Economic Shocks

Position Paper for the SASKIA Landing Place

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1. Stocks and Shocks– the contribution of economics to sustainability

Sustainability can be defined in a variety of ways. In addition to the now-standard identification of different dimensions (e.g. cultural, economic, environmental and societal) of sustainability, and the emerging recognition that the linkages among these domains may be as significant as behaviour within the domains, it is important to connect the ways we measure sustainability with the underlying behaviour. In particular, it was once customary to consider sustainability in terms of the resource stocks necessary to sustain life (human or otherwise). To the extent that these resources were indispensable, this provided valuable insights. In particular, it drew attention to the different problems associated with renewable and non-renewable resources. Maintaining adequate stocks of the former involves managing the systems by which they are renewed (e.g. forests, water systems, farmland, etc.). Maintaining adequate stocks of the latter involves recycling and, ultimately demand reduction through substitution of renewable or alternative resources or development of alternative satisfiers of human needs.

This picture, and the road maps that apply to it, tend to imply a world of certainty or predictability. This does not mean that we know everything in advance, but rather that the system remains within its material and other constraints for all (or most) probable futures.

For better or worse, the world we inhabit is much richer, and affected by unforeseen (and often unforeseeable) events. Some of these are exogenous, and others come from inside the system itself. Some can be ‘headed off’ or controlled by appropriate hedging or buffering – but this in turn depends on the ability of those who could take these actions to recognise and plan for unforeseen contingencies.

These reactions become part of the behaviour of the system, and should be taken into account when assessing sustainability. The overarching need is for a reconsideration of sustainability in terms of *resilience*. In other words, both the ability of the system to continue to sustain life (and its desirable characteristics) and the ability of the system to respond to shocks are appropriate.

Nowhere is this self-governing or self-aware aspect more evident than in the economic system. The very word economics derives from the Greek word for the household, and the essence of economics is the sustaining of life within external constraints. The global economic system is largely the result of individual self-interested decisions; the institutional persistence of the system is a result of the complexity of decisions and the fact that most inhabitants of the economic system are shaped by its functioning – in other words, we are the system, and the system teaches us who we are (at least as *homo economicus*). Of course, not all of us are – or should be – motivated by economic goals or persuaded by economic logic. At best, the economy is a means to an end, and that end is the sustainability of fulfilling human life.

Resilience

Two rather different concerns dominate analysis of the environmental consequences of economic change. As described by Perrings (1998), the concern that desirable states or processes may not be 'sustainable' is balanced by the concern that individuals and societies may get 'locked-in' to undesirable states or processes. Both concerns reflect a perception that there are many possible states of the economy and its environment, and that not all states are equally valued or equally persistent.

The 'underdeveloped' state of many low-income countries in the post-war years, for example, was interpreted as evidence of the strongly stabilizing effect of population growth at low levels of productivity. Low-income economies were conceptualised as being at a locally stable equilibrium in which any increase in per capita income above subsistence level induced income-depressing population growth. They were caught in a poverty trap by Malthusian forces (Leibenstein 1957; Myrdal 1957). Such poverty traps have since been seen as a major cause of environmental degradation (Dasgupta 1993). Other frequently cited examples of 'lock-in' with significant environmental implications include dependence on hydrocarbon-based technologies and institutional and cultural rigidities that stand in the way of change (Hanna, Folke and Mäler 1997).

On the other side of the coin, the whole sustainability debate has been driven by a concern that economic growth and the pattern of consumption in high-income countries may be both unstable and unsustainable. It has been argued that economic growth that increases both resource use and the waste emissions beyond the carrying or assimilative capacity of the environment may make societies more (not less) sensitive to external shocks (Arrow et al. 1995). Moreover, the irreversible environmental consequences of consumption may mean that future states may offer fewer societal opportunities than present states (Meadows et al. 1992).

Collaborative work between ecologists and economists has used the ecological concept of resilience to explore the relative persistence of different states of nature. The concept of resilience has two main variants. One concerns the time taken for a disturbed system to return to some initial state and is due to Pimm (1984). A second concerns the magnitude of disturbance that can be absorbed before a system flips from one state to another and is due to Holling (1973). Both variants deal with aspects of the stability of system equilibria, offering alternative measures of the capacity of a system to retain productivity following disturbance.

Most work in the area concentrates on the Holling version and its application to managing joint economy-environment systems. But given the interest in lock-in and sustainability, both have a rather natural appeal. In particular, the nature of 'network externalities' and the value of connectedness and compatibility mean that the possibility of sub optimal equilibria reflecting co-ordination failure is pervasive.

More recently, it has been argued that the concept of resilience offers a useful way of thinking about the sustainability of non-environmental dynamical systems (Levin et al. 1998). In a later edition, this concept sheet will review the concept of resilience in the analysis of economy-environment systems. It identifies linkages between resilience and stability generally and considers their contribution to our understanding of the evolution of such systems. Particular linkages include those among resilience, biodiversity and the sustainability of alternative states. From the TERRA perspective, it is worth noting that the system characteristics and much of the analytic framework appropriate to biodiversity applies equally to social, cultural and even economic diversity. The project will summarise recent developments in modelling the resilience of joint economy-environment systems, relate this to the emerging literature on network formation and indicate the approaches that seem to have greatest potential. In addition, it will discuss key methodological and substantive research questions that remain to be addressed.

3. Perspectives on resilience

Has the integration of economics and ecology revealed any emergent properties? We believe that the answer is yes, and that these concern the way that we think about the long-run dynamics of economic systems. The concept of resilience provides a different perspective on economic dynamics than that normally adopted by economists, and a different set of insights into the way economic interactions with the environment drive changes in the joint system. Instead of focusing on the system equilibria and the properties of the system at equilibrium it focuses on the basins of attraction around those equilibria, and the susceptibility of the joint system to change at different points in the basin. Indeed, one element in the path dependence of the joint system is precisely that its sensitivity to shocks varies as it converges on the equilibrium state.

Consider the concept of sustainability. Levin et al. (1998) argue that resilience offers a helpful way of thinking about the evolution of social systems partly because it provides a means of analysing, measuring and implementing the sustainability of such systems. This is largely because resilience switches attention away from long-run equilibria towards the system's capacity to respond to short-run shocks and stresses in a constructive and creative way.

Economists have generally tended to equate sustainability with both equilibrium and the steady state (cf Baldwin 1995). The sustainability of extraction or investment paths, for example, tends to be evaluated as a property of the system at long-run equilibrium, usually in a deterministic framework. Levin et al. (1998) suggest that sustainability is more an issue in stochastic than deterministic systems, and that it is best measured by system resilience whether at or away from equilibrium. In an evolutionary system this makes resilience both more policy relevant and more testable. To be sure, it is just as difficult to devise appropriate experiments in economics as it is in ecology, but the adaptive strategies or policies devised to test (and manage) the resilience of complex path-dependent ecosystems (Walters 1997) apply a fortiori to economic systems (Anderson et al. 1988; Arthur 1992).

Further work on the resilience of joint economy environment systems might use a Markov approach. This is partly because the approach focuses on the transition probabilities between states in a way that captures the essential features of the concept of resilience in the Holling sense – as a local measure of the sensitivity of the system to exogenous stress and shock. But the approach also allows us to think about transition probabilities as policy targets. Institutional or property rights reform enables the economy to respond to changing environmental conditions. That is, it influences the transition probabilities between states.

Economic development and environmental change are both stochastic evolutionary processes. Analysis, measurement and management of those processes require an appropriate set of concepts and tools. The concepts and tools developed by ecologists to deal with the evolution of multiple equilibrium ecosystems have the potential to change fundamentally the way we approach the economics of change.

Finally, we should note that recent work on the evolution of networks and of behaviour among networked individuals, reinforces this thrust. As shown in Cave (2002), many of the features of GNKS labour markets (and other economic interactions at the micro and meso level) exhibit the characteristics of co-ordination games. That is, players would rather choose strategies compatible with those adopted by their 'neighbours' and some 'conventions' (or groups of compatible behaviour) are better than others. If the chance to change behaviour is stochastic and mistakes are possible, the system follows a Markov process. It is well-known that in most fixed networks, behaviour will not necessarily tend to the payoff-dominant (efficient, sustainable) pattern, but will rather gravitate to 'risk-dominant' strategies – those that are robust against an unknown partner. There are a few network configurations and circumstances(e.g. star-shaped networks with far-sighted hub players) where the system can escape, but generally policy should seek to align risk-dominance and sustainability.
Alternatively, if players can also choose to form or break links, the results depend in a critical way on the nature of link costs (e.g. constant, increasing, decreasing), the topological layout (e.g. geographical costs vs. distance-free costs) and the starting configuration. Thus the same tools applicable to the analysis of economic-environmental systems at the macro level can be applied at the micro and meso levels. There, they can be used to relate the concepts of resilience and equilibrium to such network properties as power-law distributions, path lengths (small worlds) and clustering.

4. ISTs, networking and globalisation – is the world becoming more volatile?

The 'insulation' of 'real' and 'financial' systems from each other is clearly breaking down as a result of both volatility and the increasing participation in these markets by a whole range of new and relatively naive actors e.g. via ISTs permitting real-time information tracking, sophisticated asset valuation models (and derivative assets) driven by huge amounts of data, off-floor trading, etc.

The volatility of markets is increasing in ways that can be traced to the spread of common models (a network externality), globalisation of markets, securitisation of assets that were once non-traded (like sovereign debt) but have real implications (e.g. for public spending), cross linkage of markets (e.g. oil prices, Russian debt, Mexican investment, US banks and pension funds).

Volatility is further enhanced by speculative bubbles (like IT/telecoms, etc.).Again, these often have real implications for sectoral stability, income distribution and intergenerational equity.

Clearly, as more and more information becomes available, the *quality, distribution* and *responsiveness* of this information become crucial. More isn't better, aggregate measures are not meaningful, markets don't efficiently combine or average information, information becomes obsolete very fast, etc. As a result, the assumed relationships between data, information, knowledge, belief and (getting really odd here) truth are shifting.

The New Economy is further characterised by lots of learning-by-doing. Here, too, instability and rapid change are the order of the day.

At a deeper level, the coherence of intellectual and value structures may break down, or at least have a smaller granularity and persistence.

In terms of macroeconomics, growth shocks are less persistent than they used to be.

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