Rethinking Central Bank Design

by Kenneth Rogoff, Harvard University,[1]

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INTRODUCTION

My remarks today will focus on the paralysis that has afflicted advanced-country central banks in recent years, on how the world came to this juncture, and on alternative approaches for moving forward. I trust this is a fitting topic for the first annual Karl Brunner lecture organized by the Swiss National Bank, in honor of Brunner's fundamental contributions to the understanding of monetary policy, his role in inspiring many economists in Switzerland and around the world, and his influence on economic policy through the founding of the Shadow Open Market Committee. He is also co-founder of the two most prominent area journals on monetary economics, *The Journal of Monetary* Economics and *The Journal of Money, Credit and Banking.* Brunner (1961) is a founding father of monetarism, and was perhaps the first to clearly articulate the modern view of the transmission mechanism from monetary policy to the real economy, which he later modelled more fully in work with his long-time collaborator Allan Meltzer, who happily is here today.[2]

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[1] Draft to be submitted to MIT Press for conference volume, and subject to further revisions and editing. Not for quotation without the author's permission. The author is grateful to Marion Laboure for helpful research assistance on this paper, and for comments on an earlier draft.

[2] Laidler (1971) explains that whereas Friedman insisted on the fundamental importance of monetary policy, Brunner was really the first to lay out the mechanism. See Meltzer (2015) for a more complete discussion, also of the later work by Brunner and Meltzer that developed the analytical framework to support the intuition in Brunner (1961).

My critiques of contemporary monetary policy will perhaps be gentler than Brunner's were forty years ago, in part because most central banks are in much better shape than at the outset of floating exchange rates, with strong independence, top-flight research departments, open communication with scholars and critics and, most importantly, cogent policy frameworks. After all, central banks are widely considered heroes of the financial crisis, acting swiftly in a way governments were not, stretching their remit to take on emergency fiscal powers in order to keep credit markets from further deteriorating and to shore up the financial sector. Students of financial crises will realize that as unorthodox as central bank actions might have seemed to many people, it is quite normal for central banks to make extensive use of their balance sheets to address the first wave of a crisis, with the government general stepping in later to take over bad debts and clean up the mess. Unfortunately, in this instance, many governments have been too content to leave the much of the problem on the shoulders of central banks. With central banks continuing to take on responsibilities that are normally the responsibility of the fiscal authorities, there is every reason to be concerned about the adverse effects on central bank independence will last for a long time.

Part of problem, though, is that normal monetary policy has become mired in the zero bound on interest rates, laying bare some a fundamental limitation in the central bank toolkit which I believe is essential to address. I will argue here that central banks need to lay the foundations for fully effective negative interest rate policy. This is not something that can be done overnight, and current flirtations with negative rate policy show that various frictions – especially the existence of zero interest rate paper currency – cannot be ignored. But one hopes

that the preconditions for effective negative rate policy can be established in time to deal with the next financial crisis).[3]

Beyond fixing the central bank toolkit, I will also argue that future inflation-targeting regimes need to evolve to incorporate a *temporary* "escape clause" from, say, a 2% inflation target, to be invoked in times of deep systemic financial crisis or other national emergency.[4] I realize that such escape clauses will reintroduce some mild inflationary bias into monetary policy, mainly because it may take some time to convince markets that escape clauses will not be abused. Nevertheless, the loss of anti-inflation credibility seems a small price to pay for having the flexibility to deliberately allow inflation to rise above target for an extended period (perhaps a few years) in response to a deep systemic financial crisis, in order to accelerate deleveraging and to spur recovery. An overly strict interpretation of inflation targeting that leaves insufficient room for dealing with rare events, is very much at the heart of problems we see today, at least as much as the inability to invoke negative interest rates.

SOME PERSPECTIVE ON WHAT MONETARY POLICY CAN ACHIEVE ON ITS OWN

It is important to have some perspective. Activist monetary policy is fundamentally a cyclical tool. If a country is facing a prolonged productivity decline, adjusting to a rapidly aging population, or dealing with a zombie banking sector, monetary policy can at best soften the adjustment path. It cannot cure an economy with chronic illness (unless of course that chronic illness is bad monetary policy, as Karl Brunner and other monetarists rightly argued in the early

[3] Of course negative rate policy is not now a particularly popular position with the financial industry – and pundits who owe their living to selling their services to it. But if the necessary legal, institutional and tax changes are made, negative rate policy will facilitate financial intermediation in a deep recession, not interfere with it.
[4] See Lohmann (1992) on the need to incorporate regime flexibility into any targeting regime, and Rogoff (1985) on the tradeoff between flexibility and commitment.

1970s). Even in dealing with cyclical downturns, and especially a deep financial crisis, monetary policy is just one tool of government policy. It is not a substitute for better regulatory policy (though the central bank has some say over that), it is not a substitute for fiscal policy (although in emergency circumstances, the central bank can engage in quasi-fiscal policy by using its balance sheet if the government that oversees it acquiesces), and it is certainly not a substitute for productivity-enhancing structural reforms. It is not a substitute for fundamental tax reform to achieve a simpler, fairer and more efficient system.

By analogy, in the United States, we have four branches of the armed services: the Air Force, the Navy, the Army and the Marines. In some limited actions, one branch can handle the problem. For an all-out battle, however, the commander in chief will generally try to bring all forces to bear. If the Marines are forced to go alone into a battle that really requires air and naval support for certain success, they may fail or only partially succeed. And in any event, a good commander in chief would not send in the Marines and leave huge uncertainty about whether help might come.

Yet this is exactly the position central banks faced during the financial crisis and its aftermath. In real time, they had to choose and calibrate policies without any clear idea of what the rest of the government would do. How expansionary is fiscal policy going to be and for how long? Will regulators bite the bullet and force weak banks to recapitalize or will they pretend that bankrupt banks are solvent through regulatory forbearance? Will the government engage in productivity-enhancing policies such as improving the efficiency of the tax system, or will it be paralyzed?

THE POLEMIC DEBATE ABOUT WHAT SHOULD HAVE BEEN DONE IN THE CRISIS

There is a great deal of heated (and often very political) controversy over how the rest of the government might have performed better during the crisis. A lot of it seems predicated on the view that "we all knew" exactly how bad things might get, even though virtually all private and official forecasts proved again and again too optimistic.[5]

One school of thought is that governments should have done more to reboot credit markets, for example by implementing creative strategies to bail out subprime homeowners in the United States.[6] Many of us argued from the early days of the European debt crisis that Europe should have moved quickly to write down debts in the periphery, as otherwise debt overhang would impede recovering. Though some have argued public debt overhang never matters in advanced countries, the evidence of the past nine years particularly in the periphery of Europe, strongly suggests otherwise. Italy and Greece had massive public debt problems already back in the early 1990s and it is folly to think these have not constrained the government's options in dealing with the crisis; along with Japan (whose debt to GDP ratio is even higher), they have had the worst growth performance of any of the advanced economies over the past 20 years.

Instead of injecting public funds (in return for equity) to clean up private bank sector balance sheets, and paving the way for new lending, most governments were far more concerned with risk-proofing future private lending, not realizing they should still be worrying about getting

[5] The Reinhart-Rogoff (2009) view that deep systemic financial crises produce far more severe and long-lasting recessions than normal was hardly the central view in 2009 and 2010.

[6] Many of us recommended such strategies in the early days of the financial crisis; Mian and Sufi (2014) and many others also find this would have been the most efficient use of the federal balance sheet.

lending going again, not stopping it from overheating. Many policymakers did not seem to understand that even after the immediate financial crisis had passed, zombie banks with weak balance sheets, together with overleveraged households and firms, would impinge on the recovery for years to come. Arguably, the problem was compounded by rather blunt regulation that in many cases had the effect of shutting out smaller borrowers.[7] If one believes small and medium-size businesses ultimately produce much of the real innovation in the economy, the sharp tightening of lending conditions may have played a role in the slow pace of innovation we have seen in recent years. The same phenomenon appears to have occurred during the Great Depression.

One might also argue that governments have found it convenient to restrict private access to credit markets at a time when they themselves had massive borrowing needs, a type of financial repression Reinhart and I discuss in our 2009 book, and which Reinhart has gone on to argue played a huge role in paying off World War II debts (Reinhart and Sbrancia, 2015). Thus, to some extent, there is an endogenous component to slow productivity and low interest rates which traces back to the (necessary) run-up of public debt that occurred during the financial crisis.

Another school of thought is that governments should have engaged in a much larger and longer-lasting increase in government spending. The theoretical case is unimpeachable. However, most models do not take into account the practical obstacles to choosing and curating expenditures when they are ramped up quickly and on a massive scale, a nuance Dr. Brunner would not have missed. Mind you, economists of all stripes agree that during a deep recession,

[7] See Geanakoplos (2014).

with huge pools of idle labor and ultra-low interest rates, the government should ramp up infrastructure spending, and should pay for it via deficit financing (though there is no reason why private funding cannot also contribute.) There was never any debate among economists, and there is little debate now, that more should have been done. That said, this is an area where many academic economists are not fully attuned to practical issues. In the real world, all sorts of obstacles coming from environmental protections, right-of-way concerns, and political pressures to spread spending around, make curating and administering projects not as easy in practice as it looks on paper. This is especially the case when spending is being massively ramped up in a hurry. It is curious that economists have written so much about the need for more infrastructure but so little about what institutions the government needs to better curate projects, especially when decisions need to be reached quickly and on a large scale.

One might say, who cares, wouldn't it be good just to have the government spend on anything that increases demand in a recession? Some argue that in a crisis, even purely dissipative spending (presumably debt financed) is extremely helpful, so who cares if an infrastructure project is not really productive? What is wrong with John Maynard Keynes' proverbial public work project of having workers dig ditches and then fill them in again? Well, one can only say that this particular piece of Keynesian dogma is one that, after a great deal of research, has not stood the test of time. Karl Brunner would certainly have had a more nuanced interpretation of what stimulus can do. Keynesianism offers very important insights, but its more polemic advocates tend to understate the importance of supply-side economics and the effect of government policy on private incentives to save and invest. Indeed, some economists are arguing that economies at the zero bound should not engage in structural reforms, or sign trade

agreements, because both actions would lower inflation, raising the real interest rate and impeding demand.

HOW MIGHT CENTRAL BANK DESIGN BE IMPROVED IN RECOGNITION OF LIMITATIONS THAT WERE EXPOSED BY THE CRISIS?

Today I am taking up a seemingly much narrower issue, how to improve central bank design, but I will argue that if successful, better central bank design might go a long way towards clearing up many of today's polemic policy debates that key off the zero bound.

I will argue that both central bank toolkits and their inflation-targeting frameworks are in need of repair. First, the policy toolkit would be much enhanced by more effective negative interest rate policy, which again is difficult today and not something central banks can execute all on their own. In addition, central banks need to be able to *credibly* engage in inflationary policy during deep recessions, and to arrive at this decision reasonably quickly before deep-seated deflationary expectations have set in. That is, the basic inflation-targeting framework needs to include a safety valve, an escape clause, that enables central banks to *temporarily* raise inflation targets in extreme situations. Even today, most central banks are so narrowly committed to their inflation-targeting framework that they are blind to the fact that for much of this period, and especially during the early years of the crisis, an inflation overshoot might actually have been extremely beneficial. Anyone working with realistic forecasts in 2008 and 2009 (central banks were slow to recognize that recessions around financial crises are different) would have understood that during the crisis, inflation was by far the lesser evil.

RELEVANT CONTRIBUTIONS OF DR BRUNNER WE SHOULD BEAR IN MIND

Before delving deeper, let me add a bit more about Dr Brunner's own contributions, as they relate to my discussion. This is not for purposes of a comprehensive survey; some of Karl's closest colleagues and co-authors have already spoken.

Many of Brunner's most prominent contributions, of course, where with his close friend and colleague Allan Meltzer, whom you have already heard from. These two researchers were often ahead of their time in many areas, not just the transmission of monetary policy as I mentioned in the introduction. For example, nowadays, the profession realizes that the foundations of money (why do people need to use money at all) is an absolutely fundamental topic, even if economists are still very far from having reliable models of it. Modern technical research was opened up by Kiyotaki and Wright (1989) who developed an extremely elegant, albeit narrow and stylized, explanation of the role of money in transactions. But, in fact, it was Brunner and Meltzer (1971) who anticipated some of the key ideas.

The topic of why people hold currency may seem like pure philosophy to some. Obviously everyone likes to have money and it is useful for transactions; it is a social convention, what more do we need to know? But in fact, economists have long realized that there are great subtleties in why and how physical currency is used, and puzzled over whether it is actually as essential as people think, particularly as the world becomes more digitized. There are deep questions (for example the relationship between money and prices, or why certain kinds of money win out over others), about which we have remarkably little understanding. Today, when people ask whether Bitcoin can be a currency, or whether central banks can make use of

blockchain technologies, they are forced to revisit many of the same issues that Brunner and Meltzer raised.[8]

Another visionary theme in Brunner and Meltzer's work was its emphasis that both money *and* credit are important. They repeat this theme again and again, indeed it is a mantra (Brunner and Meltzer, 1963, 1972, 1988) Indeed, the made sure to include the words "Credit and Banking" when they founded the *Journal of Money, Credit and Banking*. We need to recall that back at the time of their writing, and for many years after (especially, for example, in the work of Lucas), the emphasis was entirely on relatively narrow definitions of money alà Friedman. Credit remained in the background, perhaps because the Chicago–Minnesota school held that financial markets work very well and that credit market frictions are essentially a non-issue. Nowadays, in the aftermath of the financial crisis of 2008, no one accepts the extreme real business cycle view anymore. As I have already argued, there is a good case to be made that the failure to effectively reboot the banking sector, and especially Europe's Japanese-style approach to postponing debt workouts and write-downs, has been a major factor underlying slow growth, slow productivity, and slow recovery today.

Karl Brunner also had an important impact on policy through his leadership in the Shadow Open Market Committee that began meeting in 1973. Today, when most central banks have large research departments and strong ties to the academic community, it is easy to forget how intellectually lost monetary authorities were at that time. After the collapse of the Bretton Woods system of fixed exchange rates, monetary authorities in Europe and Japan suddenly needed to think about their own monetary policies, instead of passively following those of the

[8] See Rogoff *The Curse of Cash* (2016) for further discussion.

United States, which itself had entered a high state of dysfunction in the Burns era. The Shadow Open Market Committee was far ahead of policymakers in understanding the importance of stable money and credit growth as a bedrock for stabilizing long-run inflation. The group brought to bear simple powerful facts and analysis that should have received far more attention and respect than they did at the time.

Indeed, when I joined the International Finance Division at the Federal Reserve in late summer 1979, many policymakers regarded the Shadow Open Market Committee as quirky outsiders whose narrow mechanical understanding of monetary policy had little connection to the complexities of the real world economy. Only when Paul Volcker took over from William Miller as Fed chair later that year did modern monetarism start to get the respect it deserved. Suddenly the views of the Shadow Open Market Committee no longer seemed so marginal. Of course, both central banking and academic research on monetary economics have evolved enormously since.

THE CARNEGIE ROCHESTER CONFERENCE SERIES ON PUBLIC POLICY

I myself did not have the pleasure of working closely with Dr Brunner, but he certainly had an influence on me, for example through his role in the Carnegie-Rochester conference volumes, which for many years were associated with the *Journal of Monetary Economics*. The conference series was yet another highly significant professional contribution of Brunner and Meltzer. One of the things the conference did was to invite scholars, sometimes relatively young ones, to write papers in a slightly different format, more extensive than that of a conventional journal, also one that emphasized synthesis and critical discussion of differing ideas. This approach is particularly valuable at turning points in research, with famous examples being Robert Lucas's famous 1978 "Lucas critique" paper, and Edward Prescott's (1986) paper on

"Theory Ahead of Business Cycle Measurement." (I was fortunate to be the discussant of the latter. I noted that great ideas are ones that seem crazy at first and much later seem obvious, and suggested that Prescott's paper definitely passed the first test.) There are many other classics, but one very relevant to modern-day research is Michael Mussa's (1986) paper showing how, contrary to the dominant strand of macroeconomic research at the time (spearheaded by Lucas and Prescott), there can be no denying that domestic goods prices adjust far more sluggishly than asset prices.

As editors, Brunner and Meltzer had a keen eye for important turning points in a literature. Through the editorial process, and of course benefiting from diverse comments at the conference, they also helped shape sometimes very rough papers to make them clearer and more accessible. Their paper-selection process and editing is, more than anything, what produced the crisp points of view characteristic of so many classic CR papers.

I had the good fortune to be invited to present a paper at the 1987 Carnegie-Rochester conference. My topic was "Reputational Constraints on Monetary Policy." It was an opportunity I greatly appreciated because I had been working somewhat alone for many years on a different approach, arguing that central bank independence and design are absolutely fundamental to performance, and in fact essentially to achieving a robust solution to the credibility problems faced by central banks. This may seem obvious today, but my game theory cum institutions approach was completely out of step with the prevailing thinking at the time (due to Kydland and Prescott, 1977, and particularly Barro and Gordon, 1983). Their work tended to paint central bank policy as one big supergame, in which what really matters are the underlying incentives of the government and the fundamental frictions of the economy. The supergame approach viewed any attempt to install institutional constraints as creating a Maginot

line which the government could jump over anytime it felt like it. While the mathematical elegance of the game-theoretic approach is undeniable, an institution-free game theory approach simply cannot not explain why central bank policy design and policy strategy seems to matter so much in practice, and gives give little in the way useful results or policy guidance. Nevertheless, in the mid-1980s, the reputation approach was much more popular among academics, in no small part because the models were fun to work on, but also because the profession was going through a wave where institutional approaches were considered "soft" and unreliable.

THE TRADEOFF BETWEEN FLEXIBILITY AND COMMITMENT

Since my 1987 paper anticipates some of the themes of this talk, I will explain it briefly. At the time, thirty years ago, there were two broad branches of work on understanding how to make central banks more credible in their anti-inflation stance. The institutional approach argued that the central bank needed to be given significant independence, and that central banks should be designed in a way that gave them either strong incentives, or at least a strong predilection, to fight inflation, so that they would be able to resist short-term incentives to excessively cut policy interest rates. However, the institutional approach also posited that central banks should not be overly obsessive about inflation and should also put a weight on output stabilization[9]. The advantage of having a very rigid inflation target, say as the ECB is designed, is that it is a very powerful device for holding down inflation expectations. Low inflation expectations in turn, hold down nominal interest rates which have, of course, inflation expectations built in. The disadvantage, as one has also seen at times in the European Central Bank, is that if the weight on inflation is excessive, and if there is no escape clause, then the economy may suffer larger

[9] Rogoff (1985) introduces a fairly simple version of inflation targeting. A central point of the paper is that there is balance between flexibility and commitment.

business cycle fluctuations than it would with more activist monetary policy. There needs to be a balance.

It is unfortunate that in recent years, central banks have coalesced around the view that there is no tradeoff, that policymakers can have their cake and eat it too. That is, they can maintain a precise 2% long-term trend inflation while engaging in extremely activist short-term policy. The modern interpretation of "flexible inflation targeting" basically states that the central bank can have great freedom in the short run as long as it is totally committed to hitting inflation targets over the long run. "Inflation-targeting evangelism" -- the belief that optimal monetary policy involves no tradeoff between flexibility and commitment -- lies at the heart of the biggest mistakes central banks made as the 2008 financial crisis unfolded. Central banks acted boldly, but only up to a point, not realizing that in a time of deep financial crisis, temporarily elevated inflation can help alleviate debt burdens (at the margin), reduce real wages to help maintain employment and, extremely importantly, prop up inflation expectations to avoid a relentless downward drift to the zero bound.

My 1987 Carnegie Rochester paper, which Karl Brunner and Alan Meltzer helped with as editors, underscored the fundamental problems of any approach the denies the importance of institutional factors in central banking. In technical terms, the basic insight of the reputation approach – which is correct -- is that monetary policy is a repeated game. If the monetary authority abuses the public trust, people will expect the same abuse to happen again in the future, and inflation expectations and nominal interest rates will shoot up. This concern over losing reputation puts a check on central banks' temptation to "cheat," which may or may not be enough to contain inflation to a satisfactory level.

In principle, reputational factors allow enormous latitude for the central bank to engage in activist policy while not undermining its reputation for keeping long-run inflation low. Indeed, this is much the logic implicit in the view that with a proper inflation-targeting framework, there is no tradeoff between flexibility and commitment. There are a large variety of ways that reputation can work, but all of them are subject to a certain underlying fragility. In particular, in a reputational world, a plethora of alternative equilibria are possible, not just the ideal one. The possibility of multiple equilibria both limits the predictive power of the model, and opens the door to market instability. Much has changed since 1987, of course, with central banks and scholars now paying extraordinary attention to minutiae of institutional detail. But we will come back to this.

CENTRAL BANKING IN A STATE OF FLUX AT THE ZERO BOUND

Where are things today? It is safe to say that after the financial crisis, the literature on central banking is in a severe state of flux, both intellectually and politically, with central bank independence being challenged on many fronts. Curiously, central bankers today seem to be widely regarded as both omnipotent and impotent at the same time. For sure, their words and actions still carry great weight in markets; the media and investors pay rapt attention to a central banker's every word. Yet at the same time, investors have come to be much more skeptical about central banks' attempts to guide expectations about the future path of interest rates and inflation. This results in a stark contrast between what the central says it is going to do and what markets actually believe it is going to do, as reflected in the response of medium- and long-term interest rates. Indeed, there is even increasing skepticism about whether central banks really have the will and the power to bring inflation in line with long-term targets, much less short-term ones.

At one level, the lack of confidence in central banks' vision of the world is a result of their awful forecasting record in the years after the financial crisis, over-predicting both growth and inflation. Even the US Fed has suffered this embarrassment. The International Monetary Fund, in its flagship semi-annual *World Economic Outlook* publication, managed to overstate global growth for eight consecutive years, going on nine. Forecasting growth is difficult in general, but consistently over-predicting growth this many years in a row is indicative of a much deeper structural problem with conventional forecasting methods. And the IMF is hardly alone. By and large the same problem has plagued almost all international organizations and central banks.

The consensus on growth continues to shift, though there is still much debate over the causes of post-crisis slow growth. Everyone agrees on "lower for longer," but exactly how long is another question. A central theme of my 2009 book with Carmen Reinhart *This Time Is Different* is that recessions after deep systemic financial crises tend to be extraordinarily long and deep. Moreover, if the political system is unable to engage in the actions necessary to restore the health of the credit system – which typically requires mechanisms for requisite restructuring of bad debts, using realistic valuations of assets and forcing rapid recapitalization of banks – the period of slow growth can persist for a very long time as in the case of Japan. Some might argue that eight years after the crisis, deleveraging and debt overhang could not possibly still be playing a role. In fact, this is far from clear. Europe is still plagued by weak banks, and of course Chinese growth is at severe risk from debt overhang. In normal times, private debt rises, it does not just stand still. Normal growth is typically associated with an upward credit trend, a trend that in most markets around the world has been very slow to resume again. There are other rationales for slow growth as well (lack of innovation, permanently weak private demand), but

the bottom line is that post–financial crisis growth has been extremely disappointing relative both to what conventional models predict, and perhaps to what the public has come to expect.

THE EPIC FALL IN POLICY INTEREST RATES

The main reason why central bankers have seemed so impotent, however, is not slow growth but the spectacular fall in interest rates that has taken policy rates down to zero (and even a little below), forcing central banks to rely on weak second-best tools such as quantitative easing and forward guidance. There are essentially two reasons why interest rates have fallen so much, both very important. The first factor is the continuing drop in inflation which, up to a point, might be taken as evidence of the great success of modern central-banking techniques. Now that ultra-low inflation has become so embedded worldwide, central banks' success in driving down inflation seems to be a double-edged sword. The overshoot of inflation to the downside, and the difficulty that central banks have had returning it to normal, underscores the importance of incorporating temporary escape clauses in the face of massive crises.

Many young people today have never seen moderate—much less high—inflation. They probably see writings on the evils of inflation as akin to their grandparents' music: once a big deal, but now largely irrelevant for advanced countries. Their views are echoed in a lot of recent academic research which views inflation as a problem that has been completely conquered, like a disease that has been eradicated by modern medicine. This claim is wildly overstated and dangerous.

When I was a graduate student at the end of the 1970s, many economists believed that that inflation would be high forever. US inflation reached 13% in the 1970s, inflation in the United Kingdom and Japan peaked at over 20%. Even as most advanced countries succeeded in

gradually containing inflation in the 1980s (well, not so much Italy and Greece), it remained a scourge in emerging markets. Indeed, just two and a half decades ago, in 1992, over forty countries in the world had inflation over 40%, as Table 1 illustrates. And although not listed separately in the table, a few even reached the Cagan definition of hyperinflation. World inflation, illustrated in figure 1, exceeded 20% in the early 1990s. Even so, there were a few countries experiencing outright deflation (falling prices), specifically the French franc–zone countries in Africa who pegged to the French franc and suffered when low commodity prices put huge downward pressure on prices and wages. The Franc zone experience shows the deflationary power of fixed exchange rate regimes, creating the possibility of deflation even in the midst of a huge global inflation. (Of course, Japan managed to do the same on a flexible exchange rate regime during the 1990s thanks to very low baseline inflation and a massive financial crisis.)

Fast forward to 2015, and Table 1 now paints an entirely different picture. Instead of over forty countries with extremely high inflation, there are over thirty countries experiencing deflation. The reach of deflation has been far and wide. Many advanced countries have been afflicted, including Greece, Spain, Finland and Switzerland, not to mention Israel and Taiwan Province of China. Middle-income countries such as Bulgaria, Hungary, Romania and Poland had falling prices, as did Thailand. So did the US Territory of Puerto Rico, which of course is afflicted by a debt crisis with many parallels to Greece. In the Middle East, countries as diverse as Jordan and Afghanistan experienced deflation in 2015. As for very high inflation in 2015, there were only conflict-torn Ukraine and Venezuela, though Argentina would probably be near the threshold but for the manipulation of price data that occurred under the Kirchner regime.

Figure 2 tells the same story in a different way, giving the distribution of inflation across emerging markets (panel 1) and advanced economies (panel 2) in 1992 versus 2015. As figure 2 shows, average inflation across advanced countries has fallen to close to 1%, with emerging-market and world inflation also at very low levels even if a few individual countries such as Russia and Brazil still have relatively high inflation. Is the sharp downward trend a result of inflation targeting? The answer is not at all obvious. Figure 3 separates out inflation-targeting and non–inflation-targeting countries according to the IMF definition. The average inflation rates across non–inflation-targeting countries are not conspicuously higher. Just as inflation across Europe would likely have come down sharply even without the euro, inflation in both advanced and emerging economies has fallen with or without inflation targeting.

As actual realized inflation has trended down, so too have inflation expectations. Certainly most consumers and markets continue to expect very low inflation for as far as the eye can see.

Figure 4 shows market-based expectations of US inflation extrapolated from inflation-indexed and non-indexed treasury bonds (the calculation abstracts from liquidity premia, risk, etc.). The figure shows expectations for the five years beginning five years from each date. For a long time, inflation expectations were reasonably stable around 2.5% (which presumably is an average of the Fed's implicit target of 2% and the slight chance the government finds itself needing to inflate much more significantly). During 2016, however, market-based measures of

long-term inflation expectations have begun to collapse. They are now closer to 1.5%, indicating very little confidence in the Fed's ability to raise inflation back to target.[10]

Figure 5 shows survey measures of consumer expectations, which have also trended down significantly, though very-long-term expectations have remained near 2%. This might seem very reassuring, but long-run inflation expectations continue to drop and do not seem to factor in any significant possibility of elevated inflation in the future which, in a world of high debt and low growth, must be a risk.

The same phenomenon is taking place in Europe. Figure 6 shows the results of consumer inflation surveys for the UK, France, Germany, Italy and Switzerland. The figure gives data from February 2013 through November 2014, and illustrates both the low level and downward drift in recent years. Although the predictions of professional forecasters are less important, Table 2 is nevertheless curious. According to the ECB, professional forecasters have been locked on 1.9% (just below 2%) for their expectations of inflation five years out, and have been so since the inception of the euro. Recently, though, the expectation has dropped to 1.8%. Although small, this shift has to be seen as significant given the near absolute constancy of the expectations until now.

Major international organizations also produce long-term inflation forecasts, and these too have been trending down, though like the professional euro forecasts, they give perhaps more weight to central bank targets than market measures do. The OECD's forecasts, which go out to 2060, are given in Figure 7. The OECD baseline projections converge to 2% for all the major

[10] One can make the case that the ultra-low inflation expectations embodied in the five year, five year forward rates actually representative a negative risk premium on inflation indexed bonds, but it seems unlikely that this is the main explanation.

countries. The IMF (Figure 8) sees Europe especially struggling to get inflation up to 1.9% even after five years, though it comes close.

Japan of course, has been stuck in deflation for a very long time and, as Figure 9 shows, the June 2016 Tankan survey shows, Japanese firms expecting inflation of only 1.2% five years hence.

What is perhaps most remarkable about the current constellation of nominal interest rates and inflation expectations is the market's virtual dismissal of any significant risk that inflation will spike ever again as it has in the past. One imagines that Karl Brunner would have argued that if the world is really going to experience slow productivity growth over the next century as Robert J. Gordon has argued, and if huge populist pressures for much higher government spending and transfers continue to build, it is a bit hard to see how inflation can stay indefinitely low. But anyway, that is what consumers and private forecasters appear to be expecting.

THE COLLAPSE IN REAL INTEREST RATES

The stunning fall in inflation and inflation expectations is only half the story of why nominal interest rates have collapsed. Another very important factor has been the massive decline in real interest rates, at both short and long horizons. The real interest rate, of course, is the nominal interest rate minus the expected inflation rate. Figure 10 gives again a market-based real interest rate estimate for the United States for the average real yield on a 30-year bond. The interest rate has fallen from over 2% in 2011, to below 1% in mid-2016. Again, these are rough approximations to the underlying theoretical construct, and ignore liquidity, duration, and risk premia in the market rates.

It is important to recognize that expected inflation and real interest rates are theoretical constructs; the empirical approximations economists use can potentially deviate significantly from the conceptual. Inflation expectations are difficult to measure precisely (notice how different the professional forecasts are from consumer forecasts, and both in turn different from measures based on comparing yields on inflation-indexed versus non-indexed bonds). Indeed, inflation itself is much harder to measure than statistical bureaus would have us believe. In principle, inflation captures how much more it will cost the representative consumer to buy a basket of goods that provides equal *utility* (welfare) to the goods he/she purchased in an earlier period. But this is in fact very hard to do precisely when there are important new goods that did not exist the year before. Although theoretically it is possible to make adjustments, this is extremely difficult to do in practice. In general, the quality of output from services is much harder to measure than the quality of output from manufactures, and this makes service inflation devilishly hard to measure. And services now constitute a vastly larger share of GDP than manufacturing. Health services alone comprise over 17% of US GDP, but that is a measure of inputs, not output. The problem with measuring government services is even worse, and of course government spending on goods and services accounts for over 40% of GDP in some countries.

Feldstein (2016) contains an excellent exposition of the problems. He argues forcefully that despite the best efforts of national statistical bureaus to correct for bias in inflation indices, measured inflation still significantly overstates actual inflation (that is, the underlying theoretical construct that governs behavior). Moreover, there is a strong case to be made that the bias has been increasing over time. As Feldstein notes, for example, US government statisticians basically measure the output of legal services by measuring hours billed. Yet there has been

enormous technological progress in legal research, for example the use of data bases. The value of social media and other new entertainment outlets is almost surely understated by statisticians. One implication Feldstein draws is that standards of living for the middle class have likely been increasing significantly faster than indicated by conventional wisdom. Another implication is that real interest rates have perhaps not fallen quite so much as they seem. At the very least, the scientific certainty with which welfare comparisons over time (for example the claim rich-country middle class are worse off today than twenty five years ago) are presented is thoroughly unjustified.

Even acknowledging large measurement error, it is impossible to deny the dramatic fall in real interest rates that has taken place in recent years. Of course, ex-post realized real interest rates were sharply negative during parts of the 1970s, but this was largely because inflation turned out to be much higher than expected. To find a precedent for the kind of extremely low real interest rates one sees today, one has to go back to the 1930s, though even then things are not as similar as they might seem. Figure 11 gives real interest rates for the US, UK, and several other countries going back to the 1930s. One difference between the Great Depression era and today is that during the first part of the 1930s, real interest rates were actually quite high. Nominal interest rates were near zero, and most countries experienced deflation (falling prices), implying a high real interest rate was actually quite high. Only as countries finally abandoned the gold standard and began to inflate, did real interest rates turned very negative. But one can argue that a lot of the inflation was unanticipated, people did not expect it, so ex-post measures of real interest rates starting in the mid-1930s might well overstate true ex-ante measures.

What is remarkable is that if one uses market-based measures, then apparently short-term real interest rates are expected to remain negative for another five to ten years. This expectation

is also consistent with the empirical results of Gourinchas and Rey (2016). They find that the consumption-to-wealth ratio is a good predictor of future interest rates, and find that this ratio has not been so low since the 1930s. According to their estimates, real interest rates will remain significantly low for at least five more years, with a point estimate of –2%.

The combination of extremely low (negative) real interest rates and extremely low sub-target inflation expectations has made it exceedingly difficult for central banks to calibrate their interest rate policy, all the more so because no one really knows where real interest rates will be in a couple years. Consider John Taylor's monetary rule from the early 1990s, where he proposed setting the policy interest rate in response to deviations of inflation and output from trend. When Taylor (1993) devised his rule, he imagined that a "normal" policy rate would be on the order of 4%, 2% inflation plus 2% real interest. Now, of course, many central banks are wondering if "normal" policy interest rates over the next few years might be 2% or less, even after the global economy fully recovers back to full employment (the US is already near this level, though Europe probably has a long way to go, even accounting for higher structural unemployment).

So why, then, have real interest rates remained so low? One school of thought has been most prominently exposited by Lawrence Summers (2013). He argues that the low real interest rates are a sign of "secular stagnation" due to chronic lack of demand over fifteen years or more. My personal view is that in fact the world is in the midst of a debt supercycle (Rogoff, 2015), the downside of which began with the subprime mortgage crisis in the United States, migrated to Europe in the European debt crisis, and now centers in China (Lo and Rogoff, 2015, and Rogoff, 2016). Hamilton et al. (2015) forcefully make the point that periods of low real rates are not necessarily followed by periods of low growth, indeed they are very poor predictors. Gourinchas

and Rey similarly find that while low consumption–wealth ratios may presage low real rates for an extended period, they are not necessarily a predictor of low growth. Instead they argue that today's high savings/low real interest rate equilibrium is far better explained by a global economy that is deleveraging after a long credit boom, a view very much in the spirit of Reinhart and Rogoff (2009), Mian and Sufi (2014), Jorda, Schularick and Taylor (2017) and Rogoff (2016). This debate will no doubt continue.

There are other explanations as well. Reinhart, Reinhart and Rogoff (2015) employ Barro's (2009) model to show that the risk-free real interest rate is extremely sensitive to perceptions of economic disaster risk and that a relatively small increase in disaster risk assessment (say from 2% to 3%) can yield a percent or more drop in the equilibrium real interest rate on risk-free bonds. Surely many people are much warier after the financial crisis.

NEGATIVE INTEREST RATES

Regardless of the root of today's low real interest rates, there is little debate that they may very well continue for years to come. What can central banks do? As Rogoff (2014, 2016) argues, the elegant approach would be to clear the institutional barriers to unfettered negative interest rate policy. This includes a host of modifications to regulations, tax laws and market conventions that can all be accommodated easily enough given a long enough lead time. By far the biggest obstacle to negative interest rate policy is the existence of government-issued zero-interest bearer bonds, that is cash. There are various ways to approach this. In my view the most robust and the most elegant idea would be simply to sharply scale back paper currency issuance to only small denominations. But there are other ways to do it, including the very clever suggestion of Willem Buiter (2005) to create a two-currency system, which has in turn been clarified and refined by Agarwal and Kimball (2015). (Rogoff (2016) notes that the basic idea of

instituting a tax to redeem paper currency at the Treasury goes back to the regime of Kublai Khan in the 13th century.) I realize there has been enormous controversy about central banks' early experiments tiptoeing into negative interest rate territory, but it is very hard to judge from these policies how unfettered negative rate policy would work. Suffice it to say that if global real rates really do remain sharply negative for an extended further period, options for improving implementation of negative interest rate policy will almost certainly be intensely explored.

There are other options for conducting monetary policy at the zero bound, for example quantitative easing, where the central bank basically issues overnight bank reserves and buys longer-dated assets. Again, the issues are covered in Rogoff (2016). The main point is that for all the hocus pocus, quantitative easing amounts to little more than a determined shortening of the maturity structure of government debt, an action that national treasuries could implement without any help from central banks. Moreover, although shortening the maturing structure of government debt does tend to bring down the interest burden on government debt, it does so by increasing government exposure to interest rate spikes and losses of confidence. As economies normalize (the US is on the verge of doing so, Europe has longer to go) it is far from obvious why governments shouldn't be taking advantage of ultra-low long-term interest rates to lock in low costs. A more potent form of quantitative easing involves central bank purchases of private debt. This kind of quantitative easing should properly be described as "fiscal QE" because it implicitly involves two operations, first pure QE were the central bank buys government bonds, and then a second stage where the government bonds are swapped for private bonds. The latter is in the same spirit that developing countries direct credit in private markets, for example in India and China. Although central banks may again be forced to rely on QE in the next recession, there is little question they would rather find another approach. Pure QE is not

conspicuously effective, and fiscal QE exposes the central bank to balance-sheet risks which really should be taken directly on the finance ministry's books. This is particularly problematic in the Eurozone where there is no real central government, and where the ECB is being forced to take on burdens and risks more typical of a developing country, without necessarily having a clear remit to do so.

OTHER IDEAS FOR DEALING WITH THE ZERO BOUND: HELICOPTER MONEY AND RAISING INFLATION TARGETS

Another idea that has become surprisingly popular is to have the central bank engage in so-called helicopter drops of money. Unfortunately, helicopter drops are simply a combination of monetary and fiscal policy, and the idea that they can be an end-around political gridlock in fiscal policy is utterly delusional. Helicopter money adds exactly nothing to the overall government repertoire. The idea can most generously be interpreted as a plea for deficit-financed fiscal policy, with deficits financed by ultra-short-term borrowing. Put this way, the benefits and risks are clear. The combination is not necessarily a bad one, but the idea that it is a free lunch ignores the obvious point that someday inflation rates and interest rates may rise and all the "free lunch" money is going to have to get replaced by interest-bearing debt in order to avoid a big spike in inflation. Total government interest rate costs could spike precipitously just as they can for any borrower that uses short-term debt to fund consumption.

There are other options for dealing with today's low nominal interest rates, such as permanently raising the inflation target (say to 4%) or engaging in forward guidance. Rogoff (2016) discusses these approaches are dominated by the simple elegant solution of clearing the way for unfettered negative interest rate policy. So we conclude that if central banks could add full-fledged negative interest rate policy to their toolkit, it would go a long way towards solving

today's problems. It is important to recognize, however, that central banks cannot do this on their own, they need supportive legislation from the government, so this is not something that can or should happen overnight.

SHOULD INFLATION-TARGETING REGIMES INCORPORATE AN ESCAPE CLAUSE?

Until now, the discussion has been mainly about the instruments of monetary policy and not the institutional design. To this we turn next. Is the only problem the instruments of monetary policy, or is there a deeper problem in central bank design? As I have already mentioned, the financial crisis revealed that today's inflation-targeting regimes are far too rigid and would work much better if they more clearly provided for "escape clauses" in the event of severe economic trauma. In particular, during the onset of the financial crisis, before inflation expectations were caught in a downward spiral, central banks were far too slow to temporarily (not permanently) jettison their inflation targets. Higher inflation would have helped boost growth through a lower real interest rate, but it also would have helped immensely in taking some of the edge off private deleveraging, and encouraging investment into the real economy. What is needed is inflation targeting with an escape clause. I appreciate that the existence of such an escape clause would necessarily introduce some upward bias into inflation expectations, but this is a reasonable price to pay for not being trapped in an inflation-targeting regime designed for normal times when there is actually an emergency.

One must acknowledge that modern inflation targeting has proven to be a far more flexible benchmark for setting monetary policy than the simple money supply rules advocated by monetarists in the 1960s and early 1970s. The fixed money supply growth rules that Milton Friedman (1965) advanced were predicated on the assumption that there is a reasonably stable

connection between some measure of money growth (say M1) and medium- to long-term inflation trends. Unfortunately, with the growth of money market mutual funds, credit cards, debit cards, electronic payments and other alternative transaction media, any connection between money growth and inflation has proven highly unstable in most countries, beginning well before the era of zero bound.

Inflation targeting solves this instability problem by targeting inflation directly. It is true that the central bank does not control inflation nearly as directly as it controls high-powered money (currency plus bank reserves). Its control of inflation is quite imperfect. As Friedman often emphasized, and Brunner and Meltzer certainly noted as well, there are long leads and lags between the implementation of monetary policy and its impact on inflation. Nevertheless, targeting inflation has the advantage of automatically adjusting for long-run trend changes in transactions technologies.

Certainly, the case for having a clear and relatively inflexible target is a strong one, above all to stabilize long-run nominal interest rates and the long-run path of prices. However, faced in 2008 with a once-in-a-generation financial crisis, the monetary authorities should have recognized that the right response was to try to let inflation drift up for an extended period, which would have helped deleveraging of both public and private debt (at least at the margin), and also contributed to keeping interest rates off the zero bound. The idea that monetary policy rules need an escape clause is made very elegantly by Lohmann (1992; see also Flood and Isard, 1989.)

Central bankers do not like the idea of escape clauses. When in late 2008, I argued that "inflation is now the lesser evil" (meaning 4–6% inflation for two or three years), this was considered a strange and unpalatable suggestion by most central bankers. I suspect it still is

today. (By the way, I did not and do not recommend permanently changing the inflation target, rather this would have been an emergency response.) Central banks did move extremely aggressively in many respects, particularly using the government balance sheet to prop up banks and financial markets. But the most potent available weapon – temporarily raising the inflation target to say 4-6% for perhaps two to three years -- was never seriously considered. In a world with myriad imperfections in financial markets and supervision, monetary policy rules need an escape clause. Yes, this would introduce a certain credibility problem back into central banking, but this tradeoff between flexibility and credibility is a fundamental challenge to monetary policy that cannot simply be solved by assuming it away.

Unfortunately, the more evangelistic interpretations of inflation targeting – most famously posited by Lars Svensson (2010), but also Bernanke, Mishkin, Laubach and Posen, and many others, also Taylor, argued that the credibility problem in monetary policy was a solved problem (especially through central bank independence), and therefore the tradeoff between credibility and flexibility emphasized in my 1985 paper was solved as well. Monetary policy could properly stabilize output without any inflation bias. That halcyon view of monetary policy must now be called into question.

How might it be possible to institute escape clauses without entirely undermining the stability of inflation expectations in normal times? Lohmann (1992) imagined giving the government the capacity to appoint a new head of the central bank under extreme duress (or if needed a new central bank board). Another idea might be to have markers of extreme duress that central banks could use to trigger discussion of inflation change rules, for example, a 20% collapse in housing prices, a sustained paralysis in credit markets, or a major catastrophe such as war.

THE VIEW THAT THERE WILL NEVER AGAIN BE INFLATION, AND DEBT IS A FREE LUNCH

Lastly, it is curious how many political economy commentators have coalesced around the view that public debt crises can never happen in advanced countries because there is always the option of inflating it away. Yet, in today's world of strong independent central banks, with very rigid inflation targets, it is far from clear that even under severe duress, inflation would be allowed to rise in timely manner. If inflation is only allowed to rise very slowly and belatedly, the option value of using inflation to partially default on government debt becomes much diminished. In this day and age of ultra-low inflation, it might take the central bank a very long time to gear up inflation in a crisis, so that the option of partial default through inflation is relatively ineffective. Some polemicists assure us no great funding need will ever arise again that might force a government to be stretched for revenues. This is not wise counsel. And it is hard to see how it is going to happen if central banks are rigidly married to their inflation targets.

CONCLUSION

In sum, today's inflation-targeting regimes were designed for the Goldilocks economy of stable prices and high growth. Although they have many virtues, they are clearly too inflexible. Properly and fully introducing the option of negative interest rates would address the biggest problems of the current system and is likely the single most important change that needs to be made. But beyond that, the system needs to build in escape clauses to deal with extreme events that, unfortunately, will almost surely happen again within most people's lifetimes. Karl Brunner was very much an academic and scholar, but he was also a very practical thinker. I believe that he would have been persuaded that any practical approach to central bank policy

must factor in the possibility of a severe shock due to financial crisis, war, national catastrophe or other extreme duress.

Central banks have been heroes of the last crisis, but the next time they do battle they should have new weapons (negative interest rates) and a more flexible mandate (the possibility of an escape clause from so-called flexible inflation targeting, which is in fact sometimes too rigid).

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Table 1

Inflation Thresholds

	Inflation ⩽ 0		10 < Inflation ⩽ 20		20 < Inflation ⩽ 30		30 < Inflation ⩽ 40		40 < Inflation	
	1992	2015	1992	2015	1992	2015	1992	2015	1992	2015
Advanced Economies (IMF)		Greece Spain Switzerland Cyprus Finland Israel Lithuania Singapore Slovak Republic Slovenia Taiwan Province of China	Greece Israel							
Sub-Saharan Africa	Burkina Faso Central African Rep. Chad Comoros Congo, Republic of Gabon Mali Niger Senegal Togo	Zimbabwe	Botswana Cape Verde Gambia, The Ghana Guinea Lesotho Madagascar Mauritania Namibia South Africa	Angola Ethiopia Ghana Zambia	Ethipioa Malawi Tanzania	Malawi	Kenya São Tomé and Príncipe Somalia		Angola Congo, Dem. Rep. of Guinea-Bissau Mozambique Nigeria Sierra Leone Sudan Uganda Zambia Zimbabwe	
Middle East and North Africa	Bahrain Kuwait Saudi Arabia	Afghanistan Jordan Kosovo Lebanon	Syria	Egypt Iran Sudan	Egypt Iran		Algeria	Yemen	Iraq Lebanon Turkey Yemen	
Europe & Russia		Bosnia & Herzegovi Bulgaria Croatia Hungary Macedonia, FYR Poland Romania	Czech Republic	Belarus Russia	Hungary				Albania Armenia Azerbaijan Belarus Bulgaria Croatia Estonia Georgia Kazakhstan Kyrgyz Republic Latvia Lithuania Macedonia, FYR Moldova Mongolia Poland Romania Russia Slovenia Tajikistan Turkmenistan Ukraine Uzbekistan	Ukraine
Asia		Brunei Darussalam Solomon Islands Thailand Tonga	Bhutan India Maldives Nepal Solomon Islands Sri Lanka	Myanmar	Myanmar		Vietnam		Afghanistan Cambodia	
America		Belize Dominica El Salvador Grenada Guyana Puerto Rico St. Kitts and Nevis St. Lucia St. Vincent and the Grenadines	Bolivia Chile El Salvador Guatemala Mexico Paraguay		Argentina Columbia Costa Rica Guyana Haiti		Venezuela Bolivia		Brazil Jamaica Nicaragua Peru Suriname Uruguay	Venezuela

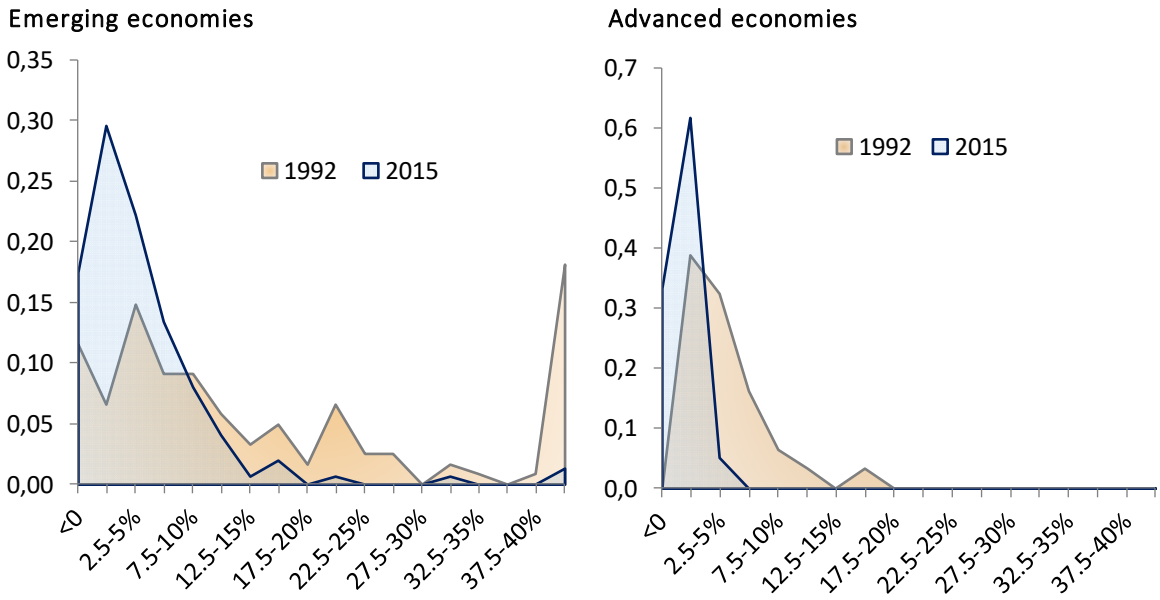
Source: IMF, *World Economic Outlook.*

Table lists all countries that kept inflation below 0 or above 10 percent in 1992 (and 2003) and 2015. Countries with inflation between 0 and 10 percent are omitted.

- In 1992, 45 countries had inflation over 40 percent while in 2015 only Ukraine and Venezuela recorded inflation higher than 40 percent.
- Deflation threatens more countries today than does very high inflation.
- MANY countries recorded deflation and very low inflation (between 0 and 5%).

Figure 2

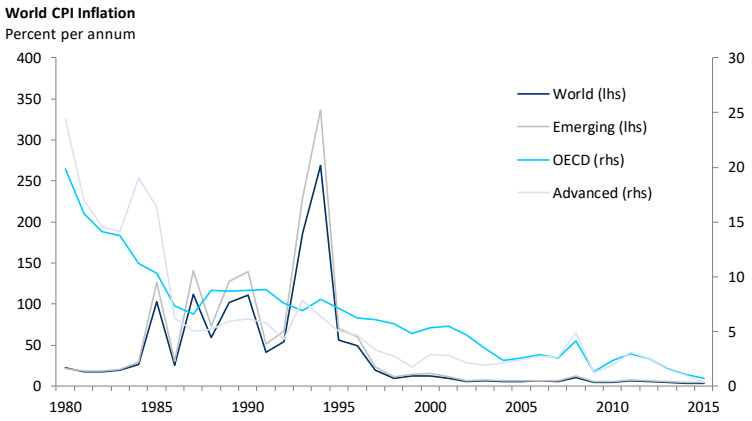
Inflation distribution



Source : International Monetary Fund, *World Economic Outlook* Database, April 2016. Note : countries equal weight.

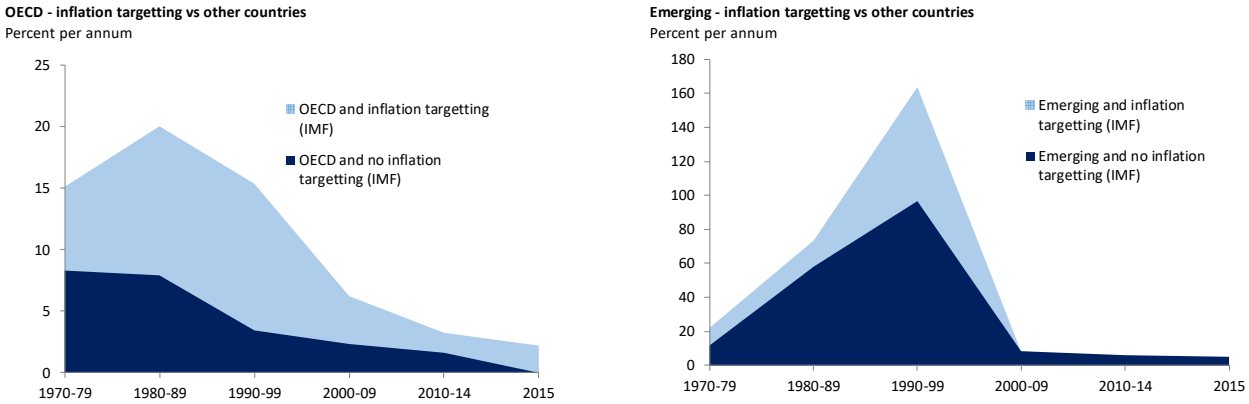
- Figures *Inflation Distribution* above for the years 1992 and 2015 take the % of countries by inflation thresholds (e.g. 100% of the advanced and emerging economies are in the 0-2.5% band).

Figure 1



Source : International Monetary Fund, *World Economic Outlook* Database, April 2016. Note : countries equal weight.

Figure 3



Source : International Monetary Fund, *World Economic Outlook* Database, April 2016. Note : countries equal weight.

Figure 4

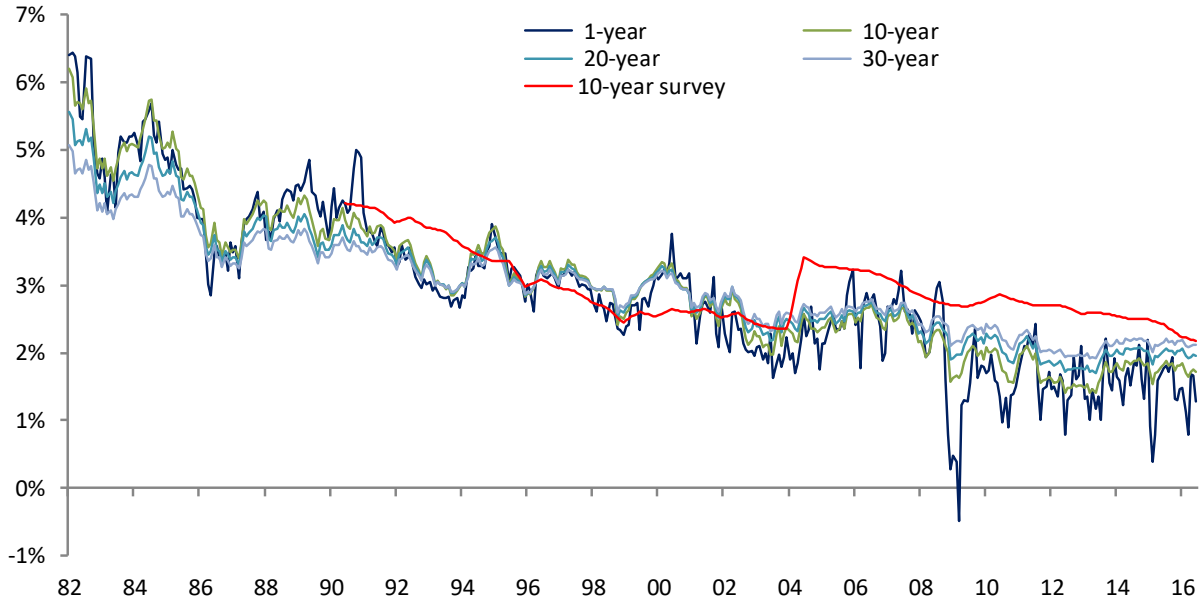
5-Year, 5-Year Forward Inflation Expectation Rate
Percent

Source: Federal Reserve Bank of St. Louis

Figure 5

US Consumer inflation expectations (%)

Percent per annum

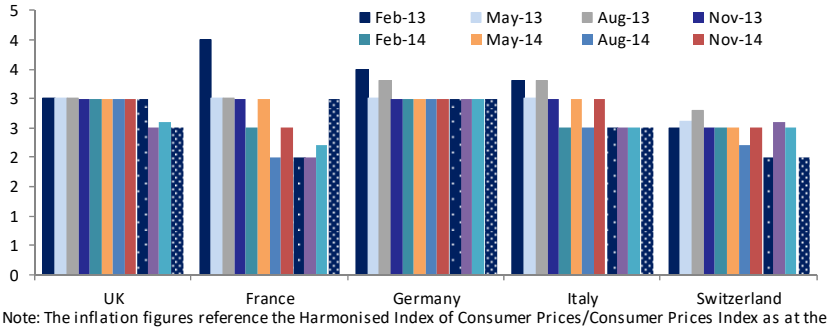


Sources: Livingston Survey, Federal Reserve Bank of Philadelphia and Cleveland Expected Inflation.

Figure 6

Public's perception of trends in inflation 5 years ahead (%)

Percent per annum



Note: The inflation figures reference the Harmonised Index of Consumer Prices/Consumer Prices Index as at the end of October 2015. Sources: Bloomberg, 01.12.15, M&G YouGov Inflation Expectations Survey Q4 2015.

Table 2

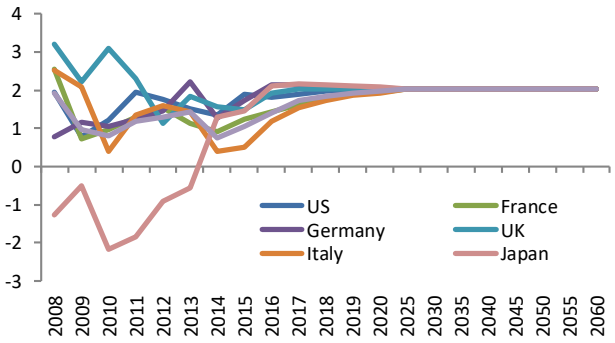
ECB Survey of Professional Forecasters for annual inflation

Year	ECB Survey of Professional Forecasters for annual inflation FIVE YEARS AHEAD
1999	1.9%
2004	1.9%
2009	1.9%
2014	1.9%
2016	1.8%

Figure 7

OECD Long-term Forecast

GDP Deflator (Market Prices) Growth (% Change)

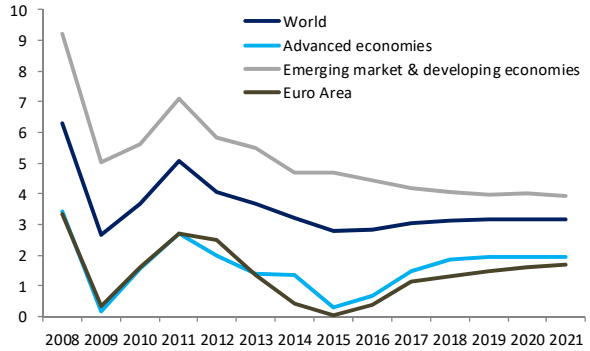


Source: Economic Outlook No 95 - Long-term Baseline Projections, 2014

Figure 8

IMF Global Aggregates: Headline Inflation

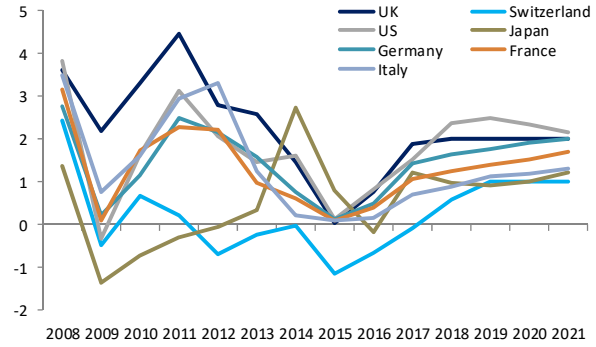
Average Consumer Price Inflation (% Change)



Source: IMF World Economic Outlook (WEO), April 2016

IMF Country Headline Inflation

Average Consumer Price Inflation (% Change)

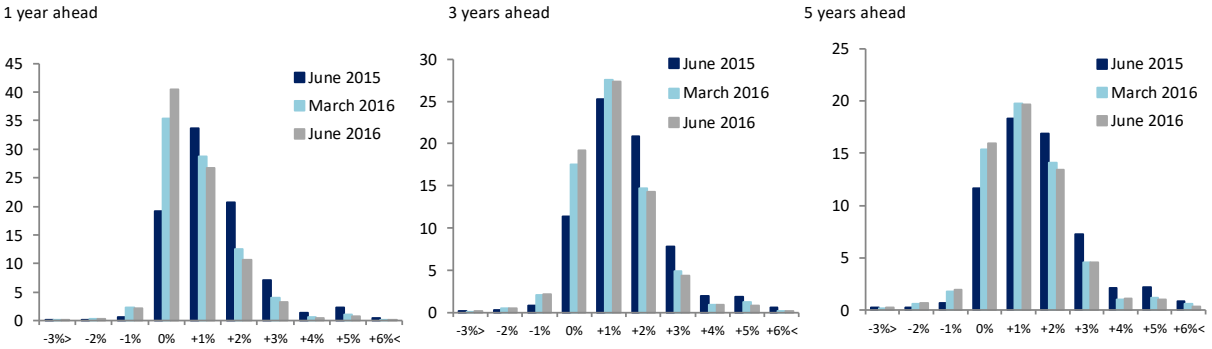


Source: IMF World Economic Outlook (WEO), April 2016

Figure 9

Japan: Distribution of Inflation expectation

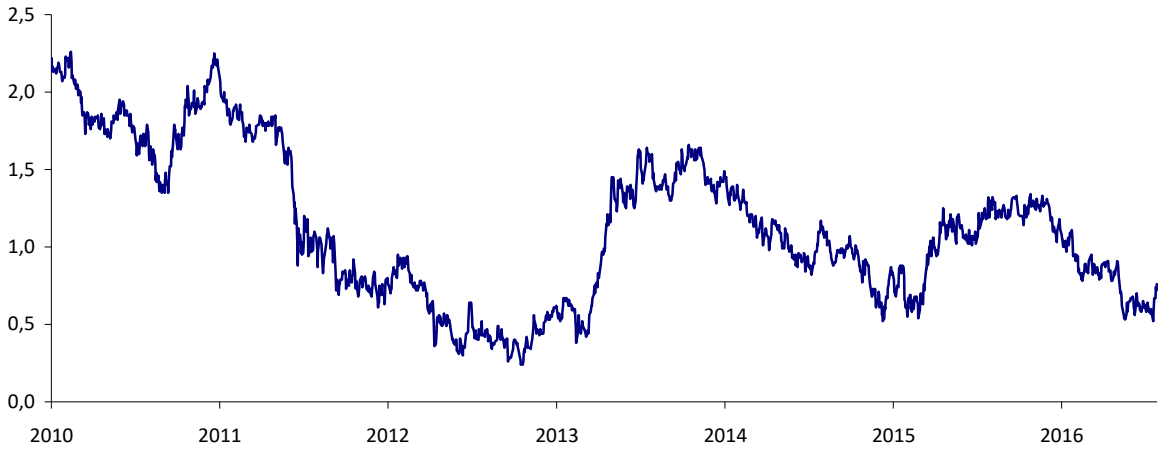
(Percentage Share of the Number of Respondents Choosing Each Alternative,%)



Source: Bank of Japan, June 2016 Survey.

Figure 10

30-Year Treasury Inflation-Indexed Security, Constant Maturity
Percent



Source: Board of Governors of the Federal Reserve System US.

Figure 11 Real interest rates: 1930s vs. 2008s