where the application and development of the technique has become more important than the explanation of the (economic) phenomena involved.

A second reason is equally important: heterodox critics of neoclassicism have failed to develop a substantial alternative theory that addresses the questions of individual agency and choice that should be part of the core of any viable analysis. The development of such a theoretical alternative is a major priority. There is progress, but it is frustratingly slow, and it is discouraged by the prevailing incentive structures of modern academic economics.

So, where do we go from here? The first injunction is: concepts have first priority, mathematical techniques second. Those that complain that it is necessary to devote an entire curriculum to neoclassical theory, on the grounds that there is 'not enough time available' to teach anything else, are typically driven by techniques, not by concepts. They stress the paraphernalia of technique rather than core ideas. They are often ignorant of the theoretical alternatives that do exist.

Pedagogic economies can and must be made. The core ideas of neoclassical theory should not be excluded from the curriculum but placed alongside alternatives. For example, the psychological assumptions that underlie 'rational economic man' should be made explicit and compared with other psychological approaches. Just as much emphasis should be placed on the conceptual limitations of game theory as on its techniques. Students should be encouraged to identify, compare, contrast and criticise key ideas.

One of the problems now is that teachers of economics have been trained in a technical fashion and are ignorant of from where the key concepts come. Economists should regain and enhance the capacity to scrutinise concepts, and give those abilities more weight than mere competence with techniques. The awful truth is that the reform of economics may now require the retraining of a whole generation of teachers of economics.

An important first step in revitalising economics would be to give more space and prestige to the methodology of economics and the history of economic thought, where greater understanding of the meaning and historical evolution of concepts and ideas can be obtained. Conceptually minded and critically able economists will once again be attracted to the profession.

Another vital step would be to introduce a plurality of theoretical approaches. Overall, in the curriculum, neoclassical theory should be just one approach alongside institutional, evolutionary, behaviouralist and other alternatives.

Turning to the second question: what use is neoclassical economics as a theoretical approach? This question is very complicated and an adequate answer would take much more space than I have available here. But I would like to stress the following points. First, for all their defects, the different versions of neoclassical theory have enormous heuristic power. It is a good intellectual work-out to read and criticise some parts of neoclassical theory. Second, neoclassical theorists such as Alfred Marshall, Leon Walras and Vilfredo Pareto were subtle and powerful thinkers and it is still worth reading their texts. Third, and above all, neoclassical approaches are deeply flawed but we have not yet developed an adequate alternative.

The development of an alternative to neoclassical theory must involve adequate answers to a number of key questions. For example: how are market prices formed? I do not believe that Marxian or Sraffian theories are sufficient here because they both lack an adequate conceptualisation of the human agency and decision-making processes. Evolutionary and institutional approaches may provide an answer, but as yet one has not emerged.

Of course, a new economics will create new questions, as well as providing new answers to old questions. But it will not replace neoclassical theory unless it can show overall superiority in both respects. The task of developing a new theory is an urgent priority. What is required is a new generation of theorists, with a broad and critical training in economics, which is lacking in the modern curriculum. Dealing with the first 'what is worth keeping?' question may well provide a solution to the problem raised with the second.

Prof. Hodgson's latest book is [How Economics Forgot History: The Problem of Historical Specificity in Social Science](#). Also see <http://www.geoffrey-hodgson.ws/wsn565D.html>.

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Two Perspectives to Guerrien's Question

Steve Keen (University of Western Sydney, Australia)

There are many perspectives from which Guerrien's question "Is There Anything Worth Keeping in Standard Microeconomics?" can be answered. I will consider two: the empirical and the mathematical.

The Empirical Perspective

There is little doubt that the conventional theory of the firm and of consumer behaviour are bad empirics.

On the former front, there are now numerous surveys in economic literature which establish that what neoclassical economics teaches as "the" behaviour of the firm -- profit maximisation by equating rising marginal cost to falling marginal revenue -- applies to at best less than 5 per cent of firms and 5 per cent of products. Research into the actual cost structure facing most products, have routinely found that in 95 per cent or more of cases, marginal costs remain constant or fall across the relevant range of output. Research into the actual behaviour of firms shows similarly that, in 95 or more per cent of cases, firms chase the maximum possible level of sales without any consideration of declining marginal revenue (Fred Lee is the modern chronicler of this literature, with his book *Post Keynesian Price Theory* being the ultimate reference).

Similarly, the vision of consumers deciding what to purchase by working out the point of tangency between the budget hyperplane and indifference hypercurve has failed miserably in experimental work. The latest and best reference on this, Sippel 1997, concludes very honestly with the observation that the theory failed to predict students behaviour in a very well designed controlled experiment, and that as a consequence economists "should therefore pay closer attention to the limits of this theory as a description of how people actually behave".

The fact that despite these empirical failures, economists continue to teach the standard theory of the firm and consumer theory is perhaps the strongest indictment one can give against standard microeconomics. It has acted as a barrier to an honest confrontation with the real world, and deserves to be dropped on that ground alone.

But of course, it won't be: because ever since Friedman's defence of the "as if" approach to economic methodology, economists have felt justified in ignoring the real world since whatever firms and consumers think they are doing, they must be behaving "as if" they were doing what economists say they do, otherwise they wouldn't be profit maximisers or rational consumers.

The Mathematical Perspective

Well, if economists can't be persuaded to consider reality because it conflicts with their mathematics, we're going to have to turn our attention to the mathematics itself. And it turns out that there are good mathematical reasons to reject standard microeconomics.

Let's take first of all the theory of consumer behaviour. The standard presentation—of a consumer making a choice between two commodities—makes the exercise appear simple. But whoever heard of a consumer living on just two commodities? Yet each additional commodity considered involves an additional set of axes—three for three commodities, 4 for four—and each axis increases by an order of magnitude the number of choices facing the consumer.

Once we get anywhere near the number of commodities and number of units per commodity that a typical Western consumer buys on a monthly basis, the number of choices explodes to such a level that simple "rational" utility maximisation is inconceivable. For example, if we simply consider a purchase of less than ten items each from a set of 30 commodities, the number of combinations to be considered is 10^{30} (to put this number in perspective, the age of the universe is under 10^{18} seconds).

This "curse of dimensionality" is a well-known phenomenon in computer science, and it is well-known that an exhaustive maximisation approach is simply impossible with such problems. Instead, consumers have to be following algorithms that drastically reduce the choice space:

letting their choices be guided by custom, convention, habit, income-constrained tastes, etc. The conventional, simplistic vision of consumers as rational utility maximisers is a positive hindrance to serious study of the interesting question of how consumers manage to make consumption decisions in the face of overwhelming choice. By not honestly considering the mathematical implications of their theory of consumer behaviour, economists are practicing bad mathematics.

The same applies in the theory of the firm, where students start off being taught bad mathematics. All economists know the “perfect competition” assumption that the derivative of the market demand curve with respect to the output of a single firm is zero. Not enough know that George Stigler—hardly a radical there—pointed out in 1957 that this is mathematically invalid: if the market demand curve is negatively sloped with respect to market output, it is negatively sloped with respect to the output of a single firm. This is a simple application of the chain rule for a continuous function (and also a product of the assumption of atomism).

A minority of economists appear to know Stigler’s attempt to get around this by redefining marginal revenue for the individual firm as market price plus market price divided by the number of firms times the market elasticity of demand, coupled with the assertion that “this last term goes to zero as the number of sellers increases indefinitely” (Stigler 1957: 8). Too few realise that this was a sleight of hand: the term is a constant if there is a minimum firm size, and therefore the firm’s marginal revenue is always less than price.

So-called mathematical economists have attempted to evade this by assuming that each industry consists of an infinite number of firms each producing an infinitesimal output (not an infinitesimal fraction of total industry output, but an infinitesimal output!). But this makes a mockery of the theory of exchange—how can consumers buy a single unit of anything if they have to go to an infinite number of producers to buy a single unit?—and of the theory of production itself—how can diminishing marginal productivity apply (the foundation of the proposition that marginal cost rises) if the minimum firm size is zero?

All these nonsense propositions have been put forward to defend the indefensible concept of perfect competition, and **they are propositions that any decent applied mathematician would reject outright.**

Yet this kind of behaviour—proposing decision processes that are empirically impossible, making assumptions that are absurd in order to preserve an initial proposition that has been shown to be fallacious—is a direct consequence of adherence to the conventional theory of microeconomics. It is bad, unscientific behaviour, that should have no place in a serious discipline.

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Superior Analysis Requires Recognition of Complexity

Anne Mayhew (University of Tennessee, USA)

Neoclassical microeconomic theory is, both in its simple, and in its most rarified forms, a theory of how a unit will respond when faced with the commercial logic that says buy cheap, sell dear, and if you don’t cover your costs over some reasonable period of time, you will cease to exist. It does not matter whether the prices to which the unit responds are changed through competitive or uncompetitive markets or by an auctioneer; the analysis is of response to price.

The question to ask, in answering Guerrien's question, is whether or not the commercial logic is applicable to units whose behavior one wishes to analyze. The sleight of hand performed at the beginning of most introductory economic textbooks, and assumed thereafter in more advanced work, is that given conditions of unlimited wants and limited resources, the logic does apply widely. The wants can be wants for revenue for firms, utility for consumers, benefits for recipients of government services. If the wherewithal to get those wants (costs of inputs for firms, work or disutility for consumers, tax revenues for governments, resources for all of society) are limited then commercial rationality is assumed to be the only possible rationality; the alternative is assumed to be irrationality.

The power of economic analysis described by Bruce Caldwell (PAE Review no. 13) in his defense of the use of microeconomic theory is the power to explain the impact of price ceilings or floors, price supports, and the like *given that the units involved react to price according to the commercial logic*. I would agree with Caldwell that if this condition is met, then microeconomic theory does have wide applicability.

However, there is a large issue that requires further exploration, and it has nothing to do with the contestable assumption that wants are unlimited and resources finite. I am quite prepared to grant these assumptions for short-term analysis of many economic issues. What I am not prepared to grant is that two additional conditions for application of the commercial logic are in fact met by most of the economic units with which economic analysis must deal if such analysis is to be useful in thinking about economic issues.

The first condition is that there must be a *numeraire* that can be used to perform the double-entry bookkeeping that is core to the commercial logic. A numeraire, or common measurement for otherwise diverse elements, is required to know if you are buying cheaply and selling dearly, and, in fact, is required if the commercial logic is to have any meaning at all.

From this observation follows the second condition that must be met if commercial logic is to apply: the goals of the units being analyzed must be the goal of having commonly measured inflows at least equal to or in excess of outflows. However, as is widely recognized the goals of many social units, such as families and even large commercial corporations, are multiple and cannot be toted up as a simple double-entry bookkeeping exercise. To take a simple example: children are not produced in accord with variation in the current, or even projected, price of labor, so that even if the amount of labor offered from an existing stock of people varies with price (a doubtful assumption), labor markets will also be rendered slightly odd by virtue of the failure of the model of commercial logic to capture the full array of relevant variables. For large firms with political, social and market power, long-term strategies of location, survival, and other goals are likely to outweigh and obscure the simple application of commercial logic.

Where both numeraire and the simple commercial goal exist, microeconomic theory *can* be a useful way of describing probable action and outcomes. Many of Bruce Caldwell's examples of the power of economic reasoning probably meet these requirements. If new rental housing is added in response to expected revenues from rent, and if apartment rental rates weigh heavily in consumer demand, then rent control may reasonably be expected to result in shortages. If, however, as is apparently the case with minimum wages, there are other factors that weigh more heavily than price on behavior of units involved (relatively fixed staffing requirements, number of unskilled people in the labor force, and so on) then neoclassical price theory becomes less useful. It is certainly less useful in exploring the behavior of large, international corporations with multiple goals, and of families with a variety of lifestyle options, than it is in explaining the behavior of small firms that operate in markets consisting of other such firms.

The answer to Guerrien's Essay is, therefore, it depends on what you are analyzing. There is certainly something worth keeping in standard microeconomics, but we should not be deluded by the fancier ways of articulating what remains a simple model, a model so simple that it cannot

capture the complexity of interaction in economies. Superior analysis requires recognition of this greater complexity.

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What Should be Retained from Standard Microeconomics

Julie A. Nelson (Global Development and Environment Institute, Tufts University, USA)

Bernard Guerrien's question, "Is There Anything Worth Keeping in Standard Microeconomics?" is one that I have been thinking about a lot, recently. In working with colleagues on writing an alternative Principles of Microeconomics textbook, we've had to address the question of what it is that we actually want students to know.

My co-authors and I come from a variety of backgrounds—ecological, social, feminist, institutionalist, and radical. While, to have a chance at adoption in most departments, a textbook must cover a number of neoclassical concepts, we've given ourselves some leeway in putting these "in context," and in deciding which to stress, and which to downplay.

We certainly don't think that the number one priority is to inculcate students into adopting a free market ideology, which is the apparent goal of many of the currently available textbooks. Nor should it be to teach students about the elegance of mathematical and graphical modeling. Even if that were to remain a priority at more advanced levels (which we would debate), the vast majority of Principles students will use their knowledge for citizenship, not further study. Lastly, we don't think, given the pressing nature of real-world economic problems, that our number one priority should be to tell beginning students about our internal professional debates about philosophy and methodology. So what should we teach?

We've rejected the usual emphasis on models of "producer and consumer choice," with all its focus on technique and all its bizarre assumptions (e.g., that efficiency is the only goal, that households are not productive, that perfect competition is the default scenario). But—and here we differ from Guerrien—we *do* see value in teaching some parts of the standard introductory microeconomics toolbox. For example:

- The general notion of choice. Choice behavior is one facet of human economic behavior—though not the only one. Putting choice in context means also recognizing the roles of habits or customs (as stressed by institutionalists) and power (as stressed by radical economists) in explaining behavior. Certain traditional microeconomic concepts like opportunity cost, and "rational" (read: reasonable) economic decision-making, in the sense of weighing both costs and benefits in coming to a decision, we have concluded, are worth teaching.
- Supply and demand curves. We introduce these as mental constructs that can give us some insight into real-world price variations, not as curves that exist "out there" in the world. While we also (for adoptability of the book) expose students to marginal cost curves and utility theory, we demonstrate that the usefulness of supply and demand analysis does *not* depend on identifying supply curves with marginal cost curves, nor with identifying demand curves with the result of indifference curve analysis. In fact, our central example in the supply and demand chapter is a highly politicized national market for petroleum. Further elaboration introduces students to the relevance of elasticities for business and government policymaking.

- Gains from trade. Ricardo's old England-and-Portugal story is the basis for the neoliberal push for globalization today, so it is important that students understand the argument. However, we also complement this story with a discussion of the drawbacks of trade. In addition, we include transfer as an important form of distribution right alongside exchange, bringing discussions about intra-household and government transfers into the core of analysis.

Our book, *Microeconomics in Context*, takes well-being as the goal of economic activity. Teaching from it will probably feel less "secure" for many instructors in that it will hold fewer cut-and-dried answers and subjects for chalk-and-talk lectures, and more opportunities for discussion. But, we believe, such teaching will be a considerably more intellectually challenging and socially responsible.

Of course, much of Bernard Guerrien's criticism might more aptly be taken to apply to advanced graduate work and professional research—Slutsky matrices and general equilibrium theory are not usually the stuff of Principles classes. I would attribute much of our profession's fascination with mathematical elegance, over understanding of the real world, to warped notions of "rigor" and a misguided attempt to achieve certainty and absolute control (see [Nelson essay](#) in *post-autistic economics review*, Issue no. 9, 20 October 2001). By keeping our eyes on the more pragmatic goal of developing and disseminating economic knowledge in the service of promoting well-being, I think we can keep what is useful in existing bodies of work—even neoclassical—while working towards developing new and more adequate forms of research and teaching.

Julie A. Nelson is the author of [Feminism, Objectivity, and Economics](#) (London: Routledge, 1966) and (with Marianne A. Ferber) *Beyond Economic Man: Feminist Theory and Economics* (Chicago: Uni. of Chicago Press, 1993). julie.nelson@tufts.edu

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An American Undergraduate Point of View on Economics Education

K.M.P. Williams (Wells College, USA)

As an economics student who has recently had to suffer through the course material, I would like to contribute to the debate regarding "what should be kept in microeconomics". To this end, I have posed two questions.

My first concerns the definition of economics. Widely used micro and macro textbooks define it as the study of the distribution of scarce resources. I wanted to know what future teachers, especially future social studies teachers who are likely to introduce students to economics, thought economics was. Through email, I surveyed education students at Wells College, asking them, "What is the definition of economics?" I received 16 responses. Here are some samples, the first three from students intending to teach high school social studies.

- "The way money and things representative of money are used by people. (??? who knows???)"
- "Economics is the study of income and commerce - it is the management of money."
- "I'm not entirely sure, to be honest. I guess I would say the study of the economy."
- "Economics was the most boring and un-interactive class I have ever taken of which I remember absolutely nothing!"
- "Economics is the study of money and consumerism."
- "I would define economics as the science that deals with income and expenditures."

Only one of these future teachers has studied economics beyond high school and, and except for an environmental science student who wants to take Environmental Economics, none plan on studying it further.

In light of these answers, I asked myself a second question: What should be the purpose of economics education? This question connects with the first. In fact, I believe that the way economists answer this pair of questions is the primary cause of the alienation that so many students and non-economists feel toward economic theory and economics courses. Karl Polanyi's answer to the first question was that economics is the study of how people transform nature to meet their needs.¹ This is very different from regarding economics as a distribution problem and has implications for answering the second question. Indeed, if Polanyi's definition of economics is adopted, the mission of economics courses becomes clear—to help students understand the 'economy' in its broadest sense. This is the position that I have come to, and from it I would like to offer a few comments on the debate begun by Bernard Guerrien.²

I disagree with Bruce J. Caldwell when he says that the conclusions from neoclassical microeconomics are a good representation of a 'basic economic reasoning' that predates it.³ To say "we live in a world in which scarcity makes choice necessary" is an ideological statement when followed by conclusions of neoclassical economics such as that there is an economically determined 'optimal' level of pollution, or that the intersection of some curves representing technical and allocative efficiency can ameliorate the problems of making choices about scarcity. Likewise, the assertion that "producing goods for which one has a comparative advantage permits gains from trade" is shown to be a 'not-so-covert defense of globalization' when, for example, mobility of capital and comparative immobility of labor are incorporated and the human costs of exploitation are examined.

I believe Jacques Sapir's "Response to Guerrien's Essay"⁴ represents a much more coherent rationale of why neoclassical microeconomics does not need to be totally thrown out. Abstraction is not an evil to be rooted out of the discipline. But microeconomics needs to be radically changed if it is to help us understand the economy. If neoclassical theory is exposed in the curriculum for 'what it is'—a theory explaining an imaginary world—and not the 'core' or most 'basic' way to explain the economy⁵, then students can profit from its being taught. Just as neoclassical economists are wrong to deny 'economist' status to those outside the neoclassical mainstream, we should not make it our aim to banish neoclassical theory forever.

The way for economics to avoid alienating non-economists, especially students at the undergraduate level, is to broaden the scope of the curriculum, while at the same time going deeper into each of the issues and problems presented. Micro-theory can play a role in this.

The future teachers surveyed above may be put into positions where they are forced to indoctrinate the next generation into believing in neoclassical economic theory. As Gilles Raveaud has noted, too many people believe "economics has nothing to do with reality. Here we draw curves and manipulate equations that have no counterpart in reality."⁶ In the US, at least, students learn this in high school, and apparently it is reinforced in colleges and universities. However, if students are taught from the beginning to understand microeconomic theory critically, including how to challenge accepted ideology and to learn from that process, then progressive theories designed to someday replace neoclassical theory will have a greater chance of being relevant for everyone, not only radical economists.

As Joan Robinson once said, the reason to study economics is to avoid being duped by economists.⁷

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Towards a New Economics

Frank Rotering (UET, Canada)

About a dozen years ago I heard a Canadian environmentalist, David Suzuki, passionately denounce standard economics for its "stupidity". Suzuki was incensed at economics for its blind faith in growth and its ignorance of "natural capital". I was concerned about the environment and wanted to see what the fuss was about, so I interrupted my computer career and returned to university to study economics.

I found exactly what the PAE movement is now rejecting: pointless abstraction, dogmatism, and a fervent right-wing bias. Evidently economics training in Canada is much the same as in France and elsewhere. I took eight or nine economics courses, dropped some upper-level subjects because of their revolting technicality, and slunk back to my computer career with a Bachelor of General Studies degree and an extended minor in economics.

In other words, I didn't become an economist, and I'm not an academic. However, I have continued to study economics intensely, and now feel justified in putting the coveted UET designation after my name - Unaffiliated Economic Thinker. As a self-appointed UET, let me offer my views on the PAE initiative.

To begin, we have to separate the teaching of economics from the discipline itself. PAE started as a reaction against both the suffocating methods of instruction and the aloof formalization of neoclassical theory. But as several contributors to PAE Review have remarked, it's time to move beyond the teaching and focus on the theory.

In his useful [A Brief History of the Post-Autistic Economics Movement](#), Edward Fullbrook states that we are now at stage three - creating a new framework for analysis and pressuring economics itself to change. I agree. In the remainder of this article I will therefore emphasize the discipline of economics rather than its instruction.

The necessary starting point in building a new theory is to be clear about the shortcomings of neoclassical economics. Numerous problem areas have been cited by PAE contributors. Besides the disconnected models and excessive use of mathematics, neoclassical economics is said to suffer from methodological individualism, from a lack of historical perspective, from a lack of contact with concrete reality, and from ignorance of culture, gender, social institutions, and the environment.

All true to some degree, but missing the essential point, which is that neoclassical economics was built for capital. Neoclassical economics is not a "stupid" theory, despite Suzuki, but one with the specific purpose of serving capital's practical and political needs. Consider the history.

Capitalism's development began around 1500. The classical economists - Steuart, Petty, Smith, Ricardo - grappled more or less objectively with the workings of the new system, until an ideological split occurred about 1800. Ricardo and Marx carried on the classical tradition, basing their analysis on the labor theory of value. Say and Senior, among others, went in a direction more suited to the rising capitalists and essentially founded neoclassical economics.

The classical branch was aggressively developed by Marx, but did not advance much after his death in 1883. Too much deference to the great man, and excessive focus on his historical and political writings, virtually froze his trenchant economic analysis in time.

The standard branch, on the other hand, was actively developed by mainstream thinkers, most importantly the marginalists: Jevons, Menger, and Walras. They uprooted the labor theory of value and replaced it with a utility theory. This purged economics of any revolutionary content and left it with a shallow analytical method, perfectly suited to capital's needs.

Why "perfectly suited"? Because the theory is fixated on the hurly-burly of exchange, which is where capitalists live. It guides them individually in competition and collectively in pressing their political demands. And it fills the intellectual space for economic ideas, crowding out theories that might probe the system's systemic depths and expose its nasty secrets.

So what's most fundamentally wrong with neoclassical economics is ... it's theirs. To the extent that we don't share capital's social role and economic objectives, neoclassical economics is a foreign tool.

It's true that, within limits, neoclassical economics can be modified and extended for alternative purposes. Paul Krugman does good things with it in his New York Times column, defending workers and whacking Republicans. Herman Daly and the ecological economists apply neoclassical economics concepts to environmental issues. Amartya Sen invokes the spirit of Adam Smith to guide the development process, although for him the standard garb is an awkward fit.

But while an adroit person can drive a nail with a rock, a hammer is the better implement, and using a rock to pull a nail is an exercise in futility.

Neoclassical economics, for instance, is a rock that can't address the human ends and human costs of economic activities. It simply has no terms or concepts for these things. It can't deal with class relations because it long ago rejected the social basis of prices and exchange. It can't handle capitalism's underlying dynamics or secular tendencies because its tools are restricted to market activity at the surface. And it really can't deal with ecological constraints, because it was built with infinite resources as a core assumption.

No modifications or extensions will fix these problems. If we want to seriously examine such issues we have to discard the rock and fashion ourselves a hammer.

If you had any doubts about the possibility of alternatives to neoclassical economics, by the way, put them to rest. Any science is an interpretation of reality and is therefore based on a specific viewpoint. In a class-based, gender-divided society, multiple viewpoints are inevitable, particularly in the social sciences. Economics is by no means a natural monopoly; it cries out for competition.

The sobering fact, however, is that entry to this intellectual market is costly. It took neoclassical economics 100 years to get from Smith to the marginalists, and 130 more to arrive at its present state. Along the way many brilliant people did a lot of hard work. While I'm not proposing a project lasting a century or two, there's much to do, so we should understand what the task entails.

An economic theory is a logical structure with a well-defined axiomatic foundation, consistent concepts derived from those axioms, and analytical tools based on those concepts.

Neoclassical economics qualifies because it posits the individual and the firm, utility maximization and profit maximization, and builds a fully integrated structure from there. We may not like the structure, but it's there. In my view, the various heterodox approaches are variations on the neoclassical theme, not fully developed theories.

A new theory must begin by specifying its analytical purpose. For example, a theory might be created to evaluate an economy's inputs and outputs in terms of their effects on human life and health.

The next step would be to state the theory's axioms, which in most cases are embedded in the definitions of core terms. For our theory we might adopt John Ruskin's intrinsic value and effectual value on the consumption side, and define absolute cost as the health effects of production.

Then, to the extent that the theory is amenable to quantification, we have to graph the relationships. This frequently points to internal contradictions. Once these have been removed we can build the analytical tools. Using our value and cost definitions, we could construct methods to determine the optimal quantity and quality of outputs, and to address economic well-being and distribution.

With such a beginning in place, or even earlier, the proposed theory must be opened to criticism and incremental improvement. This is critical. If an approach has an undocumented foundation and opaque logic, it will allow passionate debate but little scientific development. Alternative economic theories must expose themselves to the rigors of transparency and refutation.

If this process is successful we will be rewarded with a rigorous analytical method, independent of capital's viewpoint and influence.

The PAE movement should continue to push for less stultifying ways to teach neoclassical economics. But alongside this effort we should begin to formulate new theories in a disciplined manner. With luck, our children will one day open their university calendars and find our theories in the curriculum. And if we're really lucky, their teachers will be superb.
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Call for Papers from Students

The *post-autistic economics review* is planning a special all-student issue for autumn 2002. It will include between 6 and 9 essays, 2,000⁺ words or less, dealing with the need and ways to reform economics and economics teaching. **Submissions not chosen for the review but of suitable quality will be posted on a permanent section of www.paecon.net** Graduate and undergraduate students are eligible. Submissions should be sent as an email Word attachment to pae_news@btinternet.com Deadline for submissions is September 15, 2002.

* previously announced as 1,500 words.

Correction: Regarding his essay "Teaching students of political science post-autistic economics" in issue 13 of this review, Poul Thøis Madsen reports that his attribution to Keynes of "It is better to be vaguely right than exactly wrong" is incorrect. "if anybody – it was probably Marshall." Does anybody know for certain?

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