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Conducting Monetary Policy in a Complex, Adaptive Economy: Past Mistakes and Future Possibilities

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Abstract

The global economy has performed very poorly since the onset of the crisis in 2008. This paper argues that easy monetary policy has actually worsened economic prospects to date, being based on a fundamental, ontological error. The economy is not an understandable and controllable machine as assumed by conventional macroeconomic theory. Rather, the economy is a complex, adaptive system, like many others in nature and society, in which policies can have significant, unintended consequences. Among the unintended consequences of easy monetary policies to date have been a significant increase in the level of non-financial debt, the threat of greater financial instability and a decline in the potential growth rate. The risks posed by these unintended consequences imply that governments, not central banks, must finally take responsibility for resolving the crisis. Embracing complexity also leads to many practical suggestions as to how monetary policy might be better conducted in future.

Geldpolitik in einer komplexen, anpassungsfähigen Wirtschaft: Bisherige Fehler und zukünftige Möglichkeiten

Zusammenfassung

Die Weltwirtschaft entwickelte sich seit dem Beginn der Krise in 2008 nur sehr schwach. Dieser Beitrag argumentiert, dass die lockere Geldpolitik der letzten Jahre die wirtschaftlichen Aussichten bislang sogar verschlechtert hat, was auf einem fundamentalen ontologischen Fehler beruht. Die Wirtschaft ist keine durchschaubare und kontrollierbare Maschine, wie es in der konventionellen makroökonomischen Theorie angenommen wird. Stattdessen ist die Wirtschaft wie viele andere Systeme in der Natur und in der Gesellschaft ein komplexes, lernfähiges System, in dem politische Entscheidungen erhebliche unbeabsichtigte Folgen haben können. Unbeabsichtigte Folgen der lockeren Geldpolitik waren bisher ein signifikanter Anstieg des Volumens der Schulden außerhalb des Finanzsektors, das Risiko einer erhöhten Finanzinstabilität und ein Rückgang der po-

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tenziellen Wachstumsrate. Die Risiken, die durch diese unbeabsichtigten Folgen hervorgerufen werden, implizieren, dass Regierungen und nicht die Zentralbanken letztendlich die Verantwortung für die Bewältigung der Krise übernehmen müssen. Die Berücksichtigung von Komplexität führt auch zu vielen praktischen Vorschlägen, wie die Geldpolitik in Zukunft verbessert werden kann.

Key Words: monetary policy, credit, complexity, false beliefs, unintended consequences

JEL Classification: E14, E52, B52, B53

I. Introduction

The starting point for this paper is that the global economic and financial problems which emerged in 2008 have not yet been resolved. Indeed, there are good reasons to believe that the policies followed by the official sector, central banks in particular, have worsened these problems rather than moderating them. Why is this so? It is contended in this paper that the analytical frameworks used to guide macroeconomic policy, not least the models suggested by "modern macro," are fundamentally flawed. They fail to recognize that the economy is a complex, adaptive system with properties common to many other such systems in nature and in society[1]. Had central banks recognized this well before the crisis, it might have been averted. Looking forward to a time when a "new normal" has been established, the embrace of complexity also provides a significant number of lessons as to how monetary policy might be better conducted than in the past. This way of thinking owes much to the work of Hayek[2]. His emphasis on supply side developments in the economy, particularly over longer time frames, is an essential complement to more Keynesian thinking which tends to focus almost exclusively on near term influences affecting aggregate demand.

Prior to the start of the crisis, the implicit objective of monetary policy was to keep aggregate demand growing as strongly as possible; that is, at the same rate of growth as potential output. This would not only ensure a full use of potential but would also ensure a stable (presumably low) inflation rate. The analytical framework of "modern macro" was thought to provide a helpful guide in the pursuit of this single objective. However, in the wake of the crisis, the G 20 felt the need to embrace a more complex set of policy objectives; namely, "strong, sustainable and inclusive growth". Interestingly, these three issues (sources of secular growth, the business cycle and distribution) were the analytical topics

[1] For popular introductions to this literature see *Buchanan* (2000) and *Ball* (2012). The latter has chapters on predicting traffic, crowd control, social norms and decision making, how crime spreads, social networks, disease and epidemics, economic and financial systems, fostering cooperation, the way cities develop and how to model military conflict.

[2] *Hayek* (1967).

which the Classical economists (such as *Smith*, *Ricardo* and *Marx*) thought were of the greatest practical importance. *Simpson* (2013) actually draws an explicit link between the principles underlying this older way of thinking, through the Austrian School, to modern complexity theory. Treating the economy as a complex adaptive system would then seem the first step required in devising an analytical framework to help achieve the best combination of these traditional, now rediscovered, goals[3].

II. What is the Problem?

Since the end of "the Great Moderation" in 2008, global economic performance has been very unsatisfactory. Problems emerged in three waves. Disruptions in the financial sector preceded a deep recession in all the Advanced Market Economies (AME) beginning in 2008. This was followed by the beginnings of the Eurozone crisis in 2010, and then a subsequent sharp slowdown in many Emerging Market Economies. Overall, growth rates have been slow relative to traditional cyclical recoveries, with many countries not yet having achieved pre crisis levels of output. One year ahead forecasts by the IMF and others have regularly suggested incipient improvements, but have had to be revised downwards for nine years in a row. Inflation has also generally come in weaker than had been expected.

Looking at the individual regions of the global economy also indicates underlying weaknesses. The United States has recorded the biggest GDP gains in the post crisis period, but productivity growth, investment and labour force participation rates have all been unusually weak. Fears of inflation have recently begun to surface as US wages have begun to pick up. In Japan, the experiment with "Abenomics" is increasingly seen as a failure and the goal of 2 percent inflation has been put off yet again. Europe has a host of economic problems, not least a weak banking system and significant political problems as well. China has announced a transition to a more consumer driven growth, but progress has been very spotty and all transitions are dangerous. Finally, many EME's have been badly affected by lower commodity prices, and the effects of having failed to make necessary structural reforms in the period when growth was strong.

Adding to the gloom has been a sharp increase in "populist" sentiment in many countries. Recent studies[4] indicate that political polarisation (often a

[3] The OECD in Paris is currently devoting significant attention to the issue of how certain policies can support multiple objectives while others involve trade-offs. For example, later retirement ages improve both growth and inclusiveness. In contrast, policies to spur innovation might reduce inclusiveness. See *Brynjolfsson* and *McAfee* (2014). Rapid credit growth promotes strong growth, but is commonly not sustainable.

[4] *Funke* et al. (2015).

swing to those blaming "others") is common in the wake of financial crises like the one we have just experienced. This implies political impediments to government efforts to provide solutions to identified problems. In any event, most large countries now seem to have relatively little room for either monetary or fiscal expansion should any of the above weaknesses actually materialize. In short, we are not in a place where we want to be.

III. What are the Origins of the Problem?

The analytical frameworks, and econometric models, still used by most central banks are based on a large number of simplifying assumptions. These are needed in order to ensure that the framework is understandable and domestic inflation controllable, at least in principle. Perhaps most important is the assumption that deviations from full employment are quickly reversed as the economy tends to revert back to "equilibrium". Similarly, financial markets are only a veil to real activities and can thus be ignored. Money, credit and debt generally play no role while stocks and cumulative processes can also be assumed away "Representative agents" stand in for the millions of diverse agents in the real world and are commonly assumed to be all knowing about both the way the economy works and how it will unfold over time. Crucially, they know the probability of unexpected events occurring [5]. Finally, the behaviour of inflation is the critical variable indicating whether the strength of the economy is sustainable or not.

This mind set has been under attack for some years, not least because of the unrealism of many of the simplifying assumptions[6]. In effect, the accusation is that many of the issues assumed away are actually crucial to explaining and forecasting economic outcomes in the real economy[7]. A second line of attack is

[5] This contrast with the view earlier expressed by John Maynard Keynes and Frank Knight that total ("radical") uncertainty about the future could not be represented by a probability distribution. More technical assumptions underpinning modern models include Normal probability distributions and certainty-equivalence, stable functions over time and stable probability distributions. All of these assumptions might be wrong, particularly the assumptions pertaining to stability over time.

[6] For two particularly vitriolic attacks on formal models, see *Buiter* (2009) and *Romer* (2016). For a much earlier suggestion that something was not quite right see *Waldrop* (1992). He describes an early meeting at the Santa Fe Institute between some very famous physicists and economists to discuss complexity theory in an interdisciplinary way. It is revealing that the chapter describing this meeting is called "You guys really believe that?"

[7] This accusation applies most directly today to DSGE models. Note, however, that similar shortcomings were said to apply to models of the IS/LM type originally developed by Hicks. See *Leijonhufvud* (1968). Such models are at the heart of the large structural econometric models that have been used by many central banks for decades. In-

more philosophical and rests on the assertion that "knowledge" can be defined as "justified true belief"[8]. This emphasis on justification implies, as in any putative science, that theoretical assertions must be confronted with the facts. The fact that so many "modern macro" models are calibrated rather than estimated implies this has generally not been done. Finally, the serious economic problems that now confront us, in spite of the most aggressive monetary policies ever recorded, implies that the assumptions underlying those policies must be questionable.

An alternative mind set is that the economy behaves as a complex adaptive system. These systems have been well studied by other disciplines and all have similar properties. They are made up of many agents following simple rules, constantly interacting, and with behaviour that evolves in response to changing circumstances. Non linearities are common, with the size of systemic breakdowns related to their frequency by a Power law. This seems like a realistic description of a modern economy, not least in light of the recent crisis. Many such systems also demonstrate "emergent properties" that arise from the interactions between the agents and cannot be predicted on the basis of the nature of the agents themselves. Moreover, "emergent properties" provide a much more satisfying link between micro and macroeconomics than does the fiction of a "representative agent". There is no "equilibrium" in such systems and all outcomes are path dependent.

By their very nature, complex adaptive systems can only be imperfectly understood. Had this been widely accepted before the crisis, many of the false beliefs that contributed to the severity of the crisis and to its long duration might have been tempered by humility. Financial regulators falsely believed that the stability of individual institutions guaranteed the stability of the system as a whole. Lenders falsely believed that their high profits were due to cleverness (alpha) rather than risk taking (beta). Borrowers falsely believed that rising asset prices would continue rather than revert to the mean. Similarly, governments had the false belief that fiscal windfalls were not temporary but permanent, and therefore it would not be imprudent to spend them.

Finally, and the topic of this paper, central banks had the false belief that achieving stable prices was a sufficient condition to avoid all macroeconomic problems. In effect, only inflationary pressures (linked to the output "gap") needed to be carefully monitored. In contrast, in complex, adaptive systems many variables might need to be monitored to see signs of growing systemic in-

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deed, *Hicks* (1980) himself admitted in his later years to having similar, serious reservations about the use of the IS/LM model especially for policy purposes. Not least, he noted that the model assumed static expectations in a real world characterized by significant uncertainty.

[8] See *van de Lagemaat* (2011).

stability[9]. Further, policies whose immediate impact is stabilizing can actually prove destabilizing over some longer period due to the "unintended consequences" of such policies. Engineers, for example, have known of the problem of over governance of mechanical systems for over a century[10], and these insights have also been applied to economics[11].

The discussion below focuses on the conduct of monetary policy over the last few decades, and how it has contributed to the current, dangerous state of affairs. Many of the shortcomings were pointed out at the time by a handful of analysts, not least at the Bank for International Settlements.[12] They emphasised the importance of factors absent from the conventional framework, like credit and debt, as well as the importance of real and financial interactions, feedback effects over time and nonlinear responses to shocks. While not using the same technical terms, their approach seems essentially compatible with the assumption that the economy is a complex adaptive system[13].

1. The Pre Crisis Period

The ongoing crisis has its roots in macroeconomic phenomena going back many decades, indeed as far back as the "bastard Keynesian" policies (a phrase coined by Joan Robinson) that emerged after WW ll. In the 1950's and 1960's, fiscal and then monetary policies were "fine-tuned" to avoid and mitigate recessions, even at the expense of such side effects as rising inflation. At that time, it was commonly believed that there was a long term trade off and that lowering unemployment meant that inflation would stabilize at only a slightly higher level. It took the analytical insights of Friedman and Phelps, and the actual experience of high and accelerating inflation in the 1970's, to convince everyone that the long run Phillips curve was in fact vertical.

Later, after the Volker shock of 1982, as monetary policy and the pursuit of low inflation took centre stage, monetary policy was still eased repeatedly whenever growth seemed remotely threatened. The "Greenspan put" of October

[9] By way of a simple example, water turns to ice depending on a combination of temperature and pressure.

[10] See *Cooper* (2008) for a description of the early use of "governors" to regulate the speed of steam-driven saws. If the attempted control was too tight, the saw would literally shake itself to pieces after a piece of wood had been put on the blade. This became known as the "instrument instability" problem.

[11] An early example was provided by *Phillips* (1957), himself an engineer.

[12] See successive Annual Reports dating from the late 1990's. Also *Borio* and *White* (2003) and *White* (2006).

[13] The writings of George Soros and the concept of "reflexivity" can be similarly described. See *Soros* (2010).

1987, after the stock market crash, and the subsequent bouts of easing in 1991, 1998 and 2001 are important examples. Moreover, it must be noted that neither monetary policy nor fiscal policy was ever tightened as aggressively in the upturns as they had been eased in the downturns. Thus sovereign debt levels ratcheted upwards and policy rates ratcheted downwards for over three decades. The asymmetric character of these policies, designed above all to mitigate downturns, might also be linked to the gradual slowdown of productivity growth in the advanced market economies (AME's). In effect you cannot have the benefits of "creative destruction" without the destruction part. In sum, our current troubles have been building for a long time.

Historically, most significant crises have had their origins in some "good news" that has justified "rational exuberance". The most important piece of global good news in recent decades was the "fall of the Wall" and the reintegration of previously isolated economies into the world trading system. Similarly, the introduction of the euro gave a new promise to Europe. The strong disinflationary forces that accompanied these global developments were further fuelled by the strong growth in the labour force (the baby boom effect) in the AME's[14]. In this environment, wage growth in the AMEs was supressed and profits rose strongly. This implied that consumers did not have income to spend, and so relied on borrowing[15], and corporations saw a reduced need for physical investments to stay ahead of the competition. This issue of investment is returned to below.

Given a monetary system based on fiat money, the rational exuberance generated by these developments quickly morphed (as always) into "irrational exuberance". This particularly affected the household sector in the AMEs, not least the English speaking countries, as well as the peripheral countries in the euro zone. Credit growth rose sharply in the years preceding the crisis, adding to debt levels already swollen by the earlier cycles of easing. This in turn led to a whole series of "imbalances" both real and financial[16].

On the real side, household saving rates fell sharply in many AMEs. In a subset of those countries, construction activity expanded enormously. On the financial side, asset prices (houses, equity, credit spreads etc.) attained unprecedented levels as did the leverage of most large financial institutions. Finally, credit standards slipped sharply, and the "shadow banking system" expanded until it was (by some measures) bigger than the formal banking system. These

[14] For a fuller description of the importance of demographic forces during this period, see *Goodhart* et al. (2015).

[15] On this see *Rajan* (2010).

[16] An "imbalance" is defined here as a significant and sustained deviation from historical norms, for which there is no benign explanation.

"imbalances" indicated the fragility of the system as a whole, and the possibility of a phase shift of significant proportions. The trigger for the downturn was the seizing up of the US market for subprime mortgages, but in a complex system it could have begun anywhere.

The reactions of the authorities in the AME's were conditioned by the false beliefs noted above. With inflation under downward pressure, central banks tried to encourage more demand through expansionary monetary policies. Central bankers failed to see that positive supply side shocks could produce a "good deflation" as experienced many times previously in history.[17] While these expansionary policies provided further support for emerging "imbalances," most central banks were either not monitoring or not concerned about these developments. The upshot was that their easing through consecutive cycles fostered the conditions that now threaten a "bad deflation" of the sort described by *Fisher* (1933). As Hayek had earlier suggested[18], it was a fundamental error to rely on a simplified analytical framework that left out many crucial ingredients.

These developments in the AMEs had important implications for the EMEs as well. Expansionary monetary policies in the AME's in the years prior to the crisis should have led to a depreciation of their currencies against those of the EME's. Capital inflows to EMEs rose significantly. For a variety of reasons, some more legitimate than others[19], the EME's resisted this trend to exchange rate appreciation through the use of both foreign exchange intervention and through conducting an easier monetary policy than would otherwise have been the case. The end result was an explosion of liquidity at the level of the whole global economy. The associated "boom" in the global economy came to an end with the beginnings of the financial crisis in the AMEs and the subsequent deep global recession. Bearing further witness to the shortcomings of conventional analytical frameworks, none of the large central banks, nor the IMF and the OECD, saw the downturn coming[20].

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[17] The positive correlation between deflation and low output growth, seen during the Great Depression, was effectively unique in history. See *Borio* et al. (2015). Also *Atkeson* and *Kehoe* (2004). Unfortunately, this single experience has strongly influenced the conduct of monetary policy ever since.

[18] In *Hayek* (1975) p. 31 he says "in essentially complex phenomena, the aspects of the events to be explained for which we can obtain quantitative data are necessarily limited and may not include the important ones". The irony is that the relevant data was in large part available, but the central banks chose to ignore it in their analytical frameworks.

[19] Less legitimate was resistance by countries with large external surpluses who feared dilution of their export led growth strategy. More legitimate was concern about disruptive deviations of the exchange rate from the law of uncovered interest rate parity.

[20] For an excellent documentation, see *Blustein* (2012).

2. The Post-Crisis Period

Virtually all the non-monetary policies pursued in the AME's in the immediate wake of the recession had desirable short run implications for aggregate demand. Nevertheless, each also had undesirable medium term effects or "unintended consequences". Higher fiscal deficits supported demand. However, it also raised the sovereign debt of many countries to worrisome levels, leaving them exposed to sudden turns in market sentiment. Programs to support car sales (cars for clunkers) encouraged more consumption in countries already over reliant on such consumption. Government support for short time working (particularly in continental Europe and Japan) kept down the unemployment rate but impeded adjustment to the competitive challenge from EMEs. Support for the financial system (especially mergers and acquisitions in the US and UK) avoided a larger crisis but at the expense of worsening an already serious "too big to fail" problem.

As the limitations of these policies became more evident over time, policy makers tended to reduce their use. This was particularly the case with respect to fiscal policy, prompted by the onset of the Eurozone crisis which many critics blamed on earlier fiscal excesses[21]. Support for the car and banking industries were also wound down as their fiscal costs were assessed. At the same time, regulatory policy was also tightening, not least with respect to institutions that were deemed to be systemically important. Tougher regulation, allied with the desire of financial institutions to deleverage after the crisis, might well have served to reduce the supply of loans. In this environment, monetary policy was increasingly seen as the only available policy lever to help support demand.

While this was a major change in objective, from its successful use in the immediate aftermath of the crisis to stabilize dysfunctional financial markets, it was in effect "still more of the same" policies which helped create the crisis in the first place. The joint premise underlying the use of these polices was that they would work to stimulate aggregate demand and that the "unintended consequences" of their use could again be ignored. Moreover, these basic assumptions remained unchanged in spite of the need to resort to the use of ever more unconventional policy instruments. Short term policy rates were reduced effectively to zero. Indeed, in some countries, negative rates were imposed on bank reserves held at central banks. Forward guidance about future policy rates was used to drive down medium term rates, while central bank purchases (swelling

[21] This view was strongly held in Germany and some other core euro zone countries. Indeed some proponents of "fiscal austerity" even suggested it could have expansionary effects by raising business confidence. The extraordinary output declines in a number of the peripheral countries, following significant fiscal restraint, have clearly called this view into question.

their balance sheets) were used to influence both term and credit spreads. Unfortunately, as before the crisis, evidence is accumulating that these policies have become ever less effective. Moreover, with the policies being increasingly experimental, the dangers associated with unintended consequences have been increasing as well.

Why have these policies not stimulated demand more effectively? As will be described below, this is not a "liquidity trap" of the Keynesian sort. The signal arising from easier monetary conditions (higher asset prices) is clearly getting through to those who might be inclined to spend more. The problem is that people have not responded to the signal. One reason is that the serial use of such unconventional policies smells increasingly of panic. To that extent, it induces potential spenders to "hunker down" rather than "belly up" and spend more. As well, monetary policy works by bringing forward in time spending that might have been done later. By definition, it loses potency over time, and seven years of such polices is quite a long time. To put it another way, the counterpart to this earlier spending is less saving and more debt, which acts as a "headwind" reducing future spending.[22] These effects cumulate over time.

Turning to the individual components of private demand, there are also many explanations for the relatively weak response of spending[23]. Consumers must save in order to retire. If their savings accumulate at a lower rate they might have to save more to achieve a certain minimum sum to live off when retired. Lower rates also favour debtors over creditors. If the former have a lower marginal propensity to consume, this will reduce the responsive of aggregate consumption. For corporate investors, the prospects of weaker consumer spending going forward raise the issue of whether still more production capacity is required. Put another way, if corporate investors anticipate that a "bust" must follow a "boom", then new investment will not be forthcoming[24]. Further, for corporations with defined-benefit pension funds, lower accumulation rates could imply the need to divert future profits to ensure those benefits can be paid out. This will weigh on investment, as might the "unintended consequences" of interactions between low interest rates and management compensation schemes[25].

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[22] It is worth noting that *Keynes* (1936) himself said, in Chapter xiii, "If we are tempted to assert that money is the drink that activates the system, we must remind ourselves that there are many slips between the cup and the lip." This amounted to almost a total repudiation of the recommendations to ease monetary policy made earlier in the Treatise.

[23] For a fuller discussion of such issues see *White* (2012).

[24] See *Mises* (1941) who said (p. 251) that market participants "avoid using for an expansion of their operations the easy money available, because they will keep in mind the inevitable end of the boom".

[25] Andrew Smithers' blog on the Financial Times website has, for a long time, suggested that this explains both weak investment and the high rate of corporate equity buybacks and dividend payments in the US and UK. Low interest rates encourage corporate

What have been the "unintended consequences"? Two powerful but commonly ignored sets of undesirable side effects should be highlighted[26]. First, current policies foster financial instability. By squeezing credit and term spreads, the business models of banks, insurance companies and pension funds are put at risk, as is their willingness to lend. The functioning of financial markets has also changed dramatically, with market "anomalies" indicating hidden structural shifts[27], and with many asset prices having been bid up to dangerously high levels. Second, current policies threaten potential growth going forward. Resources misallocated prior to the crisis have been locked in through zombie banks supporting zombie companies[28]. Moreover, with neither financial institutions nor financial markets functioning properly, real misallocations since the crisis have been further encouraged. The dominant role of central banks has encouraged risk on/risk off behaviour, which cuts the gains from diversification as well as value investing.

A third macro consequence has received more attention. As before the crisis, easy monetary policies have encouraged a further, significant build-up of non-financial debt (household plus corporates plus governments). The *McKinsey Global Institute* (2015) records that global debt levels rose by $57trillion between 2007 and 2014, raising the ratio of debt to GDP by 17 percentage points. While some private sector borrowers in the AME's have deleveraged, government debt has increased almost everywhere with dramatic increases in some peripheral Eurozone countries. Moreover, corporate debt in the EME's has risen sharply higher with much of this EME debt being issued in off-shore centres in US dollars. There is also evidence that much of this increase has been due to lending to corporations in sectors where the rate of return on capital has been falling[29]. This raises concerns about credit risk, currency mismatch risk and even liquidity risk in a world where only the Federal Reserve can provide quick access to dollars.

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borrowing to finance these outlays which push up stock prices and management bonuses. Cutting investment provides cash flow for the same purpose. *Masson* (2015) provides empirical support for the proposition that "Whereas (US) firms once borrowed to invest and improve their long term performance, they now borrow to enrich their investors in the short run" Masson attributes this change to the shareholder revolution of the 1980's.

26 While commonly ignored by central banks today, they would have been familiar to both Minsky and Hayek. See also *Hoffmann* and *Schnabl* (2016).

27 See *Borio* et al. (2016) for evidence that the theorem of covered interest parity has not applied through virtually the entire crisis.

28 For recent empirical support for this proposition in the euro zone, see *Acharya* et al. (2016). They document how undercapitalized banks "evergreen" the loans of existing low quality (zombie) borrowers, crowding out the supply of credit to more productive and credit worthy borrowers. In turn, this reduces their capacity both to invest and to increase employment.

29 *Blundell-Wignall* and *Roulet* (2014).

These developments constitute "spill overs" from easy monetary policies in the AMEs, especially those of the Federal Reserve Board.[30] The further result has been that the EMEs have imported still more of the "imbalances" originating in the AMEs. In sum, while the EME's were part of the solution to inadequate global demand in 2007, by 2016 they have become part of the problem. Moreover, if the EMEs are internally vulnerable, they are also externally exposed. If the dollar continues to strengthen, as it has done since the middle of 2014, these problems can only get worse. In light of the "temper tantrum" of May 2013, the pace at which the Federal Reserve attempts to raise policy rates could have effects far beyond the United States. Recognition of this possibility might further bias the direction of US monetary policy towards keeping monetary conditions easy. This will, however, also increase the costs of the unintended consequences.

While the unintended consequences discussed above have been of a macroeconomic nature, other side effects might have a more direct set of social or political implications. There is a growing perception that monetary policy, largely by inflating asset prices, has benefitted the rich at the expense of others. While highly debatable, this perception could constitute a future threat to central bank independence[31]since distributional issues are archetypally political. As well, there is concern in some quarters that low rates and the increased financing of sovereign governments by central banks have created a "debt trap" from which there can be no escaping. Low debt service charges encourage governments to believe that their fiscal situation is sustainable, when it is not sustainable at anything like normal interest rates. As predicted by *Sargent* and *Wallace* (1981), and documented historically by *Bernholz* (2006), such situations can end in high inflation and even hyperinflation. Consistent with many processes in complex adaptive systems, the onset of the inflationary crisis can be quite sudden and can sometimes follow a period of relative price stability or even a period exhibiting deflationary tendencies[32].

[30] See *Rey* (2013).

[31] For example, consider the recent remarks by the British Prime Minister about the conduct of policy by the Bank of England, the vigorous response of the Governor, and the follow up in the British media. There have been similar attacks made on the European Central Bank, especially in Germany, where low rates are said to hurt German savers to the benefit of debtors elsewhere in the euro zone.

[32] *Bernholz* (2006) notes that periods of deflation raise government deficits. Barring huge expenditure cuts, they must then borrow. However, if the initial stock of debt is thought too large, willing private lenders are not forthcoming. Increased recourse to the central bank at some point causes a sharp jump in inflationary expectations. While often seen in Latin America in the past, Japan today also looks highly vulnerable to such a process. See *Plender* (2016).

IV. Where to From Here?

Recognizing the economy as a complex, adaptive system has important implications both for crisis resolution and for future crisis prevention. Concerning the former, easy monetary policies have created the illusion that governments do not need to implement the politically difficult policies required to truly resolve the crisis. Worse, they have pushed the system even closer to a point where a new and still more serious phase of the global crisis could easily be envisaged. This might seem to argue for a prompt tightening of monetary policy to reverse this process. Unfortunately, complex systems are not only crisis prone but path dependent. The damage that has been done cannot be undone. Monetary tightening against the backdrop of increased debt levels and growing financial fragility could easily be the trigger for a new phase of even greater economic difficulties. So central banks cannot go back, and cannot continue doing what they have been doing. Fortunately, there is a way forward, but at this point it demands resolute action from governments rather than central banks. Central banks should have the humility to say explicitly that their instruments are inadequate to the task of crisis resolution[33]. As for crisis prevention in the future, simply embracing the concept of the economy as a complex, adaptive system suggests many lessons. All of them again require greater humility on the part of central bankers and, indeed, on the part of other arms of government.[34]

1. Crisis Resolution

The recognition of complexity suggests a rejection of either/or choices and a certain degree of experimentation to find the best way forward. Governments might usefully follow the policy advice of both Keynes and Hayek. To please Keynes, three sets of solutions are commonly suggested. First, governments with fiscal room for manoeuvre should use it. Moreover, that room could be significantly increased through legislating medium term fiscal frameworks to ensure debt sustainability over time. Second, emphasis should be put on infrastructure investment in concert with the private sector. Third, in many countries, a higher wage share of factor incomes would raise spending overall. To please Hayek, two complementary sets of solutions are also suggested, albeit less commonly. First,

[33] To some degree, central banks are already doing this implicitly as they increasingly stress the need for structural reforms in their respective economies.

[34] There is, admittedly, a fundamental political problem in democratic societies. If voters demand near-term and costless solutions to longer-term problems, politicians doing the "right thing" will not be re-elected. This helps explain the political support for "independent" central banks thought more likely to pursue unpopular policies directed to longer term objectives.

and of crucial importance, the problem of excessive debt must be solved by careful debt write offs and restructuring. In turn this might require recapitalization or closure of those financial firms that made the bad loans. Second, structural reforms to raise growth potential and the capacity to service debt will pay longer term dividends.

There are formidable obstacles to governments doing what only governments can do. We first need a paradigm shift in thinking about how the economy and policy actually works. The "unintended consequences" problem must be explicitly recognized. Further, we need legislation to allow the implementation of many of the government policies suggested above. Finally, we need the political will to accept that central banks can only "buy time" for governments to act. These obstacles do not inspire optimism.

2. Crisis Prevention

At some point, the ongoing crisis will be resolved, whether in an orderly way or a disorderly way. Even an orderly resolution will come with heavy costs, both economic and political. It is then worth reflecting on how monetary policy might be conducted differently so as to avoid repeating what we are still going through. A number of conclusions immediately suggest themselves on the basis of insights drawn from other disciplines about the behaviour of complex, adaptive systems. Three issues need to be addressed. First, how to deal with crises? Second, how to make the system more robust? And finally, how to assess whether the system is approaching a moment of serious rupture? With respect to all three, the limitations of our knowledge must still be recognized, along with the need to reassess these suggestions in the future in light of ongoing and adaptive structural change.

First, complex adaptive systems will inevitably break down in spite of efforts to increase their robustness. The lesson to be drawn is that the official sector should be prepared. This has both ex post and ex ante implications. During a crisis, central banks must provide lender of last resort functions, perhaps in both domestic and foreign (via swaps) currencies. Since crises can vary in significant ways, central banks should also have the legal capacity to respond flexibly[35]. While central banks should likely lead a crisis management team, Treasuries must also be involved if public money has to be spent. It is also important to make preparations prior to a crisis. The authorities, in particular central banks, must have the instruments in hand needed to manage a crisis. Memoran-

[35] Some provisions of the Dodd-Frank Act in the United States are not helpful. Concerns can also be raised about the capacity of the US Congress to impede the implementation of the Fed's swap agreements with other central banks.

da of Understanding between all involved parties, special bank insolvency regimes, and regular "war games" would also be recommended.

Second, the inevitability of crises does not mean giving up on efforts to make the system more robust. Both the probability and the costs of crises can be reduced. In the uncertain world generated by complex, adaptive systems, policy should focus on minimaxing rather than maximizing. That is, the objective of policy should be to avoid truly bad outcomes. This implies a greater willingness of central banks to accept small downturns that redress imbalances in the economy. This would not only support the Schumpeterian notion of "creative destruction". As well, by redressing imbalances on a regular basis, much larger downturns with potential social and even political side effects might be avoided. Finally, a minimaxing strategy would imply that highly experimental policies should be avoided until their potential side effects have been evaluated. While this is standard practice in many industries, not least pharmaceuticals, central bankers have recognized no such constraints.

A corollary of this lesson is that monetary policy should be conducted in a more symmetric way. It should lean against economic upturns as vigorously as downturns. Historically, it appears that the size of the "bust" is closely related to the size of the "boom" that preceded it. Studies of complex, adaptive systems in other disciplines also indicate that new control instruments can sometimes play a useful role. By analogy, using so called "macro prudential instruments", to complement monetary policy in leaning against expansionary forces deemed excessive, might well be useful. It is important, however, to distinguish between this potential role for such instruments and the role currently suggested; namely, using macro prudential instruments to allow "lower for longer" interest rates.

In seeking for more robustness, it is important to recognize that there is there is a trade-off between static efficiency and dynamic stability in complex adaptive systems. The optimal combination of the two is commonly labelled "fitness"[36]. The lesson drawn from this recognition is that policymakers should influence the institutional structure with a view to increasing fitness[37]. Admittedly, this is not straightforward. For example, increased regulation to improve financial stability can cut legitimate lending, slowing the economy and creating more NPL's. The end result might less stability not more. Moreover, increased regulation and tighter controls might reduce the alertness of economic agents to both threats ("moral hazard") and opportunities. Ease of entry and exit is also crucial if evolutionary developments are to be encouraged while avoiding disruptive discontinuities.

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[36] See *Beinhocker* (2007).

[37] See *Colander* and *Kuper* (2014). For a more sceptical view of what is possible see *Kirman* (2016).

Finally, in pursuing robustness, attention should be paid to how cascading effects are avoided in other complex systems. Scaling up systems generally provides greater efficiency (positive returns to scale), but the damage caused when things go wrong can be an order of magnitude greater. At the least, unnecessary complexity should be removed. It is also common in many systems to build in redundancy and to rely on modular designs. Both imply more static "inefficiency" but also help to avoid cascading effects that can be highly destabilizing.

The development of ACE models (Agent based Computational Economics) now provides some guidance as to which institutional reforms would increase fitness, supposing different patterns of assumed behaviour on the part of economic agents[38]. Moreover, advances in both computing and data collection ("big data") imply growing scope for this kind of analysis. Guidance as to behavioural assumptions can be drawn from various sources, not least laboratory experiments. The validation of such models is provided in part by their capacity to replicate economic phenomena in the real world. Such models can also provide guidance about the effects of different policy rules on systemic stability.

The fitness of the financial sector deserves special attention. With a more stable financial sector, the burden borne by monetary policy in leaning against credit bubbles might be reduced. In this regard, there has been excessive emphasis put on regulation to foster financial stability. This should be complemented by more reliance on the other two pillars underlying the Basel Accords, self-discipline and market discipline[39]. The former would be encouraged by rolling back public safety nets, by making individuals criminally liable for unethical behaviour, by re-establishing banker's sense of fiduciary responsibility, and by changing compensation practices. This might help ease income distribution problems as well. Stronger market discipline would be encouraged by improved auditing and accounting standards, by the reestablishment of "relationship" banking to encourage trust building, and by getting rid of unnecessary complexity.

Finally, with respect to fitness, central banks should analyse the distributional implications of monetary policy more explicitly. One reason is that distributional affects might alter the transmission mechanism of monetary policy as discussed above. Moreover, if monetary policy does contribute to rising inequality (or is even perceived to do so) the undesirable social implications of this should be explicitly recognized. Central banks would then have the motivation to muster convincing arguments as to why their policies were still doing more good than harm. In this way they could confront head on an issue that might eventually be a real threat to their "independence".

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[38] For a recent review of where this modelling now stands, see *Bruno* et al. (2016).

[39] *White* (2014).

Third, accepting that the economy is a complex, adaptive system also implies constant monitoring for signs of systemic stress. Early warning of growing stresses within the system is more important than trying to identify the trigger for a crisis, if the system as a whole is unstable, anything could be the trigger, even something that is inherently totally insignificant. This insight implies that paying attention to macroeconomic "imbalances" might pay bigger dividends than developing highly disaggregated "risk maps" of the financial sector as currently being encouraged by the G20 and the IMF[40]. The latter are not only expensive to monitor, but potential rupture points in the financial fabric can change rapidly in real time. Perhaps more important, serious economic and financial crises can have their roots in imbalances outside the financial system, as attested to Reinhart and *Rogoff* (2009)[41], *Koo* (2003) and many others[42].

Which particular macroeconomic imbalances merit attention? Traditional models, which treat domestic inflation as the only macroeconomic imbalance of interest to central banks, have been proven wrong by the onset of the crisis.[43] This is all the more the case as global forces seem increasingly to influence domestic outcomes. Similarly, a Wicksellian approach that focusses on the inflationary gap between the "natural rate" of interest (near term expectations of profit) and the "financial rate" of interest can also be highly misleading. Today, many economists suggest that the "natural rate" has fallen sharply. They conclude that central banks must push down the financial rate as well if deflation is to be avoided. However, if expectations of profit have been reduced by other "imbalances", created by easy monetary policies in the past, it is not self-evident that this is the right answer. As *Hayek* (1933) put it: "To combat the depression by a forced credit expansion is to attempt to cure the evil by the very means which brought it about."

Which other indicators should central banks look at? One suggestion is that attention should be paid to "imbalances"; that is, any significant and sustained deviation of macroeconomic variables from historical norms. While comforting explanations can sometimes be found, such deviations often indicate the rising probability of a crisis and/or the costs of a potential crisis. In this regard, the

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40 The IMF had a highly developed set of Financial Stability Indicators prior to the crisis, but still failed to see it coming.

41 Reinhart and Rogoff note how a weak economy can destroy credit ratings and increase non-performing loans. Thus, damage can run from the real side to the financial side as well as running the other way. Koo emphasized excessive corporate debt in Japan, the need to deleverage, and the decade or more of very weak investment that followed.

42 Nevertheless, of the twenty recommendations for data improvements made to the G20, jointly by the IMF and FSB, only three pertained to the non-financial sector. For a fuller discussion of these data issues, see *White* (2011).

43 *White* (2006) notes as well that neither the US Great Depression nor the Japanese Great Recession were preceded by any significant degree of inflation.

Bank for International Settlements has been a leader in identifying rising levels of credit and debt as harbingers of future problems. Closely related, they have also focussed attention on gross capital inflows as indicators of future instability, not least in EMEs, as well as other financial sector imbalances. Evidently, serious attention must be paid as well to real side imbalances. Examples would include the low household saving rates prior to the crisis in a number of English speaking countries and unprecedentedly high investment ratios in China today. *Jorda* et al. (2014) and *Turner* (2016) remind us that developments in property markets should be monitored particularly closely since they have so often been at the root of subsequent problems.

Another complication in this monitoring process arises from the fact that complex, adaptive systems are always changing. This implies that central banks must be careful not to fight the last war. For example, looking back on some historical crises associated with large capital inflows, the sectoral sources and destinations of those flows commonly differed. In the nineteenth century, non-banks lent to Latin American sovereigns. In contrast, the Latin American crisis of the 1980's involved sovereigns borrowing from banks. The South Asian crisis of the 1990's had non-sovereigns borrowing from banks. Today, recent capital flows have involved nonbanks (largely asset management companies) buying non sovereign debt. Looking back on these events, central banks generally failed to identify the new faces of this old threat (capital inflows) to stability.

Similarly, the expansion of "shadow banking" and the development of new financial instruments prior to the current crisis received remarkably little attention. This is particularly unfortunate since there are some grounds for belief from the historical record that structural innovations within the financial sector can be linked to subsequent crises[44]. The crisis of 1825 was linked to massive lending to EMEs for the first time. The crises of 1857 and 1907 were linked respectively to the development of the discount houses in London and the trust houses in New York. Some link the crisis of 1929 to the introduction of consumer credit[45]. While less important than identifying growing "imbalances" in the system, the identification of "triggers" can sometimes also have value.

Viewing the economy as always changing might also throw new light on the "rules vs discretion" debate. *Haldane* (2012) has suggested that increasingly complex financial systems need not be met with increasingly complex regulation. This suggests a similar question with respect to the conduct of monetary policy. On the one hand, it could be argued that an evolving system requires an evolving policy response. On the other hand it could also be argued that rela-

[44] See *The Economist* (2014).

[45] *Eichengreen* and *Mitchener* (2003).

tively simple rules for the conduct of monetary policy might provide the best framework for guiding a continuously evolving financial system. This issue need more attention, perhaps through the use of ACE models as noted above.

Finally, and perhaps most challenging when it comes to assessing future vulnerabilities, precise forecasts in complex adaptive systems are literally impossible. This implies that traditional, near-term forecasting, on the basis of past data, is simple extrapolation and essentially useless. At the least, central bankers (and the IMF and the OECD) should admit to the limitations of their knowledge, perhaps substituting alternative scenarios for forecasts or (even less ambitious) restrict themselves to looking for plausible explanations for recent developments. For the same reason, what economic agents face is not risk (where probability distributions are known) but radical uncertainty (where they are not known). This implies that the comfort given by risk management techniques might be largely illusory and that capital buffers (for unexpected losses) should be much larger than is currently demanded[46]. More generally, it suggests more prudent behaviour on the part of all economic agents, presumably including central banks as well.

V. The International Dimension

All of the discussion above suggests ways in which the conduct of national monetary policy might be improved. It implicitly takes the "architecture" of the International Monetary System as given. *Haldane* (2015) notes that a national economy is a very complex system made up of interconnections between three already complex systems; individual financial institutions, the financial system and the real economy. Yet, there is a fourth and still more complex system made up of the interactions between these national systems. Haldane (p20) goes on to note that "It is here where the existing policy architecture may at present be most deficient". A number of shortcomings can be highlighted.[47]

First, the increased recognition being given to the "spill overs" from domestic monetary policies, noted above, attests to some retreat from the Washington consensus. Improvements in behaviour suggested by freely floating exchange rates, allied with "keeping one's own house in order," might not be sufficient to

[46] This suggestion has been made by *Admati* and *Helwig* (2013) and *Wolf* (2014). Indeed, there is something fundamentally odd about the risk weights underlying the Basel capital requirements. They seem to imply that regulators and bankers have some knowledge of the riskiness of each asset. However, this should guide provisioning for expected losses, not unexpected losses, which are assumed to come totally out of the blue. Perhaps this logic helps explain Admati and Hellwig's preference for a high level of capital relative to *unweighted* assets.

[47] For a fuller discussion see *White* (forthcoming).

ensure international financial and economic stability[48]. A second problem is that the global financial system seems dangerously unanchored. There is no external discipline to prevent any one country from using monetary policy to stimulate without limit. As a result, virtually every large country has done so. While the implications of this concerted action are simply impossible to predict, they could well be dangerous. A third problem is that exchange rate adjustments seem to have a declining influence on current account imbalances. This implies an increased possibility of a discontinuous adjustment, not least affecting the continued survival of the current dollar exchange standard. Finally, the presumption that the global monetary system is basically stable has led to the failure to develop the tools needed to manage international crises. There is no international lender of last resort, particularly in dollars. Given the widespread international use of the dollar, and a massive increase in gross cross-border capital flows, this is a significant shortcoming.

Many decades ago, *Hayek* (1937) raised theoretical concerns that the pursuit of national monetary policies might lead to international instability. While the practical shortcomings of the International Monetary System (or Non-System as many refer to it[49]) are being increasingly recognized[50], those concerns are not yet being adequately addressed. The G20 should, not only embrace complexity as a framework for guiding domestic policy, but also for guiding the needed reform of the architecture of the International Monetary System.

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[48] Consider the pre-crisis period when three sets of "improvements" were identified. Globalisation led to improved real output and disinflationary pressures. Central banks focussed more on the pursuit of price stability. The financial system devised new products to "more fully complete" financial markets. However, all three "improvements" taken together produced the undesired outcomes documented above.

[49] For example, see *Ocampo* (2015).

[50] See, for example, *Pringle* (2012).

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