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Abstract

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The failings of mainstream economics are multiple. Its central theory, the neoclassical theory, is based on absurd assumptions and its central prediction of equilibrium is plainly contradicted by real economies. It counts the wrong things in the wrong way, using Gross Domestic Product quite inappropriately to measure well being. It is blind to the dominant roles of money and debt in the dynamics of economies. The banking and monetary systems it presides over are highly destabilising. The financial markets it venerates are also destabilising, and have become parasitic. It assumes a base parody of human beings and undermines social relationships and the health of society. It has become fixated on an impossible goal - eternal growth of GDP - that is rapidly degrading the planet and will soon bring about the collapse of global industrial society.

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Bad Theory, Bad Practice: Bad Ethics

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A profession that claims to understand economies, and that has gained power over the greater part of our societies, has big responsibilities. The fundamental responsibility is to ensure its perception of economies gives some useful guidance to the behaviour of real economies. Here mainstream economics fails utterly, and has been failing for a long time. Worse, it actively resists alternative views that might overcome its failings. Ethics do not come much worse than that.

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The term "mainstream economics", as I use it here, thus refers to more than the neoclassical stream of economic theory. It refers also to those who preside over finance, banking, public policy and public accounting and drawing on an array of ancient arcane practices, rules of thumb, habits, ideology and untested beliefs, with some presumably sensible methods and ideas mixed in. It includes academics and managers in the public and private sector. It does not include a diverse array of alternative views and people that is sometimes called "heterodox economics".

Since about 1980 this form of economics, also known as free-market economics or market fundamentalism, has been imposed on much of the world. I will refer to this period as the neoliberal era.

Bad management

A central contention of mainstream economics is that free markets are good. Some would say all of the time, most would say most of the time. Failures of free markets are called "imperfections", implying they're only a little bit wrong.

Nicholas Stern, in his *Review on the Economics of Climate Change* [1], called global warming the greatest market failure in history. He is not quite right, because global warming is only one of many planetary abuses resulting from the failure of markets to include such external costs. Failure on such a scale cannot be dismissed as an imperfection.

What about the performance of free-market economies? It turns out that, even by their favoured measure, the rate of growth of GDP, performance has been retarded relative to that in the post-war decades, during which governments more actively managed economies, quite apart from the recent financial market collapse. This is demonstrated most comprehensively in a study by Weisbrot et al. [2], whose results are summarised in

Table 1. They show that during the neoliberal era GDP growth rates in over 100 countries averaged only 1.09%, less than half of pre-1980 growth rates, which averaged 2.47%.

Table 1 World economic performance, before and during the neoliberal era.[2]

	1960-1980		1980-2005	
Income range, US$	Number of countries	Annual GDP growth rate, %	Number of countries	Annual GDP growth rate, %
355-1225	29	1.7	28	1.8
1238-2332	27	2.4	30	0.7
2364-4031	24	2.6	33	1.0
4086-8977	17	3.6	40	1.3
9012-43713	12	2.6	44	1.3
Average	**(109)**	**2.47**	**(175)**	**1.09**

Each row shows results for a subgroup of countries defined by an income range. For example in the period 1960-1980 29 countries had average annual *per capita* incomes that fell between $355 and $1225; this defines the poorest group of countries. The bottom line shows growth rates averaged over all countries. Because of changes in availability of data, the particular countries falling in a given group may differ between the earlier and the later period.

For Latin America the period 1980-2005 has been the worst in their history, worse even than the Great Depression of the 1930s. Argentina has been recovering from a near-total financial collapse since 2002, but only by explicitly re-asserting control over the economy, especially the financial markets [3]. From 2002 to 2011 its GDP grew by 94% in real terms, an average of about 7% real growth, much the best in the hemisphere.

The mediocre performance of free-markets has been evident, to those willing to look, since at least 1997. Table 2 summarises some basic numbers from slightly earlier periods for Australia and for the OECD [4]. The period 1983-93 features slower growth, higher inflation and higher unemployment than in the pre-1974 period. Unemployment rates of 1-3% have now been redefined as impossible, especially with low inflation. This was accomplished by the invention of an empirical fudge-factor, the "non-accelerating inflation rate of unemployment", which is normally regarded as about 5%.

It is an indictment not only of mainstream economics but also of economic reporting that such basic and telling information is virtually unknown in mainstream political discussion.

Table 2 Economic performance, pre-1974 and post-1974. [4]

	Pre 1974	1974-83	1983-93
Australia			
GDP annual growth (from 1960), %	5.2	1.8	3.4
Inflation (CPI annual increase, from 1953), %	3.3	11.4	5.6
Unemployment (from 1953), %	1.3	5.6	8.4
Current Account Deficit (%GDP, from 1959), %	2.4	3.1	4.4

OECD			
GDP annual growth (from 1960), %	4.9	1.6	2.8
Inflation (CPI annual increase, from 1960) , %	4.5	11.1	6.8
Unemployment (from 1953) , %	3.2	6.4	8.4

The greatest indictment of mainstream economics is the Global Financial Crisis, also known as the Great Recession, that started in 2007. It is well known that the financial markets essentially seized up through the creation of excessive debt, and were only reactivated through dramatic government interventions, using about $2 trillion of taxpayers' money for bailouts. A second phase of the crisis now seems imminent, this time centred in Europe.

It is also well known that in spite of this crisis mainstream economics is still the dominant paradigm, though perhaps with slightly less assurance than before. Mainstream economists claim that the crisis was an unforeseeable event, something that no-one could have predicted, although it is well known that many did predict its occurrence, if not its precise timing. Some of these were recognised by the Revere Award of the *Real World Economics Review* [5], for warning most cogently of the approaching crisis.

The claim that the crisis could not have been foreseen might have slight credence if there had not been a Great Depression in the 1930s, and another in the 1890s, and many sudden financial malfunctions before those. There have also been lesser malfunctions, such as the 1987 stock market crash, the 1997 Asian currency meltdown, the bursting of the dot-com bubble and a number of national crises in Mexico, Japan, Argentina, Brazil and other countries. And all of these episodes are in addition to something called "the business cycle", in which slow-downs and recessions occur semi-regularly, accompanied by considerable economic disruption.

Economic managers have so clearly failed to anticipate, let alone avoid these crises that their conceptual and practical tools are clearly fundamentally deficient. A discipline that treats these phenomena as unavoidable, even natural, cannot be said to have a good understanding of the object of its study.

Bad theory

At the heart of mainstream economics is the neoclassical theory. This theory is an abstraction well over 100 years old, from a time when the idea of a clockwork universe still prevailed in science. To maintain mathematical tractability, the theory makes simplifying assumptions about people and firms. It assumes we are narrowly rational and that we can foretell the future. It assumes we have access to all relevant information for free, and can assimilate its implications immediately. It assumes we are brute materialists. It assumes there are no social interactions. It assumes there is a limit to increasing returns to scale, based on constraints peasant farmers used to face. With enough assumptions like this, you can deduce that a market will balance all supplies and demands and the economic system will come to an equilibrium. This "general equilibrium" turns out to be the most efficient conceivable configuration of this abstract system, in the sense of producing the most goods from the least inputs of human effort.

This abstraction has proven extremely seductive to rich people, because it seems to say they should keep making money as fast as they can, and to the mathematically inclined, because they can play with the theory.

However it is absurd to suggest that this abstract theory has any relevance to real economies. If any one of those assumptions is violated you get a very different answer. Thus if information is incomplete or delayed then feedback is too weak to restore equilibrium. If there are social interactions then there are things like herd behaviour that

destroy equilibrium. If we are more than brute materialists, then perhaps we want more out of life than ever more stuff, inequitably distributed. If we all cannot foretell the future then feedbacks are erratic and so is the system's behaviour. If increasing returns to scale apply up to very large firms, like Microsoft or McDonalds, then one or a few firms can grow exponentially at the expense of others, and yield oligopoly.

Abstract theories may be entertaining, but if you want them to be the basis of a science you must compare them with observations of real economies. Manifestly, human beings cannot foretell the future. Our decisions are often governed by reactions tuned to the survival of hunter-gatherers but not sensible ("rational") in modern circumstances. Herd behaviours can be observed in fashion, and are exploited by marketing. Many industries are dominated globally by a handful of firms. New technologies frequently displace older technologies, with a new group of firms bubbling up exponentially and taking over.

Most tellingly, a near-equilibrium system should only exhibit abrupt change when physical circumstances change abruptly, as in a natural disaster or a war. However there have been many abrupt falls in markets without any external provocation, as was recounted in the previous section. Thus, for example, in 1987 stock markets fell thirty or forty percent in a day, though thirty percent of the world's factories had not been bombed overnight. These sudden falls were driven by the internal dynamics of the system, and are symptomatic of dysfunctional internal interactions.

In science, the purpose of a theory is to provide guidance on the behaviour of the observable world. The neoclassical theory bears no useful resemblance, in its founding assumptions and in its central prediction of equilibrium, to observable modern economies. To apply such a deficient theory is to practice pseudo-science: it is an activity that maintains the trappings of science, but that fails the central test of science, that it is a useful guide to the behaviour of observable economies.

The neoclassical theory was a heroic attempt, modelled after the kinetic theory of gases, for its time in the late nineteenth century. However to an experienced scientist like myself it is laughable that such a deficient theory has retained currency for over a century. To have maintained this theory in the face of clear and overwhelming evidence is a fundamental ethical failure of mainstream economics.

Physicists soon established that the kinetic theory of gases is useful only in narrow circumstances (gases well above their condensation temperature), and is useless, for example, for describing liquids or solids. The neoclassical theory might apply to a village market, though even that would need to be demonstrated.

The clear conclusion from this and the previous section is that neoclassical theory, and therefore mainstream economics, has no basis in theory or practice for its claim that free markets, or mostly free markets, are the best way to organise an economy.

Socialism is not the inevitable alternative. There are good reasons why it also is insufficient. The relative success of the post-war era suggests that carefully managed markets offer a better basis for an economy.

Bad accounting and bad purpose

The near-universal goal of modern economic management is to increase the GDP, but there are several fundamental flaws in this use of GDP, and those flaws seriously distort our societies.

Being essentially the money value of all activities that involve money, the GDP is mostly a materialist form of accounting. If it only had limited uses that might not be so bad, but it has become the dominant measure of the wellbeing of a society. There are more balanced approaches available, such as "triple bottom line" [6] that assesses material,

social and environmental measures of wellbeing, but they have not yet been adopted by the mainstream.

There is a more fundamental problem involved in this misuse of GDP. No account is taken of whether an activity is useful, useless, harmful or attempting to remedy previous harm. If a chemical company produces $3 million worth of chemicals but in the process creates pollution that takes $1 million to clean up, normal people would say we were only $2 million better off. However our economic accountants would *add* both numbers into the GDP and say we were $4 million better off. Ralph Nader once noted that every time there's a car crash the GDP goes up.

The problem here is that harmful events or activities should be subtracted if we want a measure of wellbeing. We need a balance sheet or ledger, with good things on one side, bad things on the other and a net value, good minus bad. The Genuine Progress Indicator[7, 8] takes this approach. By using the GDP in this role, we are in effect entering all of our monetary transactions in the credit side of the balance sheet, whether they are income or costs. If a shopkeeper entered all his transactions in the credit column of his ledger and none in the debit column, then announced that his Gross Shop Product was booming, his family might rightly despair of his stupidity.

Another fundamental problem with using GDP as a proxy for the wellbeing of society is that there are many activities that don't involve money, so they are not counted. Marilyn Waring came up with the example of six mothers who stay at home caring for their babies [9]. Their loving care doesn't register with the GDP because they are not paid for it, so their loving care implicitly has no value according to our national accounting. However if each mother were to hire the next to baby-sit her child, then money would change hands and the GDP would go up. Thus having someone else care for your baby is treated as more valuable than caring for your own baby, in the sick world of our national accounting.

This is an even more serious omission in "third world" countries because much economic activity occurs at the household and village level with little or no money involved, so it is not counted. However if someone is forced off their land and into a city sweatshop where they have to buy everything, they would contribute to a rising GDP even though they might be much worse off.

Such deficient accounting seriously distorts our societies. In the example of the chemical company above, both the government and the company have an incentive to pollute (and thus to externalise costs, a market failure) because the GDP goes up more. The GPI, on the other hand, would correctly measure the net benefit. In the example of the mothers, there is an implicit incentive for the government to get them out working rather than doing the most valuable thing they (or anyone?) can do, which is to love and care for their own babies.

Thus our deficient accounting systems implicitly encourage exploitative activities and discourage all the things people do for each other for free, out of the goodness of their hearts. It has been a feature of the neoliberal era that the social fabric has weakened and families have suffered more damage, regardless of all the lip service paid to "family values". A profession that tolerates such distortions is ethically compromised.

Bad money - debt and instability

When a bank makes a loan, most of the money it "loans" is new money, created out of nothing. In the traditional fractional reserve system, with say a 10% reserve requirement, only 10% of the loan may be pre-existing wealth saved by someone else. Part of the deregulation of the neoliberal era was to relax even this requirement, so that even less, or none, of the loaned money might be someone's hard-earned savings. The result, either way, is that new purchasing power is created, and thus total "demand" is increased.

When the loan is paid back the new money and its purchasing power are removed. There would then be no problem, except that debt has increased at a steady exponential rate for long periods. It was such an increase in Australian private debt relative to GDP, and a comparable increase in the US, that led Steve Keen to predict the GFC [10]. In 2007 net new private debt in Australia amounted to an amazing 20% of GDP [11]. Without that new borrowing, Australia would have been in severe recession. Australia was living well beyond its means, but Australia's economic managers are regarded, by themselves and apparently by others, as world's best. The role of debt has been formalised by Keen, who defines aggregate demand as GDP plus net new debt [12].

If asset prices are bid up using new money, then an asset price bubble can result. It was the bursting of such a housing price bubble in the US that triggered the GFC. A similar bubble has occurred in Australia and many other countries. The mechanism generates an implicit Ponzi or pyramid scheme. People borrow and buy in the expectation that asset prices will continue to rise. So long as they do rise, speculators gain windfall profits. However as soon as the price levels the bubble bursts and then collapses rapidly, so those still in the market lose heavily.

Because the money borrowed to inflate housing prices flows through the rest of the economy, an housing price bubble can generate boom times. Conversely as the bubble bursts, debts are rapidly repaid or defaulted, so purchasing power drops rapidly and a recession results [12, 13].

Mainstream economists deny that this mechanism is possible. Keen [14] quotes Eggertssen and Krugman [15], who wrote ". . . looking at the world as a whole, the overall level of debt makes no difference to aggregate net worth – one person's liability is another person's asset." The latter would only be true in a barter economy or in a banking system based entirely on savings, for only in those cases would the extra purchasing power of the borrower be balanced by the reduced purchasing power of the depositor. In our real banking system, new purchasing power is created out of nothing, notwithstanding the fact that the bank makes a balancing book-keeping entry. No-one's purchasing power is reduced.

Thus the banking system operates in a way that destabilises the whole economy. Its incentive is to increase the level of debt in society, from which it profits. However if a bubble bursts the bank may be forced to rapidly call in outstanding loans to maintain its reserves. If reserves are reduced, then the money supply must be reduced by a factor of ten or more, so the (effectively) fractional reserve system dramatically magnifies the effects of failed "investments".

The problem is magnified even further by the existence of the "shadow banking" system, which creates new debt at frenetic rates, mostly for speculation. It is reported that the total debt in the world financial system was over $600 trillion just before the GFC, more than ten times global GDP. It is the evaporation of much of this supposed wealth, and the necessity for ordinary tax payers both to bail out the banks and to pay down their own debts, that is depressing demand. Europe is now poised for its own financial collapse, adding to the world's financial woes.

Mainstream economists seem to be completely blind to the problems engendered by excessive debt. This seems to be why so many claimed the GFC was unforeseeable. Evidently, and astonishingly, the reason for this is that debt and money play no role in standard equilibrium economic models [13]. How this could be, when elementary economics text books spell out at least the traditional fractional reserve banking system and how it creates new money out of nothing, is hard to fathom.

All those responsible for such a dysfunctional monetary system bear a heavy moral and ethical responsibility. This includes the bankers and financial game players, the economic managers who deregulated an already unstable system, and the academic economists who endorsed the folly.

Bad financial markets

The rate of trading on financial and currency markets is far beyond the needs of their purported purpose, which is supposedly the efficient allocation of investment. Prior to 1973 currency exchange rates were regulated and currencies were traded at a rate of $US10 to $US20 billion dollars per day. Two decades later, after the deregulation of international finance, currencies were traded at a rate of $US1200 billion per day, a jump by a factor of 60 - 120. Even in 1993 the global rate of financial trading was equivalent to turning over the entire global stock of publicly traded assets in 24 days. This is about fifty times faster than necessary, because firms in the real economy normally do not change substantially in less than a few years. Other estimates are possible, with comparable results [16]. The real, productive economy did not accelerate by a factor of 50-100. Rather, the great increase in trading was due to an explosion of speculation made possible by global financial deregulation. The implication is that only 1-2% of financial trading is beneficial. The rest is speculative.

The further implication is that the financial markets are parasitic and destabilising. The only purpose of speculators is to siphon money into their own pockets. Ultimately that wealth comes from the productive economy. The rapid and large gyrations of the financial markets are also due to this frenetic speculation. The efficient allocation of capital could be done with only 1-2% of the current rate of trading, as already established. The effect of the gyrating markets is the opposite, to make the whole economy inefficient, because managers must hedge continually against fluctuations in stock and currency prices.

With this perspective, and the perspective of frequent market crashes recited earlier, the so-called "efficient market hypothesis" is insupportable. It is also a misnomer because, on the one hand, it is a prediction of the neoclassical theory rather than an independent hypothesis, and on the other hand it is taken as self-evidently true by most mainstream economists, so to them it is a truth not a hypothesis.

A failed paradigm

Apparently it will take at least another global depression to dislodge mainstream economics from its pinnacle of power and influence, because the worst economic malfunction since the Great Depression has so far been insufficient. However it should long since have been discredited, because of the blatant and fundamental deficiencies that have been summarised here. The essence of this analysis was done over a decade ago [16] and much of it could have been done much earlier.

The extreme degree of insularity of the economics discipline is striking to an outsider. At the beginning of the neoclassical stream it missed the essential distinction between abstract modelling and real science, which is that in real science you continually check your models against observations and abandon those that are not useful. Since then the mainstream has been oblivious to the second law of thermodynamics, which deals with degradation, waste and limits, to the rich accumulations of knowledge of human behaviour and social and natural systems that have come out of anthropology, psychology, human prehistory, biology, ecology, and so on, to the liberation from mathematically tractable simplifications (especially equilibrium) enabled by computers, and to more recent developments in understanding complex systems.

It is nonsense to claim or imply that once you abandon the safe (or stultifying) neoclassical and neoliberal realm it is all too hard and there will only be confusion and chaos. Counter-examples will be given below. Rather, the mainstream discipline has exhibited an extreme lack of curiosity, ambition and imagination. Given the responsibilities it has assumed, or seized, this must be seen as ethically deficient.

Better ways

Perhaps there would be some ethical reprieve if, as is claimed or implied by many, there were no reasonable alternative to this neoliberal regime. Socialism is said to have failed, and I will argue below it is inappropriate. However the social-democratic/pseudo-Keynesian regimes of the post-war decades clearly did better, in both aggregate performance and in serving everyone more equitably, and there is no reason they cannot be adapted to present circumstances. Therefore the Thatcherite excuse "there is no alternative" does not suffice.

There is a prospect, however, of going beyond social democracy, in which government applies palliatives to some of the wounds inflicted by markets, to a regime in which markets are more actively managed so they do not inflict wounds in the first place. In other words it ought to be possible to get markets to behave more like they have been claimed, erroneously, to behave (or even better).

An economy is a system of many interacting components. It is easy to identify destabilising internal interactions, such has herd behaviours in financial markets or the exponential growth of a firm exploiting increasing returns to scale. There are also, evidently, some internal interactions that tend to stabilise, otherwise there would not be periods of relative calm. Such a system can be identified as a self-organising system [17], and the evident strength of internal instabilities identifies its behaviour as being in the realm of complexity, or perhaps of deterministic chaos [18, 19].

Complex self-organising systems have a characteristic form of behaviour. They are relatively stable for much of the time, though always with small changes occurring. Occasionally there are larger disturbances and these can shift the system into a new state, about which it will then fluctuate. During the transition to a new state the system is unpredictable in detail, because it becomes hypersensitive to tiny influences, external or internal. There are many such metastable states they can achieve. Thus there is some order and predictability, but never rigidity, and there is change, though not continuous dramatic change. Complex systems (for short) are not just out of equilibrium, they are *always far from equilibrium*. Their behaviour, it is fair to say, is *radically* different from the simple equilibrium of the neoclassical abstraction. The best exemplars of complex systems are living systems - cells, organisms, social groups, ecosystems.

Three fundamental conclusions follow from the hypothesis that economies are complex systems [16].

First, an economy can exist in many states, not just in one state that is supposedly universally optimal. It is not even useful to consider the optimality of such a system among the astronomically-large number of possible state it might occupy, and which are changing all the time anyway. This means any society may choose to tailor its economy to support the kind of society it wishes to be. Economies may be subordinate to societies.

Second, following from the same insight, human cultural diversity might thrive again. We do not have to submit to a global monoculture.

Third, if economies and living systems are of the same fundamental kind, there is no reason in principle why our economies cannot be made compatible with the living world. We might cease the destruction of living nature and learn to live in and with living nature. Indeed we must, or we will not long survive.

To those who claim that abandoning the equilibrium ground invites only confusion, those are substantial insights already. The episodic unpredictability of a complex system also indicates why the strong form of socialism does not work well - an economy cannot be managed by a bureaucracy working to a five-year plan. Rather, it must be managed

more in the way a dog or a horse can be managed, by working with its innate character and being firm but flexible and patient.

Many more implications and possibilities are explored in my book *Economia* [16]. Eric Beinhocker [19] gives an excellent survey of more detailed work modelling aspect of economies as systems of interacting agents, including work at the Santa Fe Institute [20]. Beinhocker also surveys many other implications of this conception of economies.

It is pertinent to close with one illustration of what is possible once one has embraced disequilibrium. The paper by Eggertssen and Krugman [15] mentioned earlier, in which they assert that debt doesn't matter, is hailed by some in the mainstream as a considerable advance, because it considers not just one but *two* representative agents, and one can owe the other. The paper then presents two equilibrium models, one purportedly before a market crash and one after. The crash is simulated merely by lowering the allowed level of debt - not necessarily a bad artifice, but hardly a sophisticated encapsulation of economic interactions. The paper thus tries to approach the, implicitly, disequilibrium process of the crash itself, but by comparing two static models. Keen [14] has given a more detailed critique, but these points will suffice here.

The cause of market crashes is evidently the accumulation of so much debt that some borrowers exceed their capacity to repay their debt. A chain reaction then ensues, in which each wave of defaults triggers more defaults among those who depended on the previously defaulting debtors. This can be modelled as an overshoot and crash phenomenon, well known to population biologists [21].

Figure 1 shows some results of adapting this approach to model the dynamics of debt in a very simple way. The essence of the models is that debt is assumed to grow until it reaches or exceeds a prescribed level, which is assumed to be the level that the economy can comfortably bear. The first case (black curves, "Debt, 0" and "Cap, 0") assumes that the rate of growth is slowed by a feedback term proportional to the gap between capacity and actual debt. The result is a smooth approach to the capacity value. In other words the system comes to equilibrium.

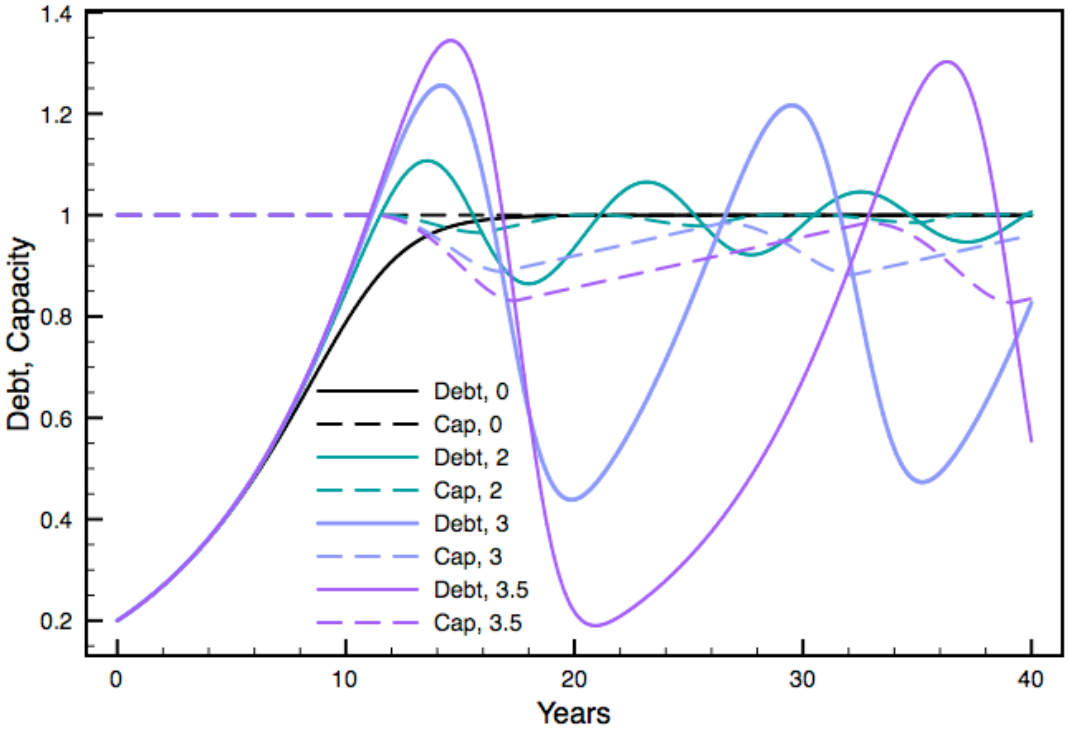

Figure 1. Calculations of the approach of debt levels to the capacity ("Cap") of an economy to bear debt. The numbers signify the feedback lag in years for each case (0, 2, 3 and 3.5 years). See text for further explanation.

However people are often slow to perceive that debt is becoming excessive, so the feedback signal can lag behind events. This can be simulated in the models by making the feedback dependent on the gap (capacity - actual) at an earlier time.

For example the second case shown in Figure 1 (green) is for a 2-year delay on the feedback (for example, at 15 years the feedback depends on what the gap was at 13 years). In this case the level of debt overshoots the economy's capacity. Then it undershoots, then it oscillates (with decreasing amplitude). This would correspond to an economy that alternately overheats and then goes into recession. In other words it crudely replicates the "business cycle".

The third case shown (blue) has a lag of 3 years. In this case the overshoot and undershoot are much larger, because things reach greater extremes before the feedback reverses the trend. This would correspond to a severe recession. Finally a case with a 3.5-year lag (purple) yields dramatic swings, from bubble to depression. Debt drops so low it takes a long time for it to build up again.

Whenever a bubble bursts many businesses go bankrupt, and this reduces the capacity of the economy for a time. This effect is included in the simulations: the capacity begins to decline whenever debt overshoots capacity, and it is assumed to recover slowly once the overshoot is eliminated. The result is that the capacity drops by about 10% in the third case (3-year lag) and about 15% with a 3.5-year lag. Capacity can then take a decade or more to recover.

These calculations are rudimentary and only illustrative. The particular numbers are not to be taken too seriously, but there are still some important lessons. One point of the calculations is to show that behaviour similar to the business cycle, bubbles, recessions and depressions can be reproduced with a relatively simple model. The models, in effect,

test the hypothesis that recessions and depressions are due to excessive build-ups of debt. Another point is to emphasise that when feedback is delayed the system is always out of equilibrium. Such behaviour is beyond the scope of equilibrium models. Eggertssen and Krugman's attempt to use before-and-after static models are invalid because the high and low points are when the system is furthest from equilibrium. The calculations also illustrate a statement made at the beginning, that if feedbacks are weak or delayed then equilibrium is lost.

Details of these models will be given elsewhere. It will just be noted here that the feedback term is nonlinear (producing asymmetrical peaks) and there are two simple first-order differential equations which can be readily integrated numerically. Other simple models of this style have illustrated dependence of land prices, wages and prices on changes in money supply [22].

Keen has published rather more sophisticated dynamical models of debt fluctuations that have, among other things, yielded an intriguing resemblance to the "great moderation" - leading inevitably into a great recession [23, 24]. There are also models of adaptive systems with many agents, closer to microeconomics in approach, that are yielding important insights quite different from those claimed by mainstream economics. Many such studies are summarised by Beinhocker [19].

There are of course many other aspects of economics that need attention. Unapologetic management of markets, using incentives, penalties and some regulation, could harness markets so they more consistently yield desirable results. A more stable banking and monetary system is urgently required. Small transaction taxes could go far to slowing and stabilising financial markets. Both banking and financial sectors should be regarded as service sectors, and they need not be large sectors of the economy. Sensible measures of overall wellbeing are urgently needed, to replace the GDP. Above all, the purpose of economies should be to support people and societies, not to dominate them.

Many further implications of identifying economies as complex systems are explored in *Economia* [16] and in a pre-publication manuscript [25]. Beinhocker [19] also explores many implications for economic and business management.

Conclusion

Mainstream economics through the neoliberal era has retarded growth. It caused the Global Financial Crisis and thereby spread hardship and stress through much of the world, except for the very rich. It exacerbated extremes of wealth and poverty, actually further impoverishing many people in both rich and poor countries [26-28]. It is rapidly degrading the planetary environment. It must therefore bear a heavy ethical and moral responsibility, which must be shared by all those who have contributed to or partaken of its dominance.

The ethical deficiency is compounded by the inability or unwillingness to recognise or acknowledge glaring deficiencies in theory and practice, even including minimising the GFC as a temporary, and evidently minor, aberration [29]. This has not been just a failure of curiosity, imagination or appropriate ambition, because alternatives have been available all along. Indeed the post-war social democracies stand as a clear alternative with a better record. Mainstream economics has certainly exhibited hubris, and it is widely perceived as actively excluding and marginalising its critics and alternative ideas [30, 31]. It has much to answer for.

Contacts

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