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COMMENTARY

Austerity and fraud under different structures of technology and resource abundance

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We present the implications of a simple analytical theory in which economic crisis emerges from rising real resource costs in systems with high fixed costs relative to variable costs. We show the integral role played by financial fraud in this process, and explain the effects of austerity and stimulus policies in the face of crisis under differing combinations of fixed and variable costs.

Key words: Austerity, Stimulus, Fraud, Resource abundance, Fixed cost
JEL classifications: D24, K42, Q30

1. Introduction

Since the panicked days of the Great Crisis, 'austerity' has replaced 'stimulus' as the fashionable response, especially in Eastern Europe and in Greece, Portugal, Ireland, the UK and the USA, but to little apparent avail. If a common judgement on stimulus was that the measures taken were inadequate, austerity is proving actually destructive, bringing on (at present writing) an escalating political and financial crisis in the eurozone, an incipient recession in the UK and the threat of stagnation in the USA.

In this paper we argue that the effects of stimulus and austerity cannot be judged in the abstract. They depend on the structure of the underlying economy and on the real cost of resources. The structural issues may be described as a matter of *fixed* costs as against *variable* costs: to what extent are economic systems locked into particular technologies, networks of relationships and resource demands? The real cost of resources depends on the marginal cost of resource production in the global economy and, for any given nation, whether that nation has access to those resources on terms that reflect those production costs. Given rising real resource costs, *structure* determines *resilience* under

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stress. High-fixed-cost systems deliver the highest living standards but they are also, necessarily, the least resilient under stress.

Our central argument is that stimulus fell short—and would have fallen short even if the amounts had been greater—because increased demand under existing high-fixed-cost structures drove, or would have driven, the price of resources too high, too quickly. The constraint on growth was not inflation generated by easy money, but the combination of the rising real marginal cost, especially of energy, combined with monopoly control of and speculative instability in energy prices, which together act as a choke chain on the return to full employment.

Austerity reduces resource demand—or bursts the bubble—and brings down the price of energy, relieving the immediate sources of stress. But it also destroys the profitability of private enterprise, the financial sustainability of public services, the possibility for high employment and hopes for improved living standards. The notion that austerity can impart confidence and restore growth is a chimera: even if confidence surged, the constraint of rising resources prices would soon be felt once again. There is thus no chance that austerity programmes can bring a return to full employment prosperity unless they are accompanied by technological miracles (such as the discovery of new continents or entirely new energy sources).

This is Scylla and Charybdis with a vengeance. And so long as technologies and fixed costs are not changed, a continued alternation between stimulus and austerity will lead to the wreck of the economy on one shore or the other. The only way through is to change the structure of fixed costs. If the channel between Scylla and Charybdis is too narrow, it becomes necessary to break up the ship, reusing the timbers to construct a flotilla of smaller boats capable of the passage. Technically, this is very difficult. But the other choice is to drown.

Section 2 of this comment describes an analytical theory relating the main factors in economic activity, including the structure of fixed and variable costs, the cost of resources, uncertainty, and other factors. The theory can explain among other things why financial fraud is a pervasive response to rising real resource costs in high-fixed-cost countries. Section 3 discusses the problem of resource scarcity and its relationship to technology and living standards, and the policy options that exist when resources are depleted, including technical restructuring as the alternative to stimulus, austerity and the threat of system collapse. Section 4 concludes.

2. A biophysical approach to economic systems

All living systems, including human beings, require resources. Organisms develop technologies, in the form of biological, mechanical and social structures, to transform resources into forms they can use. Different technologies are characterised by different levels of fixed cost and variable cost. Overall, a system is viable if it generates a surplus: if the total resources extracted exceed the cost of extracting them, both measured in energy units. Typically, a more efficient system requires a larger investment in fixed costs, though the converse is not necessarily true. Economic policies generally aim to increase fixed costs (by accumulating capital through investment) and to supplement technology and engineering with efficient resource allocation. Policies are thus tools to achieve and to increase this surplus, permitting both viability and waste, which is enjoyment (Veblen, 1899).

To think about this in concrete terms consider the difference in agricultural techniques between a poor and a rich country. In poor countries, farming is often done by human and animal labour. The energy extracted from the land, which originates in sunlight, barely

exceeds the energy required to cultivate it. For this reason, poor peasant farmers are vulnerable to drought and flood: any change in the productivity of the land can have a serious effect on the life prospects of the people who live on it. But on the other hand, agriculture as a way of life in poor countries is quite stable. It carries on for centuries, even millennia, under barely changed conditions. This tells us that while calamities can be disastrous for individuals, they do not threaten the underlying way of life, which will be reproduced as before once the calamity is over.

In rich countries, the situation is very different. Agriculture there is embedded in a vast industrial system that provides machinery, chemical fertilisers, markets, including futures markets, and transportation of the eventual produce to distant consumers. This is a much more productive system: net energy gained, yields and living standards are much higher. Why? Because the energy of the sun is supplemented by other energy sources, especially oil and natural gas, which power the machinery and are converted into fertilisers, enriching the soil. The division of labour makes possible the application of these extra sources of energy in a highly efficient way. Crucially, the cost of extracting these resources, during the two centuries or so of their common use, has been very far below the energy value that they bring to the system.

But suppose that cost rises? It may rise for either of two reasons: because the energy costs of extracting oil from the deep seabed or from tar sands is higher than the cost of extracting it from onshore fields, now depleted,; or because of market power in the extraction and distribution of energy, which may create a situation of artificial scarcity and high cost, transferring real wealth from consumers to producers or to middlemen, who hoard it. What happens then? The subsistence farmer, who does not rely much on auxiliary energy sources, may be only lightly affected. But every aspect of the industrial farmer's operations is affected directly and massively. The costs of fertiliser, transportation and farm machinery all rise. The profitability of industrial farms, which may have been very high to begin with, will fall much more sharply than the profitability—initially very low—of the subsistence farm. A similar argument can be used to compare all other industrial processes, as well as the profitability of industry as against services.

Recently, we presented an analytical theory addressed to these questions (Chen, 2005; Chen and Galbraith, 2011). The main feature of the theory is a formula of variable cost as a mathematical function of product value, fixed cost, uncertainty, discount rate and project duration. From this formula, together with fixed cost and volume of output, we can compute and analyse the returns and profits of different production systems under various environments in a simple and systematic way.

In this paper we apply this theory especially to the effects of austerity measures on different economic structures under differing conditions of resource abundance and scarcity.

Government policies influence economic performance by affecting the structure of the economic system. For example, a lower interest rate, by making large initial outlays financially feasible and projected cash flows from the distant future more valuable, tends to encourage investments with high initial fixed costs. Increasing tax rates also tends to encourage increased fixed costs: activities involving variable costs (labour) are generally taxed heavily, whereas those that depend more on once-for-all investments are taxed more lightly; once a piece of machinery is in place the economic effort to produce it will not be taxed a second time. Conversely, low taxes and high interest rates encourage an emphasis on variable costs. It is not accidental that richer countries have tended to have high taxes and low interest rates, whereas in poorer countries the situation is often the reverse.

It has long been observed that two opposing forces, economies of scale and diminishing marginal returns, exert strong effects on economic performance. Higher-fixed-cost systems, with lower variable costs, generally enjoy more significant scale economies. Higher-fixed-cost systems also require higher levels of output to break even. At the same time, higher output means more significant exposure to diminishing marginal returns, because as resources are used more intensively they become more expensive. The abundance of resources often determines the balance between these two factors. Intuitively, if resources are abundant then more resources can be used to build up fixed assets, which can then process more resources to produce final products. If resources are scarce, building up too much in the way of fixed assets will consume a larger proportion of the available resources, which will leave too little for final consumption. (This is why in countries facing severe resource constraints the mobilisation of resources for massive fixed investments—as in the USSR under Stalin—imposes extreme human hardship.)

Technical progress, which is often achieved with higher fixed cost, enables an economic system to tap into many resources that were previously not economical to extract (Wright and Czelusta, 2007). For example, new horizontal drilling and fracturing technology enables natural gas companies to develop shale gas on a large scale. At the same time, more advanced technologies are more resource intensive; hydrofracking notably requires large amounts of water. The net effect of technology on resources evolves over time. When the rate of consumption of resources becomes higher than the rate of renewal or discovery of resources, resources will become increasingly scarce. In a resource-scarce environment, social systems with more investment in technology require more resources to support the technology. As a result, net resources available for human consumption—water, fuel, land, biofuel and feedstocks such as corn—may decline, which will lower living standards.

When resources to fuel economic growth are abundant, fraudulent activities are not generally tolerated, since there are opportunities for 'honest profit' and those pursuing such profits work to control the system. However, when resources become scarce, opportunities for large profit for honest business are few. If the expected rate of profit nevertheless remains high, e.g. because the financial markets continue to demand it, fraud becomes a main channel to profitability and fraudulent activities become the standard practice. This was the pattern in the information-technology bubble, where the ultimately scarce resource was the 'viable business plan'. After that bubble burst there was a steady increase in real resource costs, so it became difficult to generate genuine economic growth. It was in the economic systems with the highest fixed costs and greatest resource dependence that profitability was hit most hard. In contrast, in resource-producing countries there was, at this time, no squeeze on economic growth and no financial crisis.

To generate acceptable apparent financial returns when resource costs squeeze profits practically requires recourse to financial fraud. Financial instruments are ideal vehicles for fraud because the value of these instruments depends on cash flows into the distant future. The current financial crisis was caused by the aggressive origination and misevaluation of financial contracts, especially mortgages, mortgage-backed securities and derivative instruments. These contracts showed a high level of paper profits, of which large amounts were distributed as bonuses. When the scheme collapsed, the large financial institutions demanded and obtained bailouts, as well as public forbearance of the frauds in the form of relaxed accounting standards. They were able to do this by threatening financial meltdown and thus taking the public as hostages. The bailouts restored them to apparent financial health and transferred losses to the general public, in the present and in the future. Because the fraud is systematic—implicating negligent regulators and other public officials and

a complaisant media as well as the perpetrators—and because few new ways to make high profits are available, there is little incentive for the establishment to discuss the issue of fraud in this financial crisis. It is, nevertheless, systemic, pervasive and inevitable.

Systematic fraud is not confined to financial institutions. Because of increasing concern about the availability and cost of non-renewable fossil fuels, renewable energy industries are able to demand and obtain large amounts of public funding, thus transforming public into private wealth. There is in this process a powerful incentive to overstate and otherwise misrepresent the potential net energy gains from renewable energy investments, e.g. in biofuels, and there is a powerful feedback mechanism from the recipients of public funds to the officials who authorise them. As in the case of financial fraud, few media will discuss systematic fraud in the renewable energy industry and such related industries as those purveying carbon offsets and tradable carbon credits. The root cause for this fraud is the doctrine of perpetual growth and correspondingly high rates of profit, which comes into conflict with the geophysical realities of life on Earth. When there is a demand for miracles, there will always be supply.

Systematic frauds can be sustained only so long as there is a general denial of their existence. When reality obtrudes, they collapse—as happened with US housing finance beginning in August 2007 and erupting in the Great Crisis of September–October 2008, which led in turn to the Great Recession. The Great Crisis posed an immediate policy choice: should the financial system be saved or reformed? The Great Recession posed a second choice: should the entire economic system be restored to the *status quo ante* by 'stimulus' or driven to a lower level by 'austerity'?

Large financial institutions are some of the highest-fixed-cost social structures. Compared with real products, financial products are highly uniform and of great volume. It pays to invest heavily for products with large volumes. For example, index arbitrage takes advantage of price differentials between spot and futures markets; it is essentially risk free and can be very profitable. But opportunities for arbitrage disappear seconds after they arise; index arbitrage requires quick calculation and execution. Since the quickest arbitrageurs take almost all the profits, there is a strong need to develop the best customised computer systems, which are extremely expensive, and to bid heavily for the top talent (Galbraith, 1998). In this area, Morgan Stanley had more than 80% of transactions for many years.

The first policy debate in the Great Crisis, over the fate and future of big banks, was an argument over whether to reduce the fixed burden of these structures. The large banks won that argument and their domination of the financial sector was confirmed. The later application of 'stimulus' policies occurred in this context. Not surprisingly, the banks took predatory advantage: they restored their profits and their bonuses but did nothing to share the benefits with the larger population, either by renegotiating existing loans or extending new credits. Meanwhile, thanks partly to commodity index speculation, energy prices rose rapidly, which reduced chances for restored economic growth. Stimulus accordingly fell short of what was hoped for it by policy makers or expected by the general population.

As the Great Recession wore on, frustration with the apparent failure of stimulus brought attention to a second *apparent* source of high fixed costs: the scale of government. The policy argument thus shifted toward 'austerity'—a drive to cut government and therefore all economic activities that depend on government funding, especially public pensions and health care. However, there are two difficulties with this approach. The first is that 'government' is not a monolithic entity and its activities, though carried out on a large scale, often involved relatively *low* fixed costs—this is true of the administration of public

pension plans and of public health care funding, for example, which are very low cost compared with their private competitors. The second is that the scale and dominance of financial institutions, as well as private insurance companies would remain unaffected (or even be increased) by these proposals. Austerity programmes thus reduce the scale of economic activity without first lowering the fixed costs of that activity.

Calculations using our theory show that when the physical cost of resource extraction trends up, reductions in fixed costs may leave more net resources for final consumption even if total output falls. However, austerity measures that leave the financial sector unaffected (thanks to the generous bailouts already in place) reduce the scale of an economy without touching the key structural problem, and they thus are sure to reduce the surplus available for consumption. Thus austerity is a programme that is destined to fail, because it will lead to an economy where the private sector is unable to earn a positive rate of return.

Intuitively, large-fixed-cost systems require large output to break even. By reducing demand without first reducing fixed cost, austerity policies will increase the *ex ante* uncertainty and decrease the *ex ante* expected profitability of new investments. Such policies control the rise of resource costs by enforcing a permanent programme of stagnation and unemployment. But the widely favoured alternative—stimulus without reform—is also a dead end.

3. Resource depletion and austerity measures

Initially, we use resources that are easy to obtain locally, such as biomass, which is cheap to extract but expensive to transport. Later, we develop more expensive technologies that can be used in larger areas due to their low transportation cost, such as coal and later oil. When the rate of resource consumption is higher than renewal or discovery, the resource will be depleted. This will diminish the expected future living standard. We work to develop new technologies to enhance the recovery rate of existing resources and to develop new resources. However, there is no logical certainty that technology breakthroughs always occur in time. So we need to compare the consequences, for profitability and net output, of the remaining three options. These are: (i) to try to maintain the status quo; (ii) to reduce output via austerity measures; and (iii) to reduce fixed costs.

Calculations using our theory (available from the authors on request) show that attempting to maintain the status quo is the worst scenario. Reducing output through austerity is second worst and reducing fixed cost is better. With different parameters, calculated results can be different. But all results indicate when resources become scarce, fixed cost and the quantity of resource extraction should be reduced to keep net output high.

However, it is often difficult to reduce fixed cost in an economic or social system, for several reasons. First, higher levels of fixed cost are widely associated with progress. Established economic theories generally emphasise the advantages of division of labour and of specialisation, which tend to increase fixed costs in economic systems. The advantages of higher-fixed-cost systems are certainly real in an expanding environment while resources are cheap and abundant. However, over a longer time horizon, the results are different. Cope (1896) summarised the pattern of biological evolution more than 100 years ago.

> The 'Doctrine of the Unspecialized' ... describes the fact that the highly developed, or specialized types of one geological period have not been the parents of the types of succeeding periods, but that the descent has been derived from the less specialized of preceding ages ... The

validity of this law is due to the fact that the specialized types of all periods have been generally incapable of adaptation to the changed conditions which characterized the advent of new periods ... Such changes have been often especially severe in their effects on species of large size, which required food in great quantities ... Animals of omnivorous food-habits would survive where those which required special foods would die. Species of small size would survive a scarcity of food, while large ones would perish ... An extreme specialization ... has been, like an overperfection of structure, unfavorable to survival. (Cope, 1896, pp. 173–4)

Second, changing the structure of an economic system is very costly and disruptive. It is something not likely to be undertaken while there is doubt about the long-range outlook. If the decline or difficulties are thought to be short term, it is often better to scale back the level of output while maintaining the essential production system intact; only when the decline is known to be long term does incurring the cost of change make sense. For this reason strategies of denial about the long-term character of change in the resource environment argue powerfully against making changes in the structure of fixed costs. Perhaps, as Mr Micawber always said, something will turn up.

Third, reducing fixed cost often involves cutting the number and the incomes of people at decision-making levels. For example, breaking up the large banks would end the jobs and compensation of the top executives at those banks. This is obviously difficult.

From the above general discussion, consider the current debate over austerity measures, which is a continuation of the earlier debate over the bailout of large banks. In general, the people who support general austerity measures often supported the bank bailouts, while the people who are against the general austerity measure often were against the bailouts. Put another way, the people who support general austerity measures often are against austerity measures towards large financial institutions; the people who are against general austerity often support austerity measures towards large financial institutions.

As we have argued, large financial institutions are the epitome of high-fixed-cost systems that can make a high level of profits in a large and expanding economic environment. (They have very low variable costs.) And so, at its heart the debate is whether austerity should aim at fixed costs or at variable costs in the economic system. From our theory, that decision should depend on whether the current economic downturn is a short-term dip in a generally growing economy or whether the long-term upward trend in the last several centuries is in a process of reversal. From the resource perspective, the decision should depend on whether the physical cost of resource extraction will remain low indefinitely into the future due to technological advance or whether it will continue to rise over time.

Empirically, it is always dangerous to predict that a well-established long-term trend will reverse in the near future. However, many signs do indicate that we are near the crest of the fossil fuel-propelled civilisation. One of these is the simple dynamics of population growth.

For the most of the last several centuries, social groups with advanced technologies have expanded: rich societies grew fastest. But since World War II, this trend has been steadily reversed, so that now social groups with low technology and resource consumption are expanding, while social groups with high technology and resource consumption are shrinking. The behaviour of fertility rates is partial evidence for this: they are very low in high-fixed-cost countries where the cost of raising children (to an acceptable standard) has become very high, while they are much higher in low-fixed-cost countries where those costs are much lower. The intensification of financial crises—propelled by fraudulent representation of profit rates that cannot be obtained by honest activity—is an even more direct indication that the fixed costs of the current social systems are too high for the resource base.

In this environment, a cutting of fixed cost should precede the cut of variable cost, in order to preserve net output and reduce the volatility of the system. The crucial debate, therefore, should be over where fixed costs actually reside. Do they reside in government, which is an amalgam of regulation, service provision and (administratively efficient) income transfers? Or do they reside in the economic system itself, notably in the concentration of financial power, and in physical systems of production? We think the latter, though even if our general framework is accepted this issue is certain to remain open to vigorous dispute.

4. Concluding remarks

There is a strong correlation between energy consumption and economic output (Hall *et al.*, 1986). Recently, Brown *et al.* (2011) presented a more quantitative relation between economic output and energy consumption. They find that the relation between economic output and energy consumption in human societies is almost identical to the relation between body size and energy consumption in animals. This suggests the universality of this relationship.

Before the financial crisis, commodity prices had been rising for several years. However, authorities thought that they had learned from past experience that inappropriate policy responses to high commodity prices, instead of the high commodity prices themselves, were to blame for past recessions. As a result, authorities were totally unprepared for the recession.

In the past, the onset of recession reduced the demand for resources and commodity prices dropped substantially, paving the way for future economic recovery. But during this recession, though commodity prices dropped briefly at the start, they quickly rebounded. This reflects the gradual increase of costs of resource production and the power of market manipulation. As time goes on, these factors will further disadvantage high-fixed-cost, resource-intensive systems. The financial crisis provided a natural opportunity to reduce the fixed cost of the social systems. Unfortunately, the bailout packages, which not only absorbed losses incurred by large financial institutions but also paid out large sums of tax dollars as bonuses, preserved and even increased the burden of fixed cost on the system. This turned the Great Crisis into the Great Recession.

The Great Recession is often compared with the Great Depression—and justly so. Among many other factors, the Great Depression was caused by the rapid transition from a railway-based economy, which was fuelled by coal, to a highway-based economy, which was fuelled by oil. The discoveries of many super oilfields in the late 1920s and 1930s made it clear to many people that oil would replace coal as the dominant fuel (Deffeyes, 2001). It took time (and much money) to build the infrastructure for the oil economy. But the infrastructure for the coal-based economy collapsed swiftly, given this rational expectation of the future. This was partly why the Great Depression lasted so long. It was also why the economy that emerged from the Great Depression, fuelled by oil—which is a higher quality energy source than coal—was so prosperous.

While the Great Depression was caused (in part) by responses to the large-scale discoveries of super oilfields over a very short period of time, the Great Recession was caused (in part) by responses to the gradual, but persistent and irreversible, increase of the production cost of petroleum and other commodities. A classical method to maintain high profits with a declining rate of return on assets is to increase the asset base. Another classical method when business opportunities are limited is to resort to fraud. These

methods were exactly what financial institutions adopted when they generated large volumes of subprime mortgages and financial derivatives—activities that relied on both volume and fraud. If natural selection had acted directly upon financial institutions, or if laws against fraud were properly enforced, the rest of society would have no lasting problem with their business strategies. However, the general public was forced to bear the losses incurred by the large financial institutions.

Austerity measures, as presently conceived, are an integral part in this further transfer and transformation of wealth. They impose a general decline of living standards and the long-term prospect of economic stagnation, in the place of a strategy to reduce fixed costs—costs imposed on society by the support of financial institutions (and other economic entities) that are no longer adapted to economic and, especially, to resource conditions. Whether this development can be challenged, or changed, is perhaps the ultimate political question.

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