Geneva Reports on the World Economy 19

And Yet It Moves

Inflation and the Great Recession

David Miles, Ugo Panizza,
Ricardo Reis and Ángel Ubide

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Foreword

The Geneva Reports on the World Economy are published annually by CEPR and ICMB and have been providing innovative analysis on important topical issues facing the global economy since 1999. This 19th report focuses on the low and stable inflation experienced across the developed world in recent decades. With most countries regarding low inflation as a key policy goal, it is tempting to describe this solid anchoring of inflation as a great achievement of monetary policy. However, inflation has been below the central bank targets for many years now, in effect leading them to seek higher inflation. At the same time, just as the Great Moderation preceded the Great Recession, could this long and steady period lead to a surprise bout of inflation?

The report first looks at the inflation outcomes for the last ten years across different countries, as compared with what standard theories might have predicted. It notes that around 2010, these standard theories all pointed towards volatile and high inflation, however, inflation was anchored at low levels in this period. The report considers many sources of data and refines versions of standard theories to make sense of what happened. The authors conclude that it was a mix of both good and bad policies and good and bad luck that kept inflation low and relatively stable.

The report then turns to the policy lessons that can be learnt from this episode in order to minimise the role of luck next time around. Particular attention is paid to the role of central banks and the extent of their activities and the authors suggest that their balance sheets should remain significantly larger than pre-crisis and that flexible inflation targeting remains a sensible strategy.

This report was produced following the 19th Geneva Conference on the World Economy held in May 2017. CEPR and ICMB are very grateful to the authors and several discussants for their efforts in preparing material for this report, as well as to the conference attendees for their insightful comments. We are also thankful to Laurence Procter for her continued efficient organisation of the Geneva conference series, to Richard Varghese for recording and summarising the discussions, and to Simran Bola and Anil Shamdasani for their work in publishing the report. CEPR, which takes no institutional positions on economic policy matters, is delighted to provide a platform for an exchange of views on this topic.

Tessa Ogden
Chief Executive Officer, CEPR

Charles Wyplosz
Director, ICMB

October 2017

Executive summary

Over the last decade, the developed world has been hit by the deepest recession since the Great Depression and a rollercoaster in commodity prices. And yet, core inflation has been both low and relatively stable. A rule of thumb that inflation is always near 2%, and perhaps more often than not just a bit beneath it, has been quite reliable. The young, or those with short memories, could be forgiven for looking condescendingly at their older friends who speak of inflation as a major economic problem. But, like Galileo Galilei told his contemporaries who thought the Earth was immovable, "*Eppur si muove*" ("and yet it moves"). Since most societies regard stable inflation as a goal, it is tempting to describe this solid anchoring of inflation as a great achievement of monetary policy. But what if it was just luck? Will the great anchoring soon be followed by a great bout of inflation, or by a descent into deflation, just as the Great Moderation was followed by the Great Recession?

The starting point of this report is a contrast between what happened to inflation after the Great Recession with what standard theories might predict. We note that around 2010, pretty much all standard theories seemed to point towards volatile and potentially unanchored inflation. Yet, inflation was stable and anchored. Why?

The report sifts through many sources of data and refines versions of standard theories to make sense of what happened. It explores the impact on inflation of the dynamics of commodity prices, the anchoring of inflation expectations, the shifts in the Phillips curve, the evolution of mark-ups, and the effect of global factors. It discusses the effect on monetary policy decisions of slack mismeasurement, attitudes towards the symmetry of inflation targets, potential hysteresis effects, consideration of financial stability, and threats to central bank independence. The conclusion is that it has, in fact, been a mixed bag of good and bad policies, and of good and bad luck, that has kept inflation low and relatively stable.

But this inflation performance is not an unambiguous success: while low and stable from an historical perspective, inflation has been lower and more volatile than in the years leading up to the crisis. As this report shows, estimates of so called 'pure inflation' and market-based measures of inflation expectations have declined both in the US and the Eurozone. It is possible that this reflects the size and persistence of the shocks that have hit the economy, and that inflation and inflation expectations will eventually return to target. But it is also possible that underlying inflation has permanently shifted lower post crisis. This is a potential source of worry if it implies that, when the next recession hits, policymakers will have less room to lower real interest rates and cushion the shock.

What are the policy lessons that could minimise the scope for policy mistakes and reduce the role of luck next time around – when the dice may fall less favourably? In the report, we discuss the desirability of periodic reviews of the inflation target and suggest that central bank balance sheets should stay much larger than pre-crisis. We also conclude that there is a crucial role for guidance on policy from central banks, but also highlight the costs of forward guidance in terms of constraining future discretion. We conclude that flexible inflation targeting remains a sensible strategy which should be implemented symmetrically when inflation is above or below target.

Central banks have achieved something that was by no means guaranteed in the aftermath of the financial crisis. But there is no room for complacency. No matter what one thinks of past inflation, it moves, and keeping it steady remains a job for central banks.

1 The inflation puzzle after the Great Recession

Inflation is one of the major macroeconomic variables that academics and policymakers strive to understand and to target. In his presidential address to the American Economic Association, James Tobin (1972) wrote that: "Unemployment and inflation still preoccupy and perplex economists, statesmen, journalists, housewives, and everyone else." Yet, over the past ten years, inflation has been low and stable for almost all developed countries, in spite of the largest downturn in economic activity since the 1930s, a large financial crisis, and a sharp contraction in global trade. Opinion polls today suggest that inflation is far from the main concern of the public. Central banks have over the past decade been subjected to greater public scrutiny and criticism because of their interventions on financial markets and very low interest rates, rather than their failure to keep inflation stable around a target. The macroeconomic puzzles that have attracted most of the attention in recent years have been focused on stagnation, slow recoveries, inequality, and financial disruption. To a young macroeconomist's ears, Tobin's quote sounds out of date.

This chapter argues that this confidence in the stability of inflation is misplaced. Policymakers and the public are at danger if they ignore inflation because they think it is yesterday's problem. Far from being comforting, we argue that the low and stable inflation of the last few years is quite puzzling. This should create doubts about what we know about controlling inflation, and so reduce our confidence in being able to keep it in line in the near future.

1.1 The volatile history of inflation

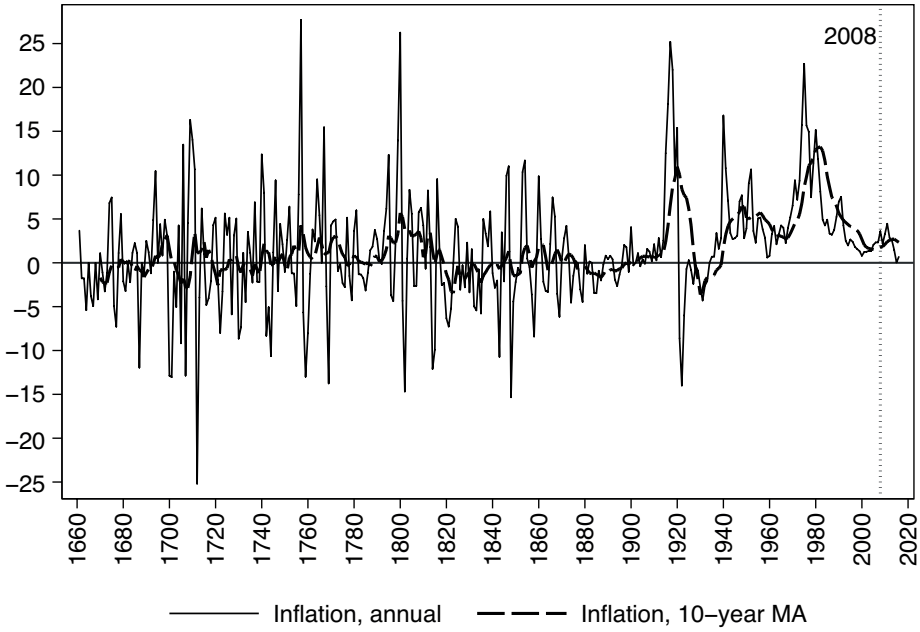
Figure 1 shows the long-run history of inflation in the UK.[1] Over the last 350 years, inflation was on average low but it was also volatile: average annual inflation was 1.5% with a standard deviation of approximately 6.5% (Figure 1.1, Panel A). These 350 years can be divided into six sub-periods: (i) the Gold Standard period (1717-1913);[2] (ii) the two world wars and the interwar period (1914-1945); (iii) the Bretton Woods period (1946-1973); (iv) post Bretton Woods until the European Monetary System (EMS) crisis (1974-1993); (v) the Great Moderation (1994-2008); and (vi) the post-global financial crisis period (2008-2016).

1 The data are available at http://www.bankofengland.co.uk/research/Pages/datasets/default.aspx#threecenturies.

2 The UK de facto adopted the Gold Standard in 1717 (the master of the mint was Isaac Newton) and formally adopted the Gold Standard in 1819.

Figure 1.1 Inflation in the very long run

A: United Kingdom, 1660-2016



B: United States, 1915-2016

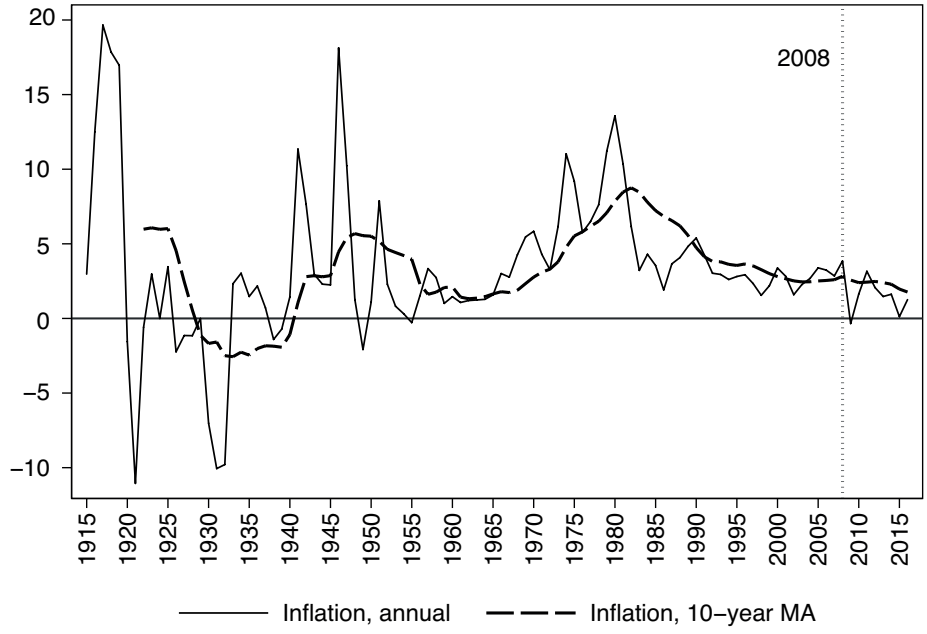


Table 1.1 shows the basic statistics for inflation for each of these periods. During the Gold Standard, average inflation was close to zero (0.5%), but inflation was extremely volatile, with annual inflation ranging between -15% and 28%, and with a standard deviation of 5.9% (top panel of Table 1.1). The war and interwar period was characterised by higher average inflation (3.6%) and high inflation volatility. Inflation peaked during World Wars I and II, but prices fell rapidly when the UK briefly returned to the Gold Standard in the interwar period.

Table 1.1 Headline inflation in advanced economies (annual data)

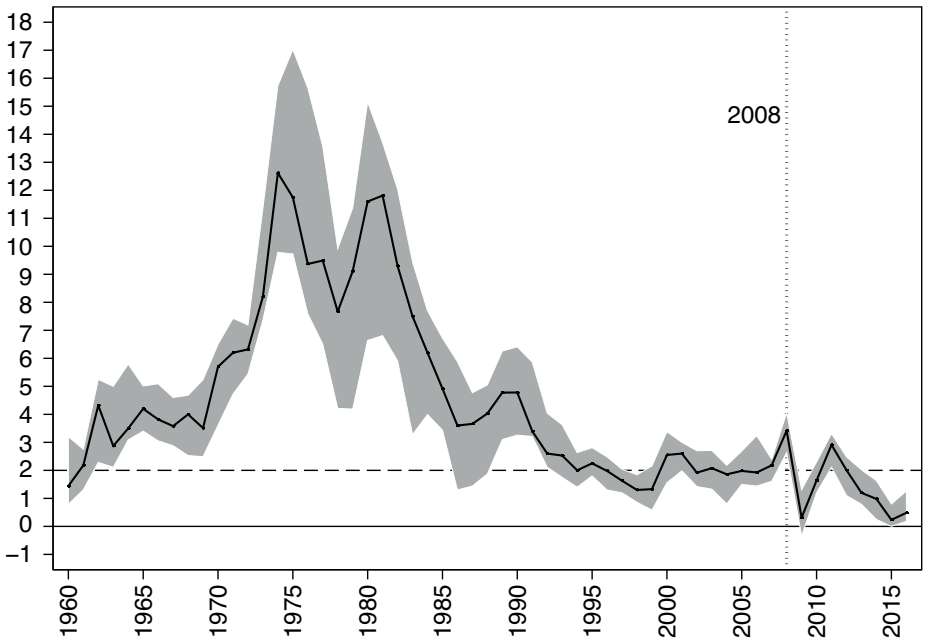
	Mean	Standard deviation	Minimum	Maximum
United Kingdom				
1660-2016	1.51	6.42	-25.19	27.71
1717-1913	0.45	5.86	-15.34	27.71
1914-1946	3.55	8.79	-14.00	25.20
1947-1973	4.77	2.66	0.60	10.65
1974-1993	8.69	5.62	2.51	22.70
1994-2008	1.87	0.72	0.80	3.60
2009-2016	2.19	1.43	0.04	4.46
United States				
1915-2016	3.23	4.94	-11.05	19.66
1915-1946	2.13	7.29	-11.05	19.66
1947-1973	3.26	3.90	-2.08	18.13
1974-1993	6.13	3.30	1.91	13.58
1994-2008	2.70	0.64	1.55	3.85
2009-2016	1.37	1.21	-0.34	3.16
Advanced economies				
1960-2016	4.38	4.03	-4.46	24.44
1960-1973	4.54	2.45	-0.32	13.33
1974-1993	7.30	4.87	-0.66	24.44
1994-2008	2.04	1.13	-0.92	5.57
2009-2016	1.21	1.35	-6.56	5.30

During the Bretton Woods period, average inflation was higher than during the previous periods (4.8%), but inflation volatility was substantially lower (the standard deviation was 2.7%). Inflation then peaked in the post-Bretton Woods period (8.7%, on average) as did inflation volatility, which reached levels close to those observed during the Gold Standard (the standard deviation was above 5.6%). However, the post-Bretton Woods period did not have any of the deflationary episodes that characterised the Gold Standard (in the post-Bretton Woods period, inflation ranged between 2.5% and 22.7%).

The Great Moderation was instead characterised by, well, 'moderate' inflation and inflation volatility. Average inflation stood at 1.9% and ranged between 0.8 and 3.6%, with a standard deviation of 0.7%. Finally, the post-global financial crisis period had average inflation similar to that observed during the Great Moderation (2.2% versus 1.9%), but greater inflation volatility. In the post-global financial crisis period, inflation ranged between 0 and 4.5%, with a standard deviation of 1.4%.

Data on US inflation cover a shorter period but show similar patterns. The time series is shown in the bottom panel of Figure 1.1, and selected moments across periods in the middle panel of Table 1.1 Average inflation was moderate (2.1%) but volatile (ranging between -11% and 20%, with a standard deviation of 7.3%) during the two world wars and in the interwar period. Inflation was slightly higher (3.3%, on average) but less volatile (standard deviation of 3.9%) during the Bretton Woods period. Inflation increased substantially in the post-Bretton Woods period (6.1%), but, unlike in the case of the UK, in the US there was no significant spike of inflation volatility during this period. Average inflation and inflation volatility decreased significantly during the Great Moderation, reaching 2.7% with a standard deviation of 0.6%. Average inflation continued to decrease during the post-global financial crisis period (with an average of 1.4%, undershooting the implicit inflation target of the US). This was also a period characterised by one mild deflationary episode (prices decreased by 0.3% in 2009) and with a level of inflation volatility almost twice as high as during the Great Moderation (1.1% versus 0.6%).

Figure 1.2 Inflation in advanced economies, 1960-2016



Note: The black line is the median value of inflation for a sample of 19 advanced economies; the shaded area is the interquartile range

Comparable data for a sample of 19 other advanced economies are only available starting from 1960. Figure 1.2 and the bottom panel of Table 1.1 show that over 1960-2015, the median rate of inflation for these countries ranged between 0% and 15% (average inflation was 4.4%, with a standard deviation of 4%). Inflation and its cross-country dispersion spiked in the 1970s and early 1980s (over 1974-1993, average inflation was 4.3% with a standard deviation of 4.9%). The 1980s were characterised by a rapid disinflation process, with inflation hovering around

2% for most of the 1990s (over 1994-2008, average inflation was 2.0%) and for the first half of the new millennium. As in the UK and the US, the global financial crisis was followed by a sudden drop in inflation (average inflation went from 2% to 1.2%) and a mild increase in volatility.

The main takeaway from this broad overview of the long-run trends is that inflation is often volatile, and that it can get into two digits for prolonged periods even in developed countries. There is nothing inherent to advanced economies that guarantees low and stable inflation. At the same time, the modern era of central banking (characterised by flexible exchange rates, independent central banks, and an inflation-targeting framework) has delivered two decades of low and stable inflation. This is a remarkable achievement when compared with previous periods characterised by either low average inflation and high inflation volatility (the Gold Standard), unsustainable exchange rates (the Bretton Woods period), or high average inflation and high inflation volatility (the post-Bretton Woods period).

1.2 The challenge in 2010

Given this historical background, and especially the recent past, what would an economist have expected at around 2010 for inflation in the coming years?

Of course, we now know what actually happened subsequently. Figure 1.3 shows the behaviour of inflation in advanced and emerging economies since 2000. We display both headline inflation as well as a core measure that excludes changes in food and energy prices from the index used to calculate inflation. Data for the post-2000 period show a sudden spike of headline inflation in mid-2008 (in the US, inflation peaked in August 2008) and a sudden drop in inflation in mid-2009. High inflation volatility around 2008-09 was due to the joint effect of one of the largest commodity shocks in history (the Goldman Sachs commodity price index went from 490 in mid-2007 to 860 in mid-2008, a point we return to in the next section) and the immediate aftermath of the epicentre of the crisis in September 2008 that saw big swings in currencies.

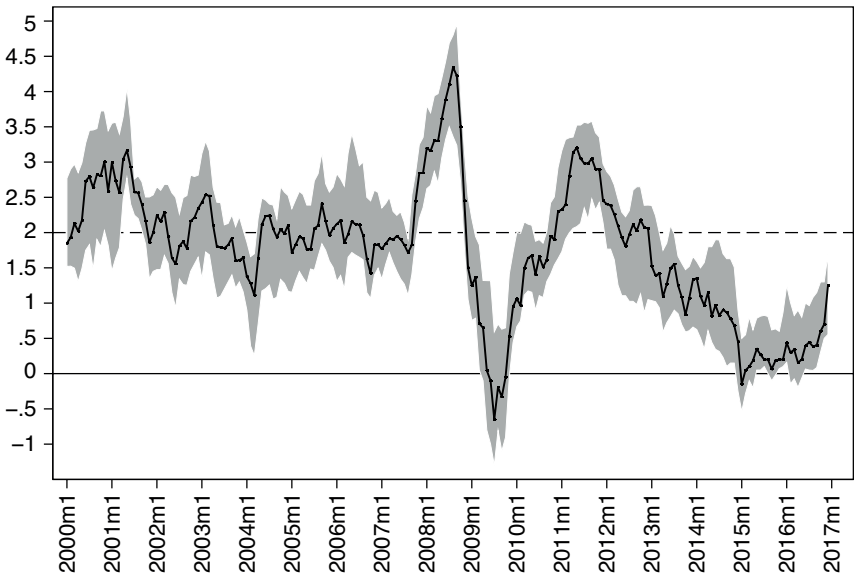
A comparison of headline and core inflation shows that the (already moderate) post-2000 inflation variability was largely due to the most volatile components of the price index. The volatility of core inflation is substantially lower than the volatility of headline inflation (30% lower in the average advanced economy, and about 50% lower in the Eurozone, UK, and US). Importantly, core inflation was only moderately more volatile in the aftermath of the global financial crisis.

After 2010, average inflation in advanced economies was somewhat lower, but only slightly so. Emerging market countries are characterised by higher average inflation and higher inflation volatility (both cross country and over time). As in advanced economies, there are no signs of any break in 2010. Inflation neither trended up nor down, nor did it become more volatile.

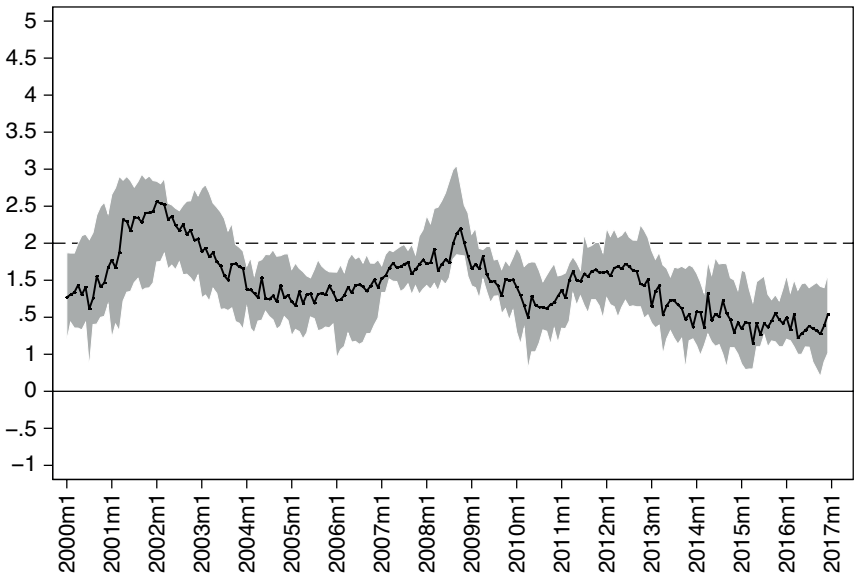
This is what inflation was. The question we posed is what might it have been reasonable to expect in 2010. Next, we try to answer this question from the perspective of different economic approaches.

Figure 1.3 Headline and core inflation in advanced and emerging economies, 2000-2016

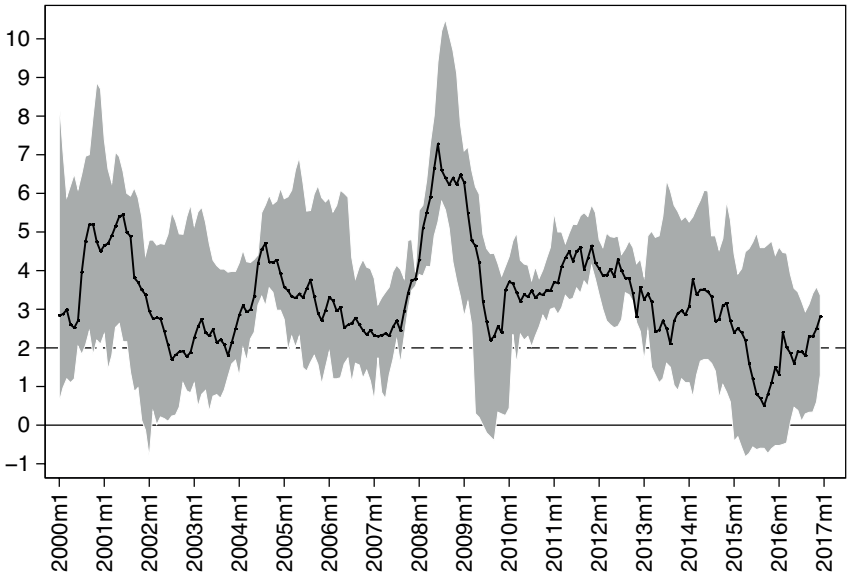
A: Headline CPI inflation in advanced economies



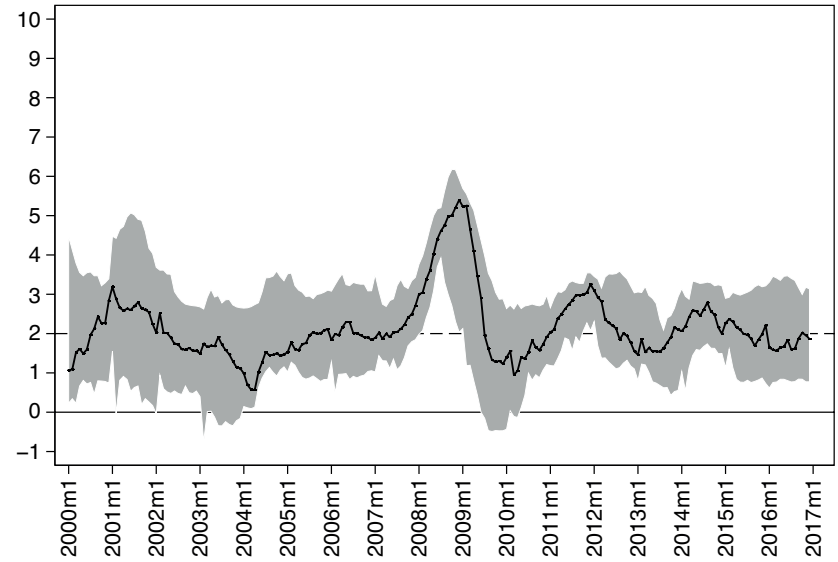
B: Core CPI inflation in advanced economies



C: Headline CPI inflation in emerging economies



D: Core CPI inflation in emerging economies



Notes: The black lines are the median value of CPI inflation, the shaded areas are the interquartile range. The sample includes 19 advanced economies and 16 emerging market economies.

1.3 Four major strands of thinking on inflation

Today, there are broadly four different approaches to what determines inflation and its movements over time. The academic literature is filled with debates on which is best, and heated arguments among theorists about the limitations of each of these approaches. Policymakers and applied economists, instead, typically use all four of them. We review each and assess what they suggest would have been reasonable inflation expectations in 2010.

1.3.1 The Phillips curve view

Alan Blinder (1997) once described the belief by many central bankers that the Phillips curve is useful as the "clean little secret" of the study of inflation and central banking. A.W. Phillips at the London School of Economics first noted that inflation seemed to be negatively correlated with unemployment. After the influential work of Samuelson and Solow (1960), the Phillips curve became central to Keynesian economics by neatly summarising the breakdown of the classical dichotomy, and Friedman (1968) stated its modern version, which puts expectations at the centre. In its simple version, the Phillips curve relates inflation to some measure of economic activity and to expected inflation, which is sometimes modelled using past inflation through an implicit assumption of backward-looking expectations.

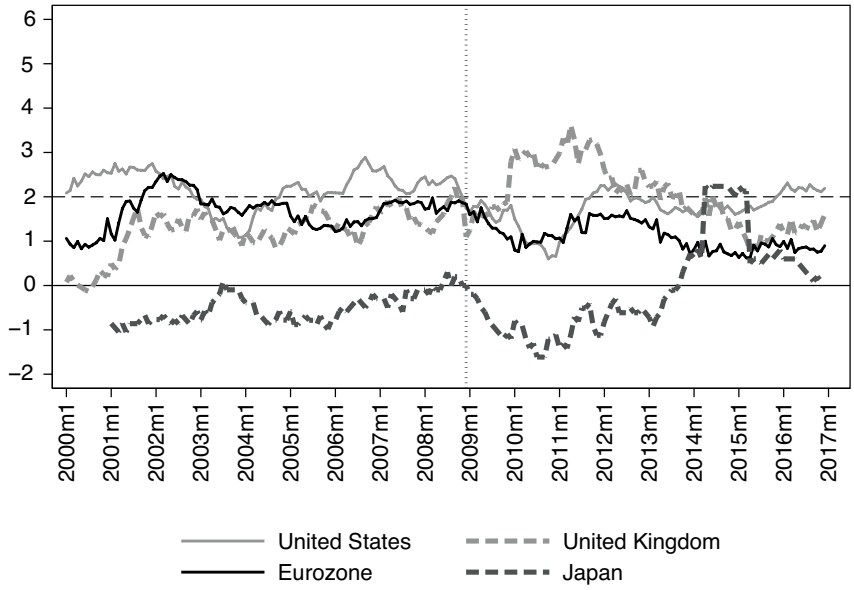
Figure 1.4 focuses on the four largest advanced economies since 2000 and shows the two determinants of inflation according to this simple Phillips curve. The top panel displays a measure of core inflation that excludes changes in food and energy prices. Over the period 2000-2008, the central banks of the largest advanced economies were remarkably successful in keeping inflation close to their 2% target. Yet, in 2009 core inflation dropped well below target both in the US and in the Eurozone. In Japan, core inflation was in negative territory for most of the 2000-2008 period (over 2000-2004, average core inflation in Japan was -0.5%). But, after a sudden spike up in 2008, Japan then looked similar to the Eurozone and the US with a sharp decline in inflation. The experience of the UK is somewhat different. A sharp depreciation of the pound (over 2008-2009, the pound depreciated by 20% with respect to the dollar and 25% with respect to the euro) led to a jump of both core and headline inflation above the 2% target.

The bottom panel of Figure 1.4 shows the behaviour of the unemployment rate in these four economies. After 2008, the unemployment rate rose very sharply in each, albeit starting from quite different points and rising at different paces. The unemployment rate kept on rising, peaking at the end of 2009 in the US, the UK, and Japan. While in the US, the unemployment rate reached 10%, in the UK employment did not rise as much and in Japan it remained below 5.5%. In the Eurozone, unemployment kept rising until mid-2013 and surpassed 12%.

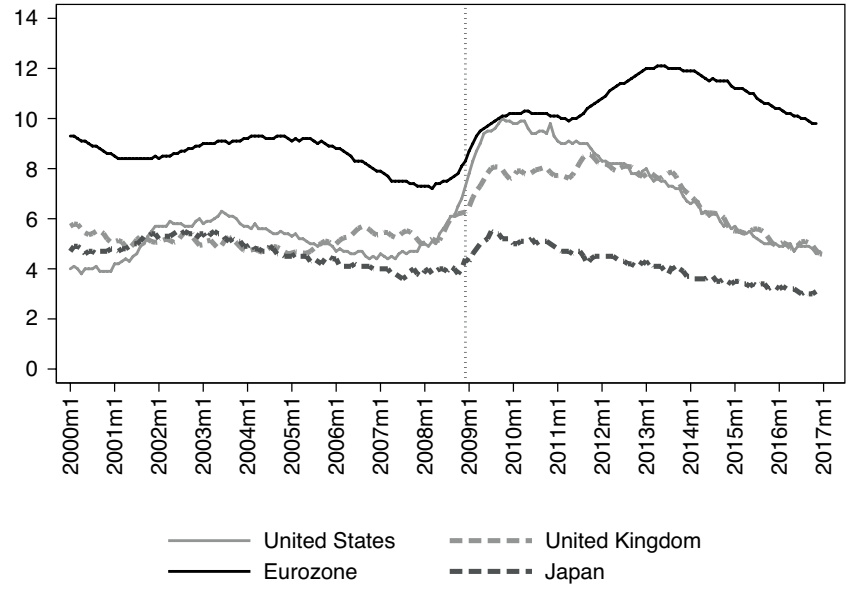
Looking at these two pieces of data, the simple Phillips curve would have led one to expect a significant deflation after 2010. Real activity was clearly depressed, and with the sharp decline in inflation in 2008-10, backward-looking expectations of inflation should have been very low as well. And yet, no deflation occurred across either advanced or developing countries.

Figure 1.4 Core inflation and unemployment in G4 economies, 2000-2016

A: Core inflation

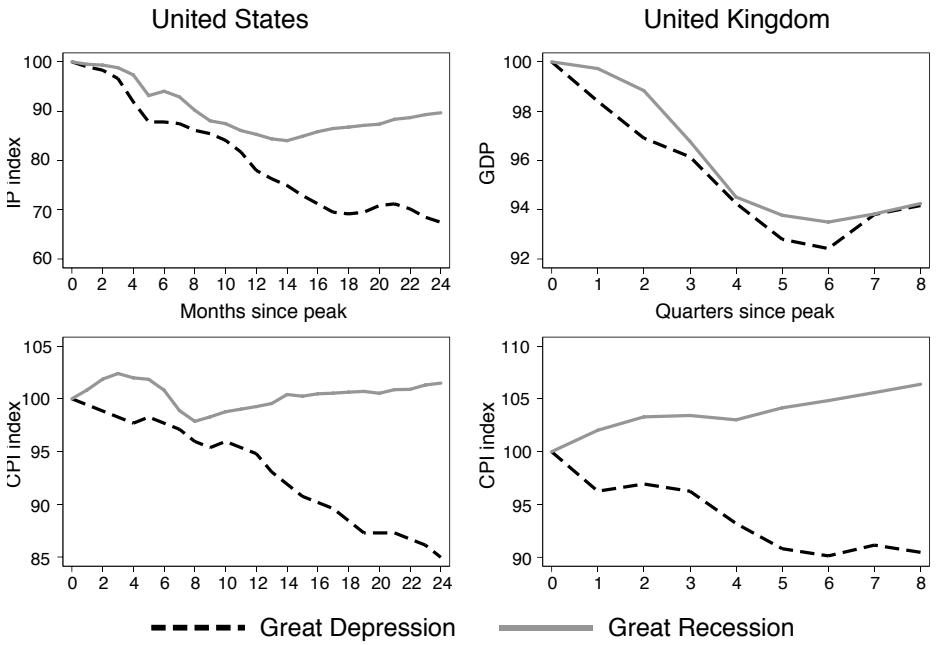


B: Unemployment rate



A striking way to make this point is to compare the evolution of inflation at the beginning of the Great Recession with that at the beginning of the Great Depression. The comparison is relevant because in the first 12 months of the Great Recession, global industrial production tracked closely the evolution of global industrial production during the Great Depression (Eichengreen and O'Rourke, 2010). In the US, the first 12 months of the Great Recession were slightly less severe than the Great Depression (industrial production fell by 20% during the Great Depression and by 15% during the Great Recession; see Figure 1.5) but were still comparable. In the UK, the evolution of GDP during the first two years of the Great Recession was comparable to that of the Great Depression (in both cases, GDP fell by approximately 6%). The evolution of inflation, however, was dramatically different. In the US, prices dropped by 6% during the first 12 months of the Great Depression and barely moved during the first 12 months of the Great Recession (inflation was positive in the first half of the year and negative in the second half). In the UK, prices decreased by 7% in the first year of the Great Depression and increased by 3% in the first year of the Great Recession. Two years after the onset of the Great Depression, the UK consumer price index (CPI) had dropped by 12%, while two years after the onset of the Great Recession, the UK CPI had increased by 7%.

Figure 1.5 Output and inflation in the Great Depression and Great Recession



Notes: The top panels plot the evolution of output (industrial production for the US and GDP for the UK) in the first two years of the Great Depression (black dashed lines) and the first two years of the Great Recession (solid grey lines). The bottom panels plot the evolution of the consumer price index during the two episodes. All variables are rescaled to take value 100 at the inset of the episode.

Some might say that the lack of deflation should not have been surprising. The empirical performance of the simple Phillips curve has been at best mediocre for a long time. A plot of changes in inflation against the unemployment rate over the past 60 years for most advanced economies shows a cloud of points, with no discernible pattern. The slope and fit of the Phillips curve move often, as the curve shifts in erratic ways that seriously compromise most out-of-sample forecasts (see, for example, Blanchard et al., 2015). Attempts to exploit this Phillips curve in the US in the 1970s ended up leading to stagflation, with both inflation and high unemployment.

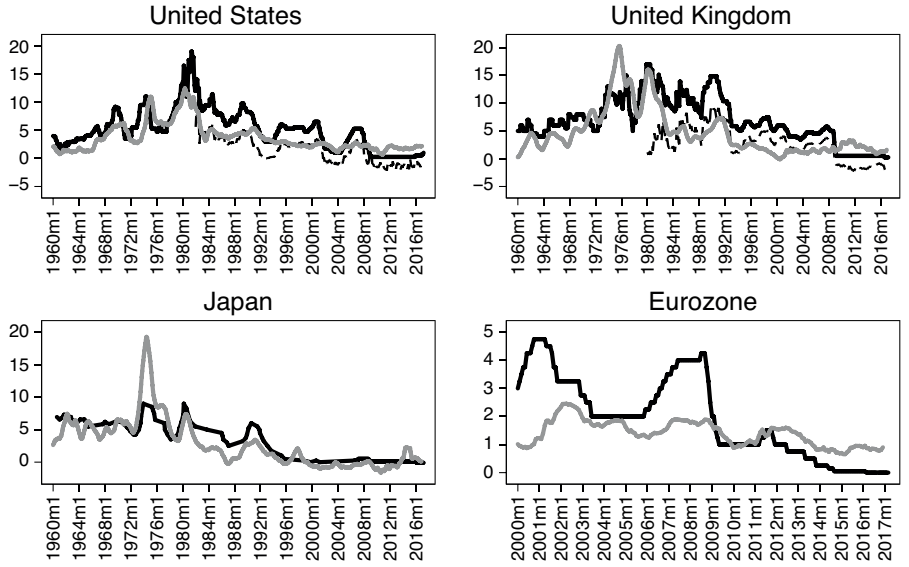
1.3.2 The interest rate view

An alternative model links inflation to the behaviour of nominal and real interest rates. The Fisher equation states that expected inflation is equal to the difference between the safe nominal interest rate and the real interest rate for investments of equal maturity. A simplistic reading of this relationship would lead to the conclusion that lower nominal interest rates are associated with lower inflation. Hundreds of studies aimed at estimating what happens when central banks actually lower nominal rates show the opposite: inflation rises, it does not fall (see, for example, Boivin et al., 2010). Equally important, changes in monetary policy have a clear effect on real interest rates.

Figure 1.6 illustrates this link between interest rates and inflation since 1960. The top panel shows that periods of high inflation in the 1970s and early 1980s were also characterised by high nominal policy rates (especially in the US and the UK), but this relationship between policy rates and inflation no longer holds when inflation dropped below 5%. The period from the mid-1980s to 2008 was characterised by frequent movements of the policy rate and relatively stable inflation. More formally, a simple regression of the change in inflation over the lagged value of the change in the policy rate shows no statistically significant correlation between the two variables. The top panel also shows that movements in the policy rate are reflected more in movements in the real interest rate than in movements in inflation. The bottom panel suggests a similar conclusion if we focus on medium-term (five-year) nominal and real interest rates. Rather than being followed by changes in inflation, nominal interest rates changes are followed by real interest changes; this is consistent with the idea that inflation expectations move relatively slowly.

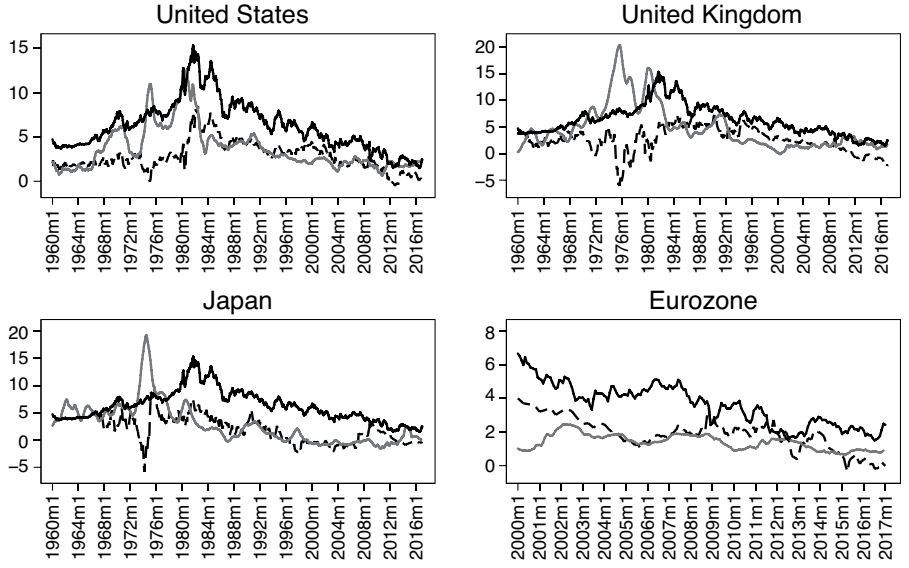
Figure 1.6 Inflation and interest rates

Panel A. Real and nominal policy interest rates and inflation



Notes: The solid grey lines plot core inflation, the black solid lines the policy rate (overnight interbank rate when the policy rate is not available), and the black dashed lines the real policy rate (policy rate minus professional forecasters one-year head inflation expectations).

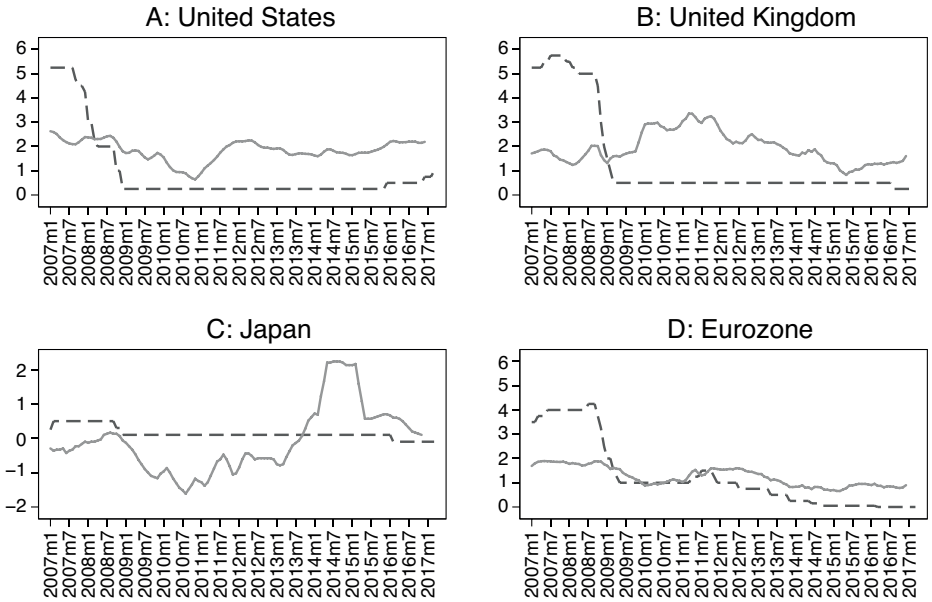
Panel B. Inflation and 5-year nominal and real interest rates



Notes: The solid grey lines plot core inflation, the black solid lines the yield on five-year government bonds (medium term bonds when five-year bonds are not available), and the dashed black lines the real yield on five-year government bonds (medium term bonds when five-year bonds are not available). We use yields on inflation-protected bonds when available, when yields on inflation protected bonds are not available we use five-year inflation expectations from professional forecasters and when expectations are not available we model inflation as a simple AR12 process.

Figure 1.7 shows the behaviour of policy interest rates since 2007 for the three major economies and the Eurozone. In Japan, interest rates had been very low even before the crisis. In the US and the UK, they were sharply cut and kept low from the start of 2009 to the end of our sample. The European Central Bank (ECB) cut interest rates more gradually following the Great Recession, and raised them slightly during 2011. Across all four countries, short-term interest rates were close to zero and constant for a prolonged period.

Figure 1.7 Inflation and policy interest rates, 2007-2016



Notes: The solid grey lines plot core inflation and the black dashed lines the policy rate (overnight interbank rate when the policy rate is not available).

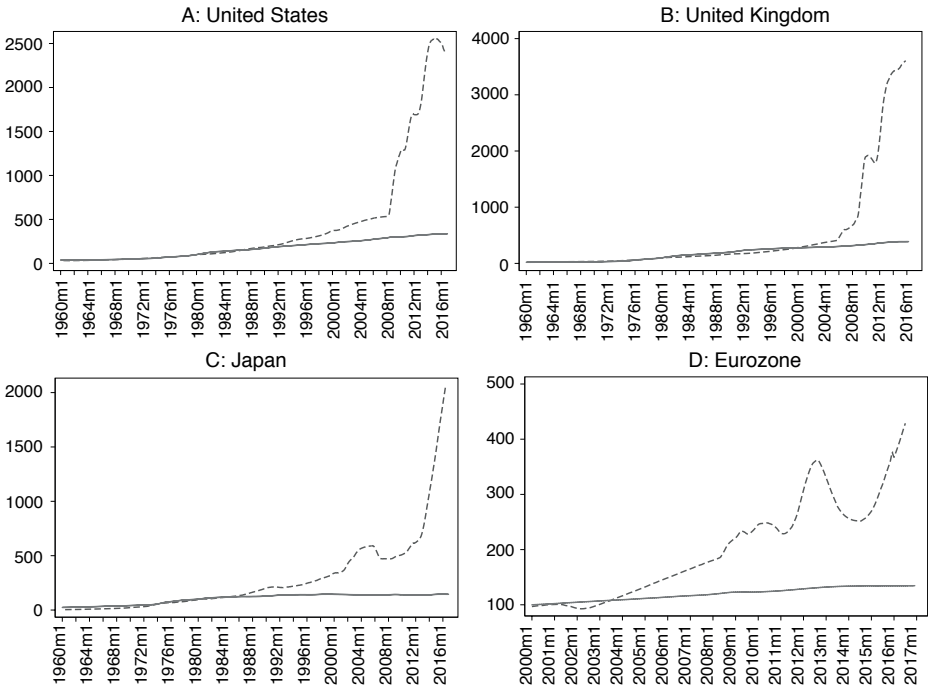
The sharp cuts in nominal interest rates might be expected to have led to sharp movements in inflation. They did not. The constancy of nominal interest rates might be expected to have led to inflation mirroring real rates. Real interest rates have been volatile after 2010, with their downward trend inspiring discussions of a 'secular stagnation'. This might lead one to expect that inflation might also have been particularly volatile. But it has not been.

Moving a little beyond Econ 101, an important result in monetary economics is that if the nominal interest rate is kept fixed by monetary policy, then the price level is indeterminate in equilibrium (Sargent and Wallace, 1975). For a given real interest rate, a fixed nominal interest rate pins down expected inflation, but without further policy actions this leaves both actual inflation and the price level free to take on any value. If it is the case that with pegged interest rates monetary policy ceases to be able to anchor inflation, then with interest rates fixed close to zero after 2009 economies risked entering into either inflation or deflation spirals. But that clearly did not happen. The pre-2010 consensus linking interest rates and inflation appears to starkly fail to explain the new data (Cochrane, 2017).

1.3.3 The monetarist view of inflation

MV = PY is not quite E = mc^2, but it is one of the most famous equations in economics. M stands for money, and P for the price level. Keeping V and Y (respectively, velocity and output) fixed, then a proportional increase in M leads to a proportional increase in P. Therefore, if money growth increases by 1%, inflation will increase by 1% as well. Understanding why people want to hold money and how to measure its effective supply in an economy is the focus of the 'monetarist' school, which sees money as the key to understanding inflation. Milton Friedman's famous claim that "[i]nflation is always and everywhere a monetary phenomenon" suggests there will be surges in inflation whenever there is continued fast growth in the stock of money.

Figure 1.8 Prices and money



Notes: The solid lines plot the price level and the dashed lines the monetary base. Both series are indexes set =100 in 1990 (for the Eurozone the indexes are set to 100 in 2000).

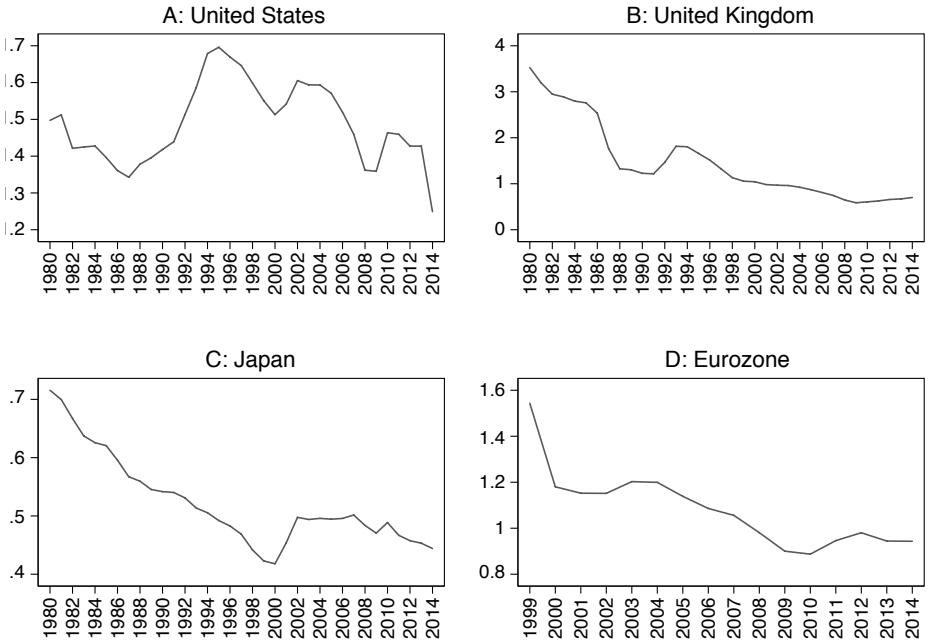
Figure 1.8 plots the relationship between the price level and the monetary base for the US, UK, Japan, and the Eurozone.[3] The period after 2007 should offer a good test of monetarism. The main central banks responded to the global financial crisis with massive monetary injections on a scale not seen in decades. Yet, the four or five-fold expansions of the monetary base between 2008 and 2014

3 In Section 2.5, we discuss why the focus of the discussion should be on currency or the monetary base and not on broader definitions of money.

were not followed by any discernible increase in inflation. Looking at currency instead of the monetary base (which includes currency and reserve balance held by banks at the central bank), the monetarist model still has trouble helping to predict the stable inflation post 2010.[4]

This failure is not surprising given the historical antecedents. The monetarist model, as first laid out and applied by Philip Cagan (1956), successfully explains hyperinflations because when money growth is several hundreds, if not thousands, of percent a year, changes in velocity or output are, by comparison, negligible. In modern economies, when the rate of money growth is comparatively small, neglecting what happens to velocity and output leads to large relative errors. Moreover, velocity – or its twin sibling, the demand for money – turns out to be highly volatile, difficult to model, and hard to measure. Figure 1.9 shows this by plotting velocity since 1980 for the three major countries and the Eurozone. Movements in P end up being dominated by unexplained movements in V rather than in M. Whenever central banks kept monetary aggregates steady as a policy, inflation ended up being quite volatile.

Figure 1.9 Velocity of M3 in the US, UK, Japan and the Eurozone



Source: World bank Development Indicators (velocity is measured as M3/GDP).

4 Even though currency grew slightly faster after 2008 than in the years before, simple regressions of inflation on the rate of currency growth mostly give insignificant results. Statistically, the link between measures of money and movements in prices is weak.

1.3.4 The central bank view of inflation

The last view of inflation puts the central bank at the centre. Whether it is by controlling money supply or interest rates, and whether it is through a Phillips curve or other transmission channels to the economy, central banks one way or another are able to steer prices in the direction they want. This set of theories treats inflation as a control process, putting the focus instead on what inflation rates the central banks choose to pursue. To understand inflation, one must therefore understand the goals and the methods of communication of the central bank, together with the strategies that it follows. From this perspective, inflation rises when policymakers allow it to rise.

After the financial crisis, the operations of central banks in advanced economies changed in unprecedented ways. In terms of goals, a large weight started being placed on financial stability as a separate goal for the central bank, together with the usual dual mandate that focuses on real and nominal stability. Even without a change in the legal mandate, there was a realignment of weights across different parts of that mandate. This led in turn to central banks using tools that were either new, or had not been used in decades – an era of macroprudential regulation had begun. In relative terms, putting more weight on financial stability must mean putting less weight on inflation, since the two are not perfectly aligned at all times. In turn, in response to a large recession and financial crisis, the temptation to deviate from the announced inflation target in order to pursue those other goals should have been higher. Both should have led to more volatile inflation. At the same time, the use of macroprudential policies changed the effective tightness of the policy stance at different times, which should have increased volatility. But we didn't see a marked shift in the inflation process.

A second branch of the central bank view of inflation emphasises instead its interactions with fiscal policy. On the one hand, central banks are fiscal agents, in that their actions have fiscal consequences and generate resource flows for the fiscal authorities. On the other hand, inflation is determined in general equilibrium by the interaction of monetary and fiscal policies. Fiscal expansions raise inflation, both through their effect on real activity and via the Phillips curve, and through the increase in the public debt that increases the likelihood that it will be inflated away in the future. High deficits and high public debt are often predictors of high inflation even though they are not under the control of the central bank. In turn, the end of most hyperinflations is preceded by fiscal reforms (Sargent, 1982).

Taking this view would also lead one to expect higher inflation. Federal debt as a ratio of GDP rose with the crisis in the US to levels not seen since World War II and also increased markedly in many other advanced economies. Public deficits rose in 2008-10 as expansionary policies were adopted to fight the crisis. Then, after 2012, tighter fiscal policies were implemented to lower the deficits even as the public debt barely fell. This prompted some to forecast that inflation would explode, to inflate away the debt, or that it was going to be very volatile in response to the stop-go fiscal policies. And yet, neither of those things happened.

Table 1.2 Major monetary policy announcements and events

	Global
8 October 2008	Co-ordinated rate cut by six major central banks during the worst of the crisis.
	United States
25 November, 2008	QE1 (first round of quantitative easing) is announced for GSE and MBS
16 December, 2008	Forward guidance: "The Committee anticipates that weak economic conditions are likely to warrant exceptionally low levels of the federal funds rate for some time."
3 March, 2009	QE1 is extended to Treasuries
27 August, 2010	Fed Chair hints at QE2 (second round of quantitative easing) during Jackson Hole Speech
3 November, 2010	QE2 is announced
21 September 2011	Operation Twist is announced
3 September, 2012	QE3 (third round of quantitative easing) is announced
12 December 2012	QE3 is expanded
19 June, 2013	Taper Tantrum
18 December, 2013	Tapering begins
28 January, 2015	Fed drops the sentence "considerable time" from its forward guidance announcements
17 December, 2015	Policy rate lift-off begins
	United Kingdom
5 March, 2009	Bank rate cut to "floor" (as judged by MPC then) and asset purchases commence
6 October, 2011	Asset purchases restarted after almost 2 year of no purchases
7 August, 2013	Forward guidance launched with critical level of 7% unemployment
4 August 2016	Bank Rate cut to ¼% and asset purchases resumed in wake of the "Leave" vote of June 23rd.
	European Central Bank
10 May, 2010	Activation of the Securities Markets Programme
7 April, 2011	Policy rate increase
7 July, 2011	Policy rate increase
26 July, 2012	"Whatever it takes" speech by ECB president Mario Draghi
6 September, 2012	Details of the OMT (outright monetary transactions) programme are disclosed
5 June, 2014	ECB brings deposit rate to negative
22 August, 2014	ECB President hints at QE during Jackson Hole Speech
22 January, 2015	QE is announced
10 March, 2016	QE is expanded
	Japan
4 April, 2013	QQE (quantitative and qualitative easing) is announced
19 November, 2014	QQE is expanded
29 January, 2016	Bank of Japan cuts deposit rate to negative
21 September, 2016	YCC (yield curve control) announcement

A final version of a central bank view of inflation focuses on the tools used by central banks, and especially on how they are perceived by the public. In the last decade, the Federal Reserve started, for the first time, to pay interest on the reserves held by banks at the central bank. All major central banks engaged in quantitative easing policies, issuing reserves to buy a variety of assets under different programmes with different methods of implementation, and undertaken over different horizons. Finally, interest rate policy gave way to forward guidance, whereby central banks tried different forms of communicating how they expected to set interest rates in the future, with varying forms of commitment. Table 1.2 lists some of the major policy announcements during this period; the length of the list is testament to the amount of central bank innovation that took place.

Many of these unconventional policies were untested. Most were revised as they were implemented. For all of them, there were communication mistakes along the way. With this degree of experimentation, one would have expected inflation to be quite volatile. Yet, inflation's volatility was of a similar order of magnitude as in the years pre-2007, when all the central banks did was to raise of lower interest rates by 25 basis points every so often.

1.4 Conclusion: The puzzling stability of inflation

At this stage, we can refine the question we posed at the start: given how volatile and often high inflation has been in the past, given that there was a deep recession and brief deflation episode in 2008-10, given that nominal interest rates were virtually constant (and the real interest rate was not), given that the monetary base increased five-fold, and given that central banks undertook unprecedented policies in a context of fiscal volatility, what would have been your guess about the stability and volatility of inflation from 2010 onwards?

Simple versions of dominant economic theories, or superficial readings of economic history, would have all pointed to the conclusion that inflation should have at least been volatile, and possibly drifted up or down. Yet inflation was low and relatively stable. We did not observe deflation even in the presence of massive macroeconomic shocks and a sudden rise in unemployment, nor the much-feared inflation spiral that many expected after unprecedented easing in monetary policy. It is remarkable that the volatility of inflation remained so low, in spite of new policies and many shocks. While in the US core inflation went back to 2% at the beginning of 2012, core inflation in the Eurozone remains close to 1% (Figure 1.4). UK core inflation returned to 2% in 2012 and decreased to 1% in 2015-16. The depreciation of the pound following the outcome of the June 2016 Brexit referendum is expected to take UK inflation to close to 3%.

Overall, inflation has not diverged much from its 2% target and, if anything, has been below and struggled to return to 2%.

One reaction to these facts is complacency: inflation is a solved problem that we do not need to worry about. This report rejects this view. We will suggest that the stability of inflation poses puzzles for our existing theories, suggesting that inflation control is far from a solved problem. Complacency, in our view, can quickly lead to inflation getting out of hand, in any direction, in the coming years. Moreover, complacency breeds populism; it may encourage the view that any small deviation of inflation from target reflects mistakes (or worse!) by an elite including policymakers and economists.

One form of complacency is the belief that if inflation is at either, say, -2% or +4% it really does not matter much. It is well known that it is hard to pin down significant costs of inflation of a few percentage points. One reason why this poses a problem is that if central banks have adopted a 2% inflation target, then delivering numbers significantly far from it will necessarily lower the credibility of the central bank. If inflation expectations start deviating from the announced target, then the inflation framework that worked well over the last 20 years comes into question. A second reason is that unexpectedly too low inflation hurts borrowers and by leading to a debt deflation problem (Fisher, 1933), it may lead to financial instability and deeper recessions. With public debt at historically high levels, this compromises the solvency of many governments. We explore these sorts of dangers later in the report.

The rest of this report is structured as follows. The next chapter digs deeper into the facts seen in the light of the inflation theories sketched above. Chapter 3 extends theories to provide a richer account of what determines inflation. Chapter 4 starts discussing the implications for policy, asking a fundamental question: was recent low inflation the result of good policy or good luck? Chapter 5 asks whether the stability of inflation since the financial crisis should be viewed in a positive or negative light and draws out policy implications for the future.

2 Digging deeper: Facts about inflation

The previous chapter listed many potential determinants of inflation. We now consider them in more detail, assessing how they may have contributed to the recent behaviour of prices across countries. We have already observed that core and headline inflation behaved somewhat differently from each other during this period, and we start by focusing on the measurement of inflation and relative prices. Different theories have different predictions on trend versus transitory movements in prices, so we then focus on inflation persistence. Next, we further explore the Phillips curve and the extent to which slack drove inflation. In the following section, we focus on interest rates as drivers of inflation by analysing data on expected inflation, from both surveys and markets. We then inspect in more detail the components of central banks' balance sheets and assess whether movements in money were a major factor behind inflation. Finally, we look at market reactions to monetary policy announcements and assess the credibility of central banks.

2.1 Measurement

Inflation is the overall increase in prices in the economy. While its definition is uncontroversial, measuring actual inflation in an economy during one year, or one month, is far from easy. Given thousands of price changes over many goods and services, measures of inflation consist in taking an average over all of them. There are many different ways to assign weights to individual price changes to calculate this average. The most popular of these are the consumer price index, which uses fixed expenditure shares from household surveys of consumption to set the weights, and the deflator on a measure of economic activity such as GDP or personal consumption expenditures, which uses national accounts to measure the weights of each good over this period and the next. Central banks differ in which of these measures of inflation they use to set the inflation target for their individual country.

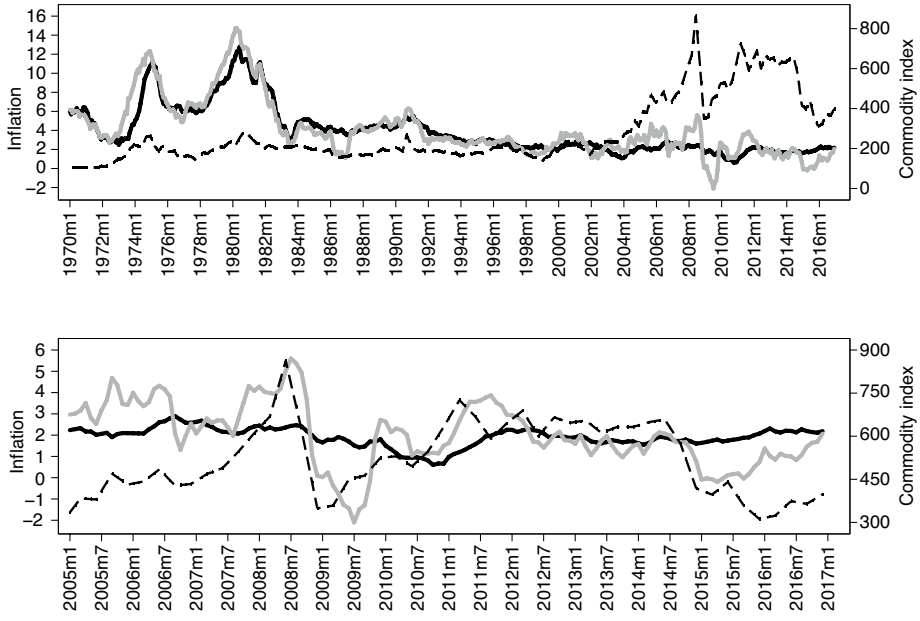
Measures of inflation have two components. The first, sometimes called *pure* inflation, corresponds to the common proportional change in all prices. It measures a change in the unit of account in the economy, and is independent of changes in relative prices. In other words , it measures how much the cost of an arbitrary basket of goods would change, no matter how it is weighted. This component is the same across all measures of inflation. It is also the component over which economists believe that monetary policy can have most control in the long run. Its most common and simplest measure is *core* inflation. This is a measure of inflation that excludes goods characterised by transitory price volatility such as food items and energy products.

The second component is the change in relative prices, where the prices of some goods rise by more and others by less (or fall). Measures of inflation differ in how they weight these relative prices in order to measure changes in the cost of living, taking into account that people will alter their spending in response to changes in prices. In most modern models of inflation and monetary policy, which assume there is no money illusion, behaviour and outcomes respond only to these relative price changes. Relative price changes lie behind the real effects of inflation and are the reason why central banks may need to trade off stabilising inflation against stabilising real activity.

The targets for most central banks are expressed in terms of *headline* inflation. This combines both pure inflation and relative price movements. By virtue of their mandate, central banks usually focus on headline inflation averaged over a few years to remove any short-term fluctuations. There isn't much that central banks can do about some relative price movements. Global shocks to commodity prices are perhaps the most notable of these movements, and excluding them from headline inflation leads to measures of core inflation. Focusing on core inflation may lead to better policy making in terms of what central banks should respond to and aim to control.

In Chapter 1, we noted that after 2004, core inflation was significantly more stable than headline inflation. Figure 2.1 confirms this, and also shows an index of movements in commodity prices compiled by Goldman Sachs. The very large movements in commodity prices since 2004 stand out, both relative to overall inflation and relative to past experience. This accounts for the large differences between headline and core inflation.

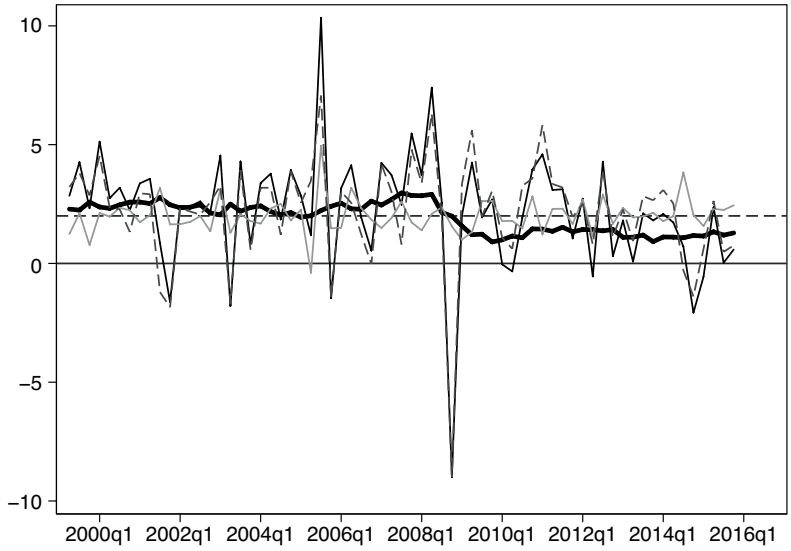
Figure 2.1 Inflation and commodity prices



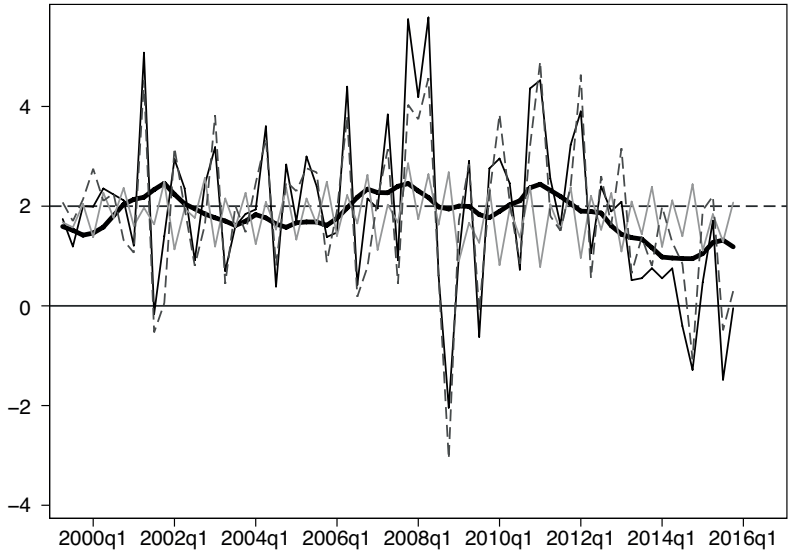
Notes: The solid grey lines plot US headline inflation, the solid black line US core inflation, and the dashed line plots the Goldman Sachs commodity price index.

Figure 2.2 Decomposition of inflation into pure inflation, relative price component and idiosyncratic shocks

A: United States



B: Eurozone



Notes: The solid thick black lines plot 'pure' inflation, the thin black line plots inflation, the solid grey lines plot the aggregate relative prices component of inflation and the grey dotted lines the idiosyncratic component differs across goods. For the US, we introduce a floor at -9 for all series.

One way to better understand the difference between headline and core inflation is to systematically measure the evolution of other relative prices, beyond commodities, during this period. Reis and Watson (2010) use a dynamic factor model to separate the evolution of inflation into three components: an index of common changes in all prices that measure pure inflation; an index of aggregate relative price changes, such as changes in the price of energy or services that affect many sectors; and a measure of idiosyncratic relative price changes that affect a single sector in isolation, such as the response to a process innovation in that sector. An application of Reis and Watson's decomposition to US and Eurozone inflation shows that their measure of US pure inflation remained essentially constant at about 2% over 2000-08 and then decreased by approximately 80 basis points over a four-quarter period after 2008; it then remained at this lower level (top panel of Figure 2.2). The data also show that aggregate relative prices changes contributed to inflation volatility in the US, but that most of the inflation volatility is associated with idiosyncratic relative price changes. This is consistent with the divergence between headline and core inflation being driven by global commodities, and by other relative prices in the economy. The behaviour of this measure of pure inflation is consistent with the core measure of pure inflation, although the former shows a larger trend fall and the latter a larger increase in volatility.

In the Eurozone, pure inflation oscillated around 2% over 2000-2010 and then decreased over 2010-2014. The 2015-16 period shows a slow recovery of pure inflation, but it remains 60 basis points below its long-run average (bottom panel of Figure 2.2). The index of aggregate relative price changes was more volatile in the Eurozone than in the US, but as in the US, the behaviour of inflation in the Eurozone was mostly driven by idiosyncratic price changes.

From now on, this report will mostly focus on the behaviour of core inflation, since it seems to provide a good approximation of pure inflation, and it filters out movements in global commodity prices that central banks would have trouble controlling. Core inflation has been even more stable than headline inflation since the financial crisis.

2.2 The persistence of inflation

The distinction between pure inflation and relative prices is connected to the distinction between permanent and transitory components of inflation. Commodity prices, in particular, often change quickly and only temporarily. Because of their weight in the consumption basket, these short-lived relative price changes can have a large effect on inflation over a few quarters that dies away within a couple of years. Policymakers may worry about these changes, but at the same time acknowledge that not much can be done about them. Monetary policy operates with lags and with sufficient imprecision that controlling inflation over a few quarters is a hopeless task. In turn, insofar as economic agents can smooth out very short-lived fluctuations but may have more trouble responding to longer-lived shocks, there may also be a welfare argument for focusing on measures of inflation that have been filtered from high-frequency movements.

The serial correlation of inflation fell in the largest advanced economies from the end of the 1990s. At first, researchers attributed this to a fall in inflation persistence, rejecting the usual hypothesis that inflation has a unit root (Cogley and Sargent, 2002). However, it was quickly understood that the persistence of inflation (measured by the size of its largest autoregressive root) had in fact not changed, and had remained close to one (Pivetta and Reis, 2007). The observed apparent fall in the serial correlation of inflation is instead explained by changes in the types of shocks that affect the inflation process. Stock and Watson (2007, 2010) put forward a new parsimonious model for inflation that accounts well for the changes in the inflation process after 2000. That model is described in Box 2.1.

Box 2.1 Modelling inflation persistence: The Stock and Watson approach

In the model of Stock and Watson (2007, 2010), inflation can be modelled as the sum of two unobserved components: a trend τ_t and a transitory shock η_t. Formally:

$$\pi_t = \tau_t + \eta_t$$

with $E(\eta_t) = 0$ and $var(\eta_t) = \sigma^2_{\eta,t}$ is the variance of the transitory shock. The trend can be then modelled as:

$$\tau_t = \tau_{t-1} + \varepsilon_t$$

with $E(\varepsilon_t) = 0$ and $var(\varepsilon_t) = \sigma^2_{\varepsilon,t}$ is the varianxce of the permanenty shock. They also assume that $cov(\varepsilon_t, \eta_t) = 0$. Stock and Watson (2007) develop an estimator for this unobserved components-stochastic volatility (UC-SV) model and show that the UC-SV model can be also represented as a time varying moving average model for the first difference of inflation:

$$\Delta\pi_t = a_t - \theta_t a_{t-1}$$

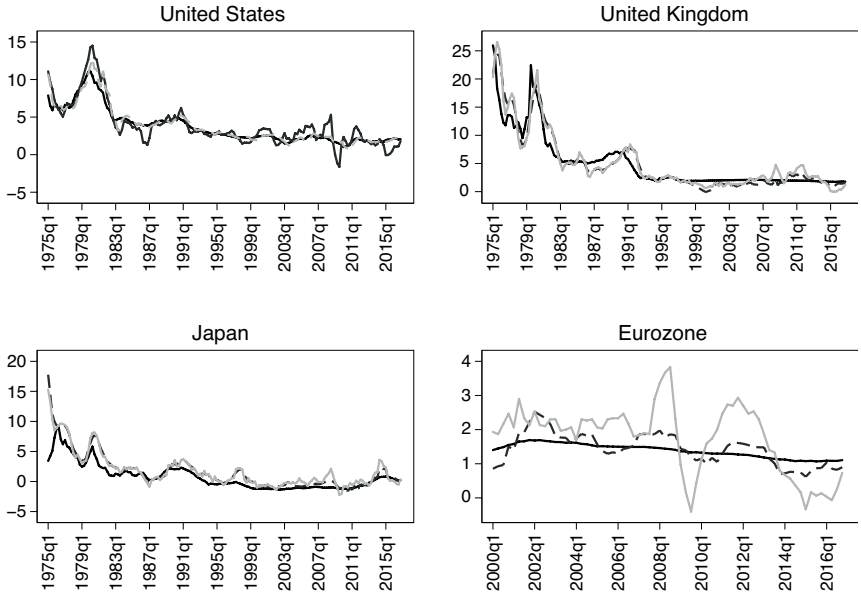
where a_t is an iid error term with $\sigma^2_{a,t}$ which is a function of $\sigma^2_{\varepsilon,t}$ and $\sigma^2_{\eta,t}$. The parameter θ_t is also a function of these parameters, decreasing in the $\sigma^2_{\varepsilon,t}/\sigma^2_{\eta,t}$ ratio.[5] Note that θ_t is inversely related to the persistence of the inflation process. When θ_t is close to zero (i.e., when the variance of the persistent shock is very large), most of the weight is placed on recent observations and a simple AR model will have parameters close to one. When θ_t is instead close to one (i.e., when the variance of the persistent shock is relatively small), the trend puts more weight on past realisations of inflation.

5 Specifically: $\sigma_a = \frac{-\sigma_\varepsilon - \sqrt{\sigma^2_\varepsilon - 4\sigma^2_\eta}}{-2}$ and $\theta = 1 - \frac{\sigma_\varepsilon}{\sigma_a}$.

Box 2.1 (contd.)

The UC-SV model provides an estimated of trend inflation which, like core inflation, eliminates transitory shocks and also allows one to show the relative importance of transitory and permanent shocks. Figure 2.3 compares trend inflation estimated with the UC-SV model with headline and core inflation and shows that the UC-SV trend tracks core inflation.[6]

Figure 2.3 Inflation and trend inflation



Notes: The solid black lines measure trend inflation estimated with the UC-SV model, the solid grey lines measure headline inflation, and the dashed black lines core inflation.

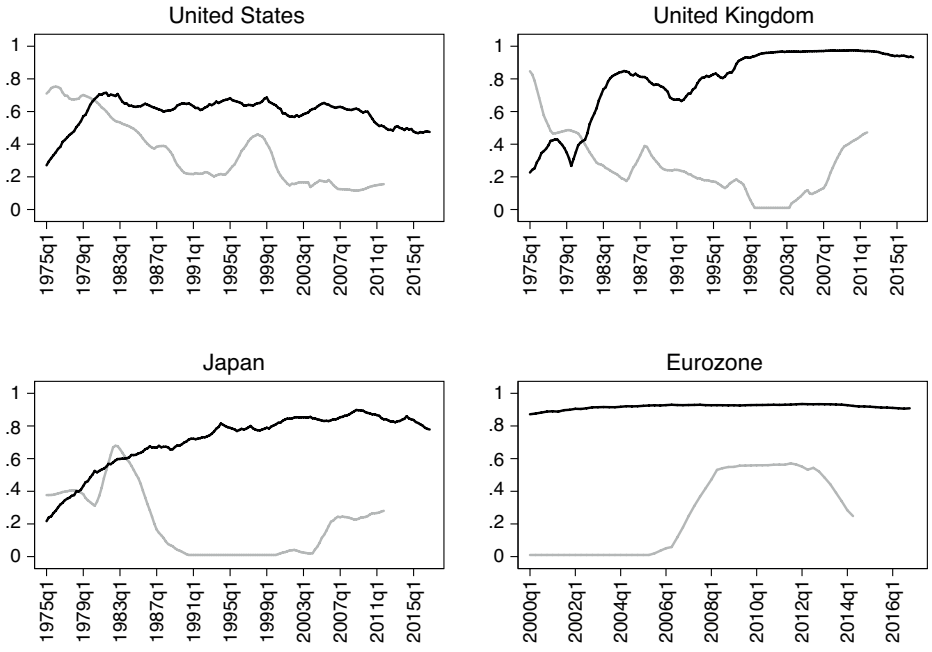
6 Thanks to Martina Hengge for help with coding the UC-SV model.

The view of inflation that comes from taking Stock and Watson's approach to separate transitory and more long-lasting components of inflation coincides with the view that came from separating relative prices from pure inflation. There were large transitory relative price changes after the global financial crisis. Trend inflation was stable and well anchored, however, and a simple and naïve measure like core inflation, which simply removes energy and food prices, does a good job in capturing both the pure and the permanent components of inflation, since most of the relative price changes were due to global commodity prices.

Figure 2.4 shows the coefficients of a simple autoregressive model (estimated with quarterly data and a 12-year window for the US, the UK, and Japan, and a 6-year window for the Eurozone) and the values of θ obtained with the Stock and Watson model. The figures for the US, UK, and Japan show that the decrease in

the autoregressive coefficient matches the decrease in the volatility of permanent inflations shocks (captured by an increase of the parameter θ in the Stock and Watson model). The figure shows that in the US, the volatility of permanent shocks decreased rapidly between the mid-1970s and the mid-1980s. The same phenomenon occurred in the UK and Japan, but at a slower pace (in both countries, the volatility of persistent shocks kept decreasing until the late 1990s). Insofar as the volatility of the permanent process captures the risk that inflation becomes unanchored and drifts away from target, these estimates support the view that inflation remained stable, albeit at lower levels with respect to the pre-crisis period, and well anchored during the recent period.

Figure 2.4 Persistence of trend inflation



Notes: The grey lines plot the coefficients of a simple autoregressive model (estimated with quarterly data and a 12-year window for the US, UK and Japan, and a six-year window for the Eurozone) and black lines plot the values of θ obtained with the Stock and Watson model.

2.3 Revisiting the Phillips curve

As we described in Chapter 1, using simple Phillips curve logic leads to two conjoined puzzles – first, that there was no large fall in inflation after unemployment peaked in 2009-10; and second, that there was no large increase in inflation when the recovery was well under way in 2015-16. These are the 'missing disinflation' and the 'missing inflation' puzzles.

Both puzzles are based on the deviation between actual inflation and the inflation predicted by a standard inflation-augmented Phillips curve. To illustrate them, we estimate a simple Phillips curve for a panel of 18 advanced economies (details are provided in Box 2.2) and plot the median and the interquartile range of the deviation between actual inflation and inflation as predicted by the Phillips curve.

Figure 2.5 shows that in late 2008 and over 2010-11, actual inflation was approximately 80 basis points above predicted inflation (with spikes of 160 basis points for the upper quartile). In other words, inflation did not fall as much as one would have expected given the depth of the recession. This is the missing disinflation puzzle highlighted by Hall (2011), Coibion and Gorodnichenko (2015), and Friedrich (2016). The 2012-15 period was characterised by the opposite phenomenon – inflation was well below predicted inflation. This is the missing inflation puzzle described by Costâncio (2015) and in IMF (2016). The negative values of 2009 (a period in which actual inflation was well above predicted inflation) are explained by the large commodity price shock discussed above.

Box 2.2 Phillips curve estimates

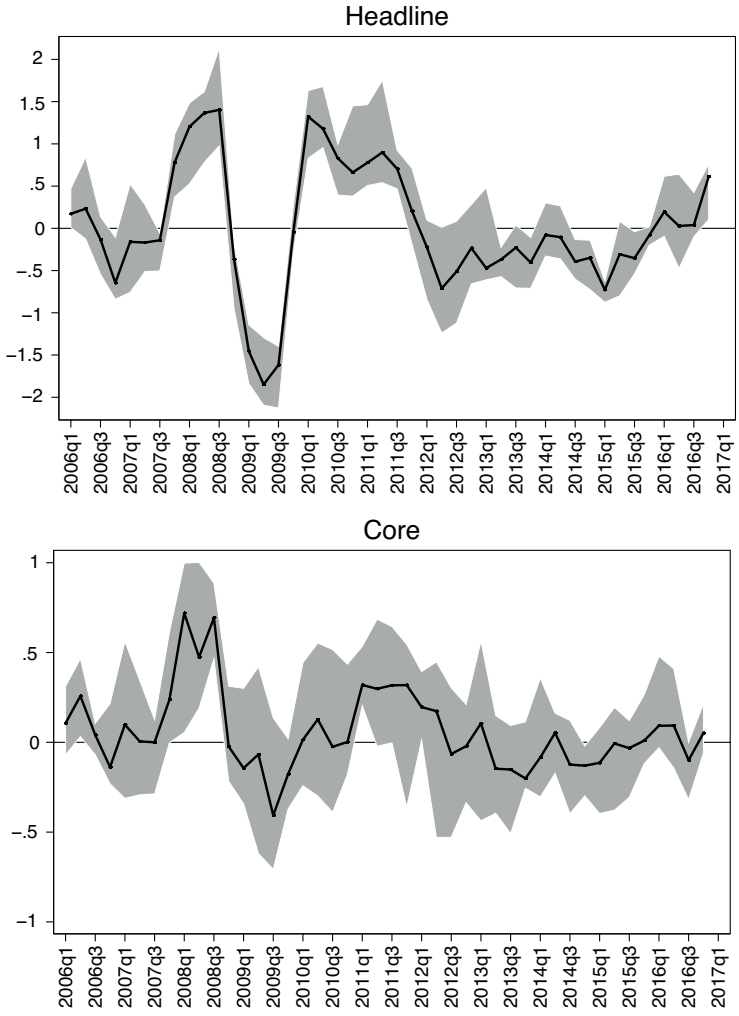
We estimate the following regression for a panel of 18 advanced economies using monthly data over 1968Q1-2016Q3:

$$\pi_{c,t} - E_{t-1}(\pi_{c,t+1}) = \alpha_c + \beta\,(U_{c,t} - \overline{U}_{c,t}) + \varepsilon_{c,t}$$

where $\pi_{c,t}$ is inflation in country c at time t, $E_{t-1}(\pi_{c,t+1})$ is expected inflation in the next period based on the information set available at time t-1, $U_{c,t}$ is unemployment in country c at time t, $\overline{U}_{c,t}$ is average unemployment in the previous four quarters, α_c is a country fixed effect, and $\varepsilon_{c,t}$ is a well-behaved error term. Next, we use the coefficients of this equation to predict inflation conditional on $E_{t-1}(\pi_{c,t+1})$ and $U_{c,t}$ and compute the deviation between realised inflation and predicted inflation (we have 18 predictions and realised values for each period).

The literature on what is the right model of the Phillips curve is extensive and controversial. How to measure inflation expectations, how to capture slack in the economy, and whether to include measures of supply shocks as further controls are all heavily debated topics. The equation above is a compromise over these debates. We take expectations over inflation next period (as in sticky price models), but set expectations with a one period lag (as in sticky information models); we measure expected inflation with fitted autoregressions as in backward-looking models (Fuhrer, 2017). On measuring slack, we use unemployment relative to a very short recent average (Ball and Mazumder, 2011). On supply shocks, we use core inflation to filter out the major global commodity prices, and because we found before that core inflation approximates reasonably well both pure inflation and trend inflation. The estimates are robust to different subsamples, including using data only to 2008, and to using the level of unemployment instead.

Figure 2.5 Deviation from predicted inflation



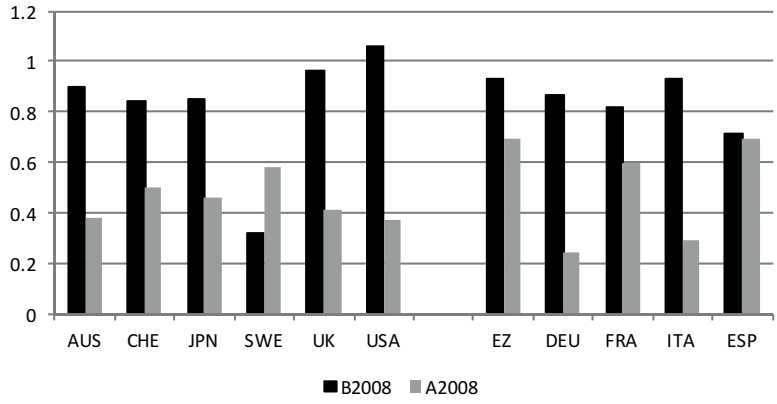
Notes: Deviation between actual inflation and predicted inflation. The model is estimated using pooled data for 19 advanced economies. The solid lines reports median values and the shaded areas the interquartile range.

If we focus on core inflation (bottom panel of Figure 2.5), the deviation between actual and predicted inflation is much smaller, but we still find that in most countries inflation was higher than expected over 2010-2012. This is partly related to the role of global factors, and especially commodity prices. Bobeica and Jarocinski (2017) show that in the Eurozone, global factors play a relatively more important role in explaining the behaviour of inflation over 2008-11, and domestic factors are relatively more important over 2012-14.

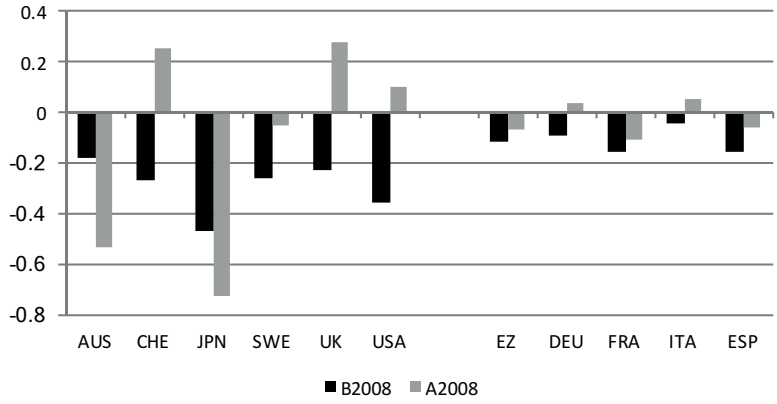
It is also possible that the period of low inflation that followed the global financial crisis changed the nature of the Phillips curve. To assess this possibility, we follow Blanchard et al. (2015) and estimate country-specific Philips curves allowing for different coefficients in the pre- and post-2008 periods (see Box 2.3 for details). We find strong evidence that the impact of inflation expectations on realised inflation was significantly lower in the post 2008 period (top panel of Figure 2.6). We also find that in ten out of the 12 countries (or groups of countries) included in our sample, the Phillips curve is flatter (i.e., there is a weaker relationship between unemployment and inflation) in the post 2008 period. In seven of these countries, the difference in slopes is statistically significant, while the Phillips curve has steepened in Australia and Japan (bottom panel of Figure 2.6).

Figure 2.6 Coefficients of Phillips curve on core inflation, backward inflation expectations and quarterly data

A: Coefficient on inflation expectations



B: Coefficient on unemployment rate



Notes: The black bars plot the coefficients for the period up to 2008 and the grey bars plot the coefficients for the post-2008 period.

Box 2.3 Country-specific Phillips curves with 2008 break

We estimate the following equation:

$$\pi_t = \alpha + E_{t-1}(\pi_{t+1}) \times (\beta_1 + \beta_2 D_t) + U_t \times (\delta_1 + \delta_2 D_t)\, \alpha_c + D_t + \varepsilon_{c,t}$$

where all variables are defined as above and D_t is a dummy variable that takes value zero before 2008Q4 and value 1 afterwards. In this setting, β_1 and δ_1 capture the inflationary impact of inflation expectations and unemployment before 2009 and $\beta_1 + \beta_2$ and $\delta_1 + \delta_2$ measure the inflationary impact of inflation expectations and unemployment after 2008. A negative value of β_2 would suggest that expectations are a less important driver of inflation in the post-2008 period, and a positive value of δ_2 would indicate that unemployment is less closely related with inflation in the post-2008 period (i.e., the Phillips curve has flattened).

Table 2.1 reports estimates of the equation described above for ten advanced economies and for the Eurozone as a group; Figure 2.16 plots the main coefficients of these regressions. For the Eurozone, we estimate two different models. In the first model, we treat the currency area as a single country and estimate the model using the Eurozone's averages. In the second model, we pool all the countries together and we estimate a fixed effects panel model with one observation for each country-period.

We find that β_1 is positive (as expected) and statistically significant for all countries (or group of countries) that we consider. In most countries, the coefficient is large but smaller than one (indicating that inflation does not vary one-for-one with inflationary expectation). The exception is the UK, where the coefficient on expected inflation is 1.06. We also find that δ_1 is negative (as expected) for all countries (or group of countries) that we consider, but it is not statistically significant for France.

Looking at β_2, we find that this estimated parameter is negative in 11 of our 12 models (the exception is Sweden) and negative and statistically significant in 9 of these 11 regressions (these are the coefficients highlighted in red in Table 2.1). There is thus strong evidence that the impact of inflation expectations on realised inflation was significantly lower in the post-2008 period (Figure 2.6, Panel A). In Germany, we find no statistically significant correlation between actual inflation and expected inflation in the post-2008 period.

When we look at the relationship between unemployment and inflation in the post-2008 period, we find that δ_2 is positive (indicating a flatter Phillips curve; Figure 2.6, Panel B) in ten of our 12 regressions, and that it is statistically significant in five of these ten regressions. In seven regressions (US, UK, Sweden, Switzerland, Germany, Italy, and Spain), we find that in the post-2008 period there is either no statistically significant relationship between unemployment and inflation or that this relationship has switched from negative to positive and is statistically significant (this is the case for the US and the UK). We also find two cases for which δ_2 is negative (suggesting that the Phillips curve has become steeper in the post-2008 period), with a statistically significant coefficient in Australia.

Box 2.3 (cont.)

Table 2.1 Philips curve estimates (quarterly data)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)*
E(π)	1.064***	0.856***	0.956***	0.320	0.840***	0.901***	0.866***	0.818***	0.927***	0.711***	0.928***	1.064***
	(0.0525)	(0.0864)	(0.0431)	(0.218)	(0.0419)	(0.0341)	(0.0287)	(0.232)	(0.0764)	(0.109)	(0.0105)	(0.0525)
U	-0.360***	-0.473***	-0.231***	-0.259**	-0.270***	-0.182***	-0.090***	-0.156	-0.040**	-0.160***	-0.116***	-0.360***
	(0.0636)	(0.147)	(0.0465)	(0.125)	(0.0409)	(0.0534)	(0.0165)	(0.151)	(0.0181)	(0.0360)	(0.0213)	(0.0636)
E(π)*D08	-0.692***	-0.401**	-0.544**	0.264	-0.343**	-0.522***	-0.621**	-0.217	-0.635***	-0.023	-0.232***	-0.692***
	(0.190)	(0.166)	(0.214)	(0.256)	(0.150)	(0.156)	(0.253)	(0.253)	(0.142)	(0.144)	(0.0357)	(0.190)
U*D08	0.264***	-0.259	0.557***	0.212	0.521	-0.353*	0.049	0.0545	0.092*	0.096	0.053***	0.264***
	(0.0684)	(0.220)	(0.134)	(0.156)	(0.341)	(0.185)	(0.0578)	(0.156)	(0.0496)	(0.0617)	(0.0150)	(0.0684)
D08	-0.0411	1.288	-1.494***	-2.253*	-1.885	2.631**	0.192	-0.015	-1.295	-0.908	-0.155	-0.041
	(0.476)	(0.954)	(0.345)	(1.288)	(1.156)	(1.164)	(0.466)	(1.013)	(1.036)	(0.664)	(0.131)	(0.476)
Const.	1.845***	1.730***	1.462***	3.079***	0.934***	1.680***	0.932***	1.479	0.745***	1.900***	0.944***	1.845***
	(0.314)	(0.611)	(0.259)	(1.082)	(0.176)	(0.404)	(0.190)	(0.901)	(0.214)	(0.385)	(0.139)	(0.314)
N. Obs.	200	199	184	64	188	154	200	51	122	75	200	2,121
R2	0.870	0.866	0.904	0.421	0.890	0.872	0.910	0.696	0.900	0.721	0.891	
E(π)+E(π)*D08	0.372**	0.46***	0.41***	0.58***	0.50***	0.38***	0.24	0.60***	0.29**	0.69***	0.69***	0.37**
p-value	0.04	0.00	0.05	0.00	0.00	0.01	0.33	0.00	0.02	0.00	0.00	0.04
U+ E(π)*D08	0.10*	-0.73***	0.28***	-0.05	0.25	-0.53***	0.04	-0.11***	0.05	-0.06	-0.07***	-0.10***
p-value	0.00	0.00	0.01	0.61	0.46	0.00	0.46	0.00	0.26	0.20	0.00	0.00
	USA	JPN	UK	SWE	CHE	AUS	DEU	FRA	ITA	ESP	Eurozone	
											Average	Pooled

Notes: E(π) is backward-looking expected inflation, U is unemployment, D08 is a dummy that takes value 1 after 2008.

2.4 The central role of expectations

Ever since Milton Friedman's (1968) presidential address to the American Economic Association, expectations have played an important role in the specification of Phillips curves. Higher inflation expectations would feed into higher actual inflation because, in anticipation of inflation, firms will raise prices and workers will raise wage demands, leading to a materialisation of inflation. From another perspective, and one emphasised by Friedman, if inflation equals inflation expectations, then real activity would be at a 'natural level', which monetary policy can do little to affect. The relative stability of consumer inflation expectations post-2010 kept actual inflation stable (Coibion and Gorodnichenko, 2015). Moreover, the estimates of the Phillips curve described in Box 2.3 showed that the post-2008 period is characterised by a weaker link between expected and realised inflation. One problem with that analysis is that it was based on simple, backward-looking expectations.[7] We now examine the relationship between realised inflation and forward-looking inflation expectations.

Interest rate theories of inflation also place expectations as a key determinant of inflation. They suggest that anchoring inflation expectations – preventing them from either drifting or being driven by market panics or self-fulfilling beliefs – is half the battle of keeping inflation under control. Survey-based and market-based measures of inflation expectations allow the predictions of those theories to be judged against the facts.

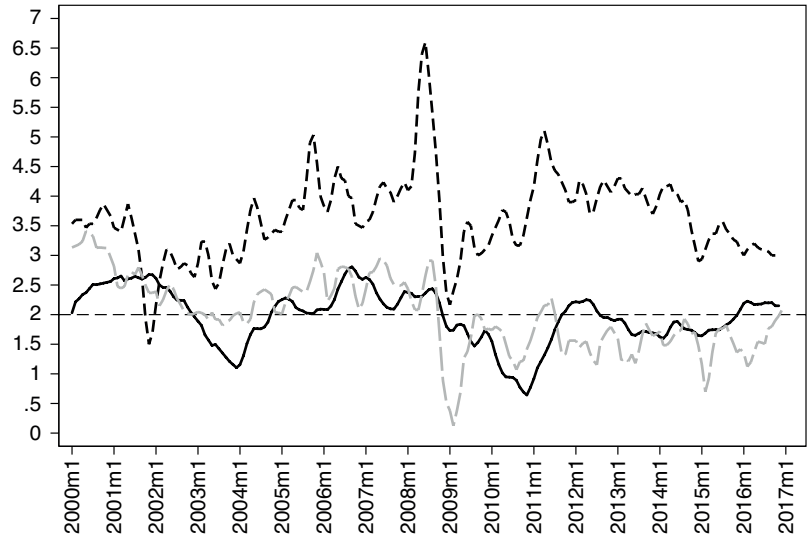
We start with the US and explore the link between actual inflation and two survey-based measures of inflation expectations: (i) the University of Michigan's Survey of Consumers, and (ii) the Federal Reserve Bank of Cleveland's Survey of Professional Forecasters. The top panel of Figure 2.7 plots one-year-ahead inflation expectations from these two surveys (we always use median values) together with realised core inflation. Over the past 12 years, consumers' inflation expectations have consistently overshot actual inflation. The expectations of professional forecasters, however, do not appear to show any systematic bias. Like inflation itself, they have stabilised slightly (but significantly) at below target. While the forecasts are more volatile than core inflation, they are much closer to core than to headline inflation. Professional forecasters are doing a better job at anticipating the behaviour of core inflation than at forecasting headline inflation (see also Trehan, 2010).

The bottom panel of Figure 2.7 plots realised inflation and five-years-ahead expectations of consumers and professional forecasters. While professional forecasters' expectations appear to be well anchored around the 2% target (in fact, five-year-ahead expectations of professional forecasters are close to their one-year-ahead expectations), five-year-ahead consumer expectations are systematically closer to 3% than to the 2% target. Consumers' long-term inflation expectations decreased slightly in the aftermath of the global financial crisis (from 3% in early 2009 to 2.5% at the end of 2016), but they remain well above the Fed's inflation target.

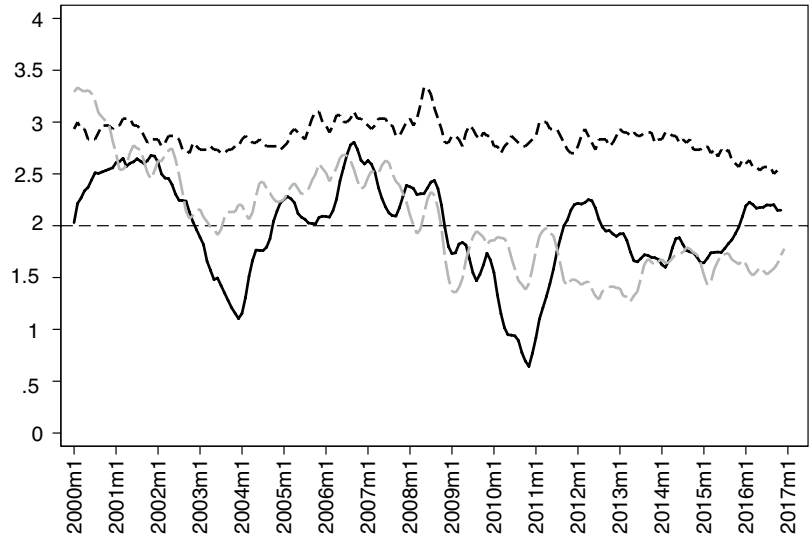
7 We rely on backward-looking expectations because of lack of long cross-country data on forward-looking inflation expectations.

Figure 2.7 Core and expected inflation in the US

A: One-year-ahead expected inflation



B: Five-years-ahead expected inflation



Notes: The black solid lines plot realised core inflation, the black dashed lines plot consumers' expectations and the grey lines plot professional forecasters' expectations.

In Table 2.2, we formally test for systematic biases in inflation expectations. Specifically, we compute the difference between actual inflation at time t and 12-month-ahead inflation expectations at time t-12, and then check whether this difference is statistically significant. When we use US data for the full sample (1986Q1 to 2016Q4) and focus on headline inflation, we find no systematic difference between realised inflation and professional forecasters' expectations

(at 0.04 percentage points, the difference is small and not statistically significant; see column 1, top panel of Table 2.2). We do find a substantial difference, however, between realised inflation and consumers' expectations. Over the full period, consumers expected an inflation rate which was almost 0.5 percentage points higher than realised inflation (column 2, top panel of Table 2.2). Next, we check whether the global financial crisis affected the relationship between expected and realised inflation. Looking at the survey of professional forecasters, we find that inflation expectations in the post-2008 period were 0.3 percentage points higher than realised inflation, but that the difference is not statistically significant (column 3, top panel of Table 2.2). Focusing on the consumers' survey, however, we find large deviations between expected and realised inflation in the post-2008 period. Specifically, average realised inflation in this period was more than 1.8 percentage points lower than expected inflation (column 4, top panel of Table 2.2). This finding is consistent with the results of the Phillips curve estimates described in Box 2.3, where we found no correlation between expected and realised inflation in the US for the post-2008 period. This suggests that consumers' expectations are unlikely to be forward-looking. Replacing headline inflation with core inflation yields similar results.

Next, we compare realised and expected inflation in the UK (Figure 2.8). When we focus on the full sample, we find that professional forecasters' expectations are in line with realised headline inflation, but they overstate core inflation by approximately 50 basis points (column 1, middle panel of Table 2.2). Consumers' expectations overstate both headline (70 basis points) and core inflation (100 basis points), but track retail price inflation. When we split the sample, we find that professional forecasters' expectations overshot realised inflation in the pre-2009 period (46 basis points for headline inflation and 97 basis points for core inflation; column 3, middle panel Table 2.2), but they did not make any systematic mistake in the post-2008 period. Consumers' expectations, instead, overshot realised inflation in both periods, but by more in the post-2008 period (although the difference is not statistically significant).

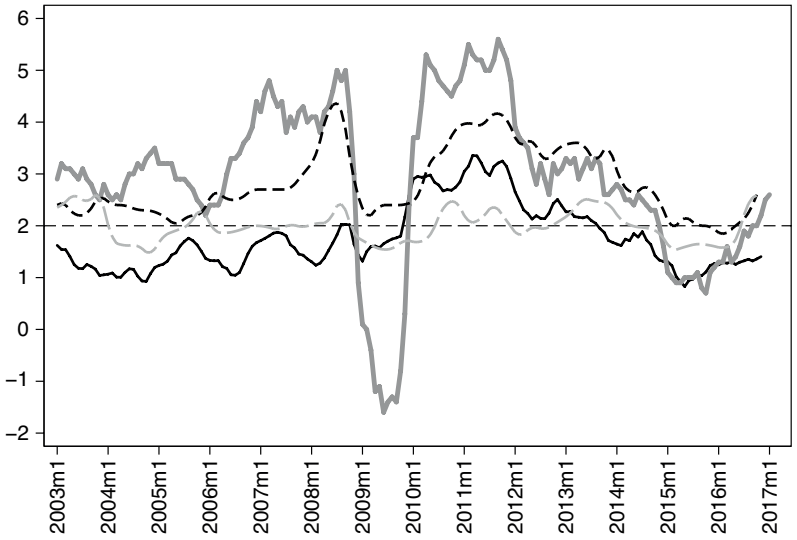
Figure 2.9 compares actual inflation with professional forecasters' inflation expectations in the Eurozone. The figure suggests that before 2005, professional forecasters' expectations undershot actual inflation in the Eurozone, and after 2005 they overestimated inflationary outcomes in the currency area. The bottom panel of Table 2.2 shows that when we use headline inflation for the whole 1999-2016 period, there is no systematic difference between expected inflation and headline inflation realisations 12 and 24 months ahead. Professional forecasters, however, overshot realised core inflation (columns 1 and 2). When we split the sample into before and after 2009, we find that in the 1999-2008 period headline inflation was about 0.5 percentage points above the expectations of the professional forecasters surveyed by the ECB. After 2008 professional forecasters' expectations overshot actual inflation realisations by approximately 0.4 percentage points at a 12-month horizon, and 0.6 percentage points at a 24-month horizon. Focusing on core inflation, we find that professional forecasters always overshot realised inflation, but more so after 2008. Professional forecasters may thus have missed the shift in pure inflation illustrated in Figure 2.2.

Table 2.2 Deviation between actual inflation and expected inflation

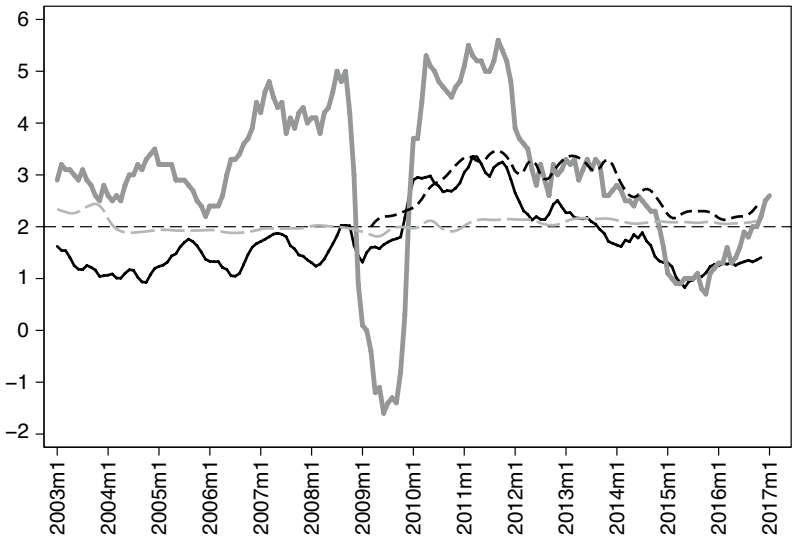
	(1)	(2)	(3)	(4)
USA (1986Q2-2016Q4): Deviation between actual inflation and one year ahead expected inflation 12 months before				
		Headline inflation		
Average	-0.0369	-0.433***	0.0555	0.0358
	(0.200)	(0.131)	(0.233)	(0.127)
D08			-0.358	-1.816***
			(0.458)	(0.251)
Core inflation				
Average	-0.0295	-0.426***	-0.055	-0.075
	(0.169)	(0.088)	(0.197)	(0.082)
D08			0.100	-1.357***
			(0.388)	(0.161)
Expectations are from	Professional forecasters	Michigan Survey	Professional forecasters	Michigan Survey
UK (1997Q1-2016Q3): Deviation between actual inflation and one year ahead expected inflation 12 months before				
		Headline inflation		
Average	-0.196	-0.669***	-0.461***	-0.403***
	(0.138)	(0.140)	(0.273)	(0.192)
D08			0.654***	-0.541
			(0.273)	(0.274)
		Core Inflation		
Average	-0.569***	-1.052***	-0.966***	-0.984***
	(0.097)	(0.088)	(0.105)	(0.124)
D08			0.982***	-0.137
			(0.164)	(0.177)
Expectations are from	Bank of England Forecasters Survey	Bank of England Consumer Survey	Bank of England Forecasters Survey	Bank of England Consumer Survey
Eurozone (2001Q1-2016Q4): Deviation between actual inflation and one and two-year ahead expected inflation 12 and 24 months before				
		Headline inflation		
Average	0.0978	-0.0565	0.534***	0.525***
	(0.109)	(0.126)	(0.129)	(0.146)
D08			-0.928***	-1.162***
			(0.187)	(0.206)
Core inflation				
Average	-0.252***	-0.358***	-0.095*	-0.042
	(0.045)	(0.059)	(0.06)	(0.061)
D08			-0.355***	-0.633***
			(0.081)	(0.087)
Horizon	One year ahead	Two years ahead	One year ahead	Two years ahead

Figure 2.8 Core and expected inflation in the UK

A: One-year-ahead expected inflation

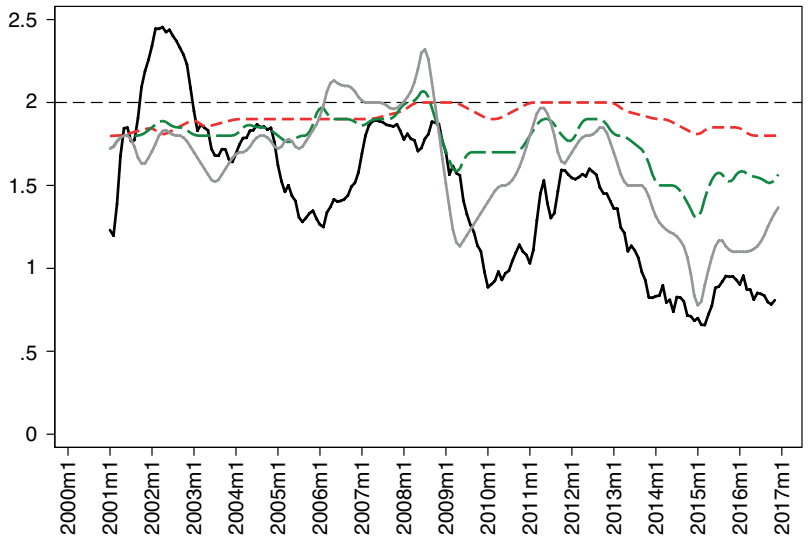


B: Five- and three-years-ahead expected inflation



Notes: The black solid lines plot core inflation, the solid grey lines plot retail inflation, the black dashed line plots expectations from the Bank of England consumer survey, the grey dashed lines plots expectations from the Bank of England survey of forecasters (one and three years ahead).

Figure 2.9 Core and expected inflation in the Eurozone



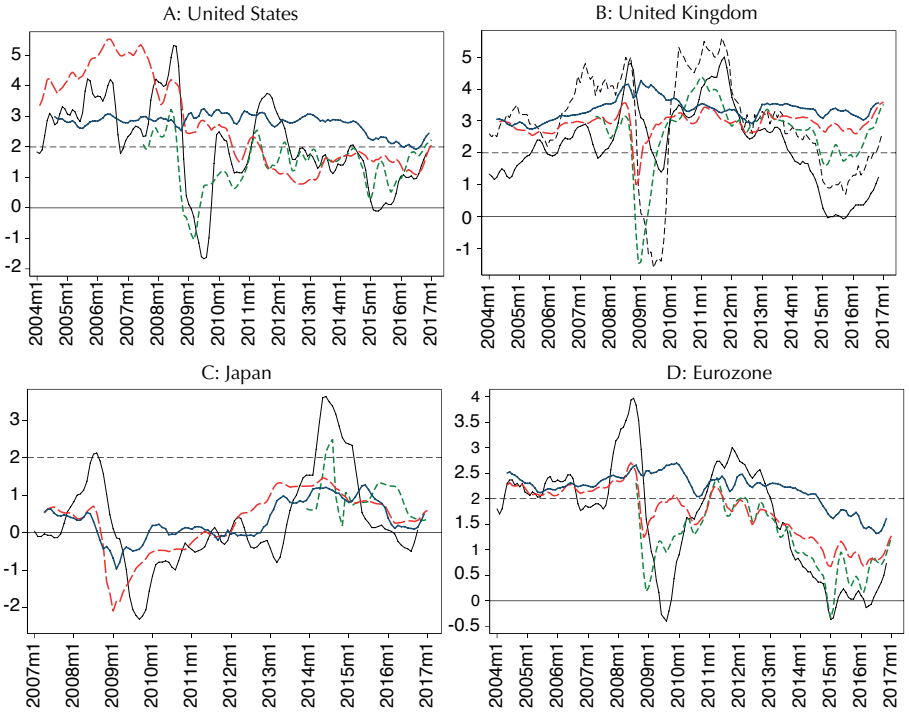
Notes: The black line plots core inflation, the grey line plots one-year-ahead expectations from the ECB survey of professional forecasters, the red line plots five-years-ahead expectations from the ECB survey of professional forecasters and the green line plots two-years-ahead inflation expectations from the ECB survey of professional forecasters.

An alternative measure of expected inflation comes from markets instead of surveys. The two differ in many ways, making them complements rather than substitutes. For one, while surveys capture expectations of the public and reflect a modal or central tendency, market measures capture the view of the marginal financial participant, who may have different information and goals from the firms setting prices. Moreover, while surveys measure inflation from the perspective of the cost of living, markets measure inflation from the perspective of investors and may include a significant element of compensation for risk.

We use three measures of market-based expectations: (i) one-year inflation swaps; (ii) five-year inflation swaps; and (iii) the five-year/five-year breakeven rate. The latter measure captures market expectations for five-year inflation five years from now. It is a standard measure of long-run inflation expectations that seems to be more robust to liquidity problems that affect measures based on the yield of long-term inflation-indexed bonds.

The data for the US show that before the global financial crisis, medium-term (five-year ahead) market-based inflation expectations were well above core inflation (the red line in Panel A of Figure 2.10), partly because they reflect expected headline inflation plus a risk premium. However, from 2010 onwards, market-based five-year expected inflation started tracking average inflation (though not the volatility of realised inflation). We also find that market-based one-year-ahead inflation expectations closely track actual inflation. Long-term inflation expectations were remarkably stable at about 2.5% for the whole 2004-14 period and overshot realised inflation for the full post-global financial crisis period. Long-run market-based inflation expectations slowly decreased towards 2% over 2014-15 and then picked up slightly during the second half of 2016.

Figure 2.10 Actual versus market-based expected inflation



Notes: The black lines plot core inflation (the black dashed line in the UK graph plots retail price inflation), the green lines plot inflation expectations from one-year interest rates swaps, the red lines plot inflation expectations from five-year inflations swaps, and the blue lines plot five-year over five-year inflation swaps.

In the UK, we find that all measures of market-based expected inflation were above realised CPI inflation over 2005-08, and one-year expected inflation greatly undershot realised inflation during 2010-12. All measures of expected inflation remained above actual inflation over 2013-16 (Panel B, Figure 2.10). Expected inflation tracks retail price inflation – the underlying index, which is often higher than CPI inflation – quite well .

In the Eurozone, medium-term marked-based expected inflation overshot actual inflation until 2012 (with the exception of 2009) and moved in sync with realised inflation over 2013-16. Long-term inflation expectations, as measured by five-year over five-year inflation swaps, instead remained near 2% until 2014 but declined sharply after that to below 1.5%, while overshooting actual inflation for most of the period (Figure 2.10, Panel D).

The case of Japan is different from those of the US, the UK, and the Eurozone. Panel C of Figure 2.10 shows that market-based inflation expectations hover between 0% and 1% and do a good job at tracking realised inflation. The fact that in Japan inflation expectations do not overshoot realised inflation is probably due to the country's two-decade experience of near-zero inflation.

In summary, in the US, UK, and the Eurozone market participants, professional forecasters, and consumers alike did not fully anticipate the period of extremely low inflation that followed the global financial crisis. However, this extended period of low inflation did not have much effect on long-term inflation forecasts, which remain anchored just below the 2% target.

With inflation expectations anchored near the target, inflation tended to remain stable in spite of a peg to interest rates. Moreover, with fewer shocks to expectations, one important driver of shocks to actual realised inflation is no longer present. The constancy of inflation expectations becomes an important driver of inflation itself.

From the perspective of a standard, expectation-augmented Phillips curve model, the presence of inflation expectations above actual inflation should have contributed to a faster recovery of actual inflation towards the target. However, we found in our simple Phillips Curve estimations in Table 2.1 (see Box 2.3) that expectations now have less predictive power for subsequent inflation (see also Nalewaik, 2016). This helps to explain the long period of subdued inflation that followed the global financial crisis.

2.5 The central bank balance sheet

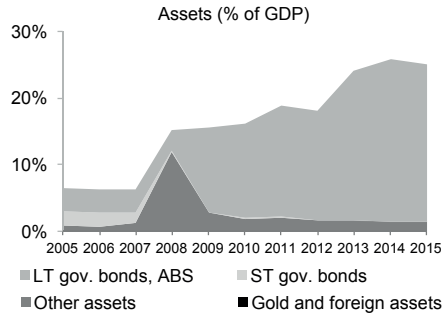
While students learn to recite MV = PY, they often do not understand it well enough to realise two of the underpinnings of this equation. First, the equality assumes that nominal interest rates are positive, so that people want to economise on their cash holdings. If people are indifferent between holding money and other financial assets, then they will be willing to hold any amount of money above what is strictly needed for transactions. Since interest rates were close to zero during this period, the equality, MV = PY, becomes an inequality.

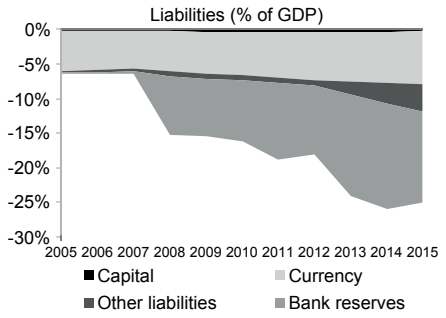
Second, to be reliable, M should refer to non-interest-bearing currency or zero-interest required reserves. These are the means of payment that agents will hold, in spite of being dominated in return relative to other financial assets, because of their role in making transactions. Interest-paying reserves are not such an asset insofar as they pay an interest rate close to that on short-dated government bonds and other similar financial assets. During this period, the policy rate in all four major economic areas was very close to the interest rate on overnight repurchase agreements or on other very short government-issued instruments.

Figure 2.11 plots the evolution of the balance sheet of the major four central banks (the figure harmonises the treatment of balance sheets so that the components are comparable). The liabilities of the central banks, or the monetary base, are the sum of currency plus reserves. Figure 2.11 shows that post 2007, almost all of the increase in the monetary base was due to an increase in interest-paying reserves. In the light of that, the lack of a link between the monetary base and inflation is not so surprising. With interest on reserves close to market interest rates, it was currency, not reserves or the monetary base, that was the appropriate measure of M in MV = PY, and currency grew at a steady rate during this time, consistent with the steady growth of the price level.

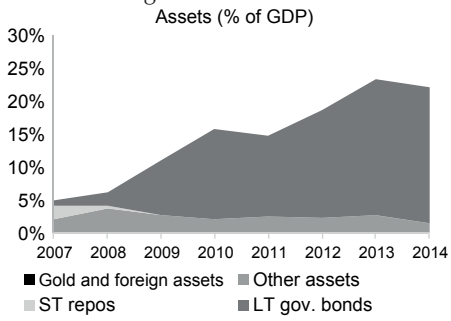
Figure 2.11 Balance sheets of the main central banks, 2005-15

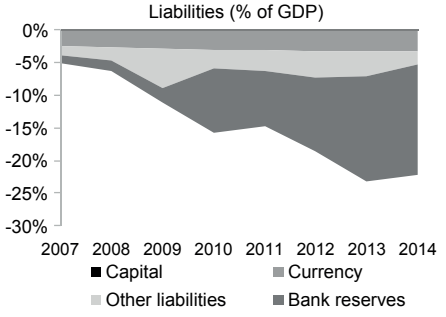
A: Federal Reserve System



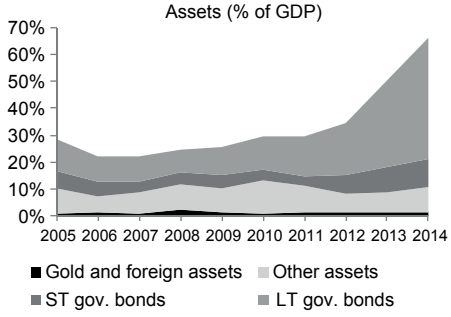


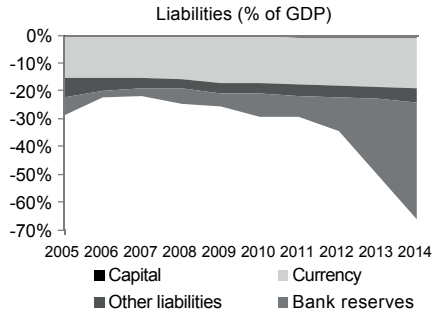
B: Bank of England



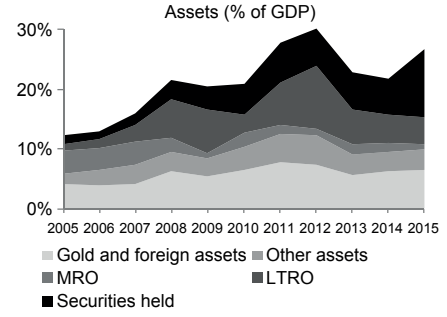


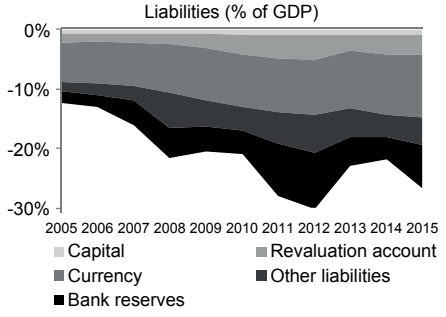
C: Bank of Japan





D: Eurozone



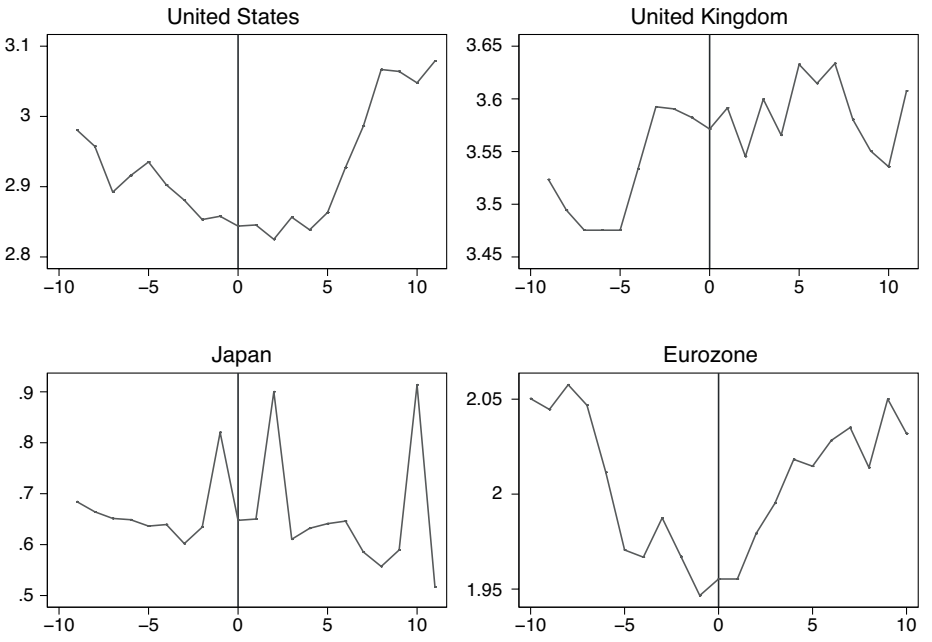


Source: Reis (2016).

2.6 Policies and inflation expectations

Finally, as we described in Chapter 1, this was a time of new policies and methods of communicating these policies. Market-based indicators of inflation expectations, which are available at high frequency, are useful for evaluating the effect of monetary policy announcements on inflationary expectations. Figure 2.12 shows that monetary policy announcements (where we only include announcements of a more accommodating policy stance) are followed by an increase in inflationary expectations in the US and the Eurozone and, to some extent, in the UK. However, there seems to be no effect in Japan. Moreover, there is substantial volatility in the post-announcement period, and Figure 2.13 shows that not all announcements have the same effect on inflationary expectations.

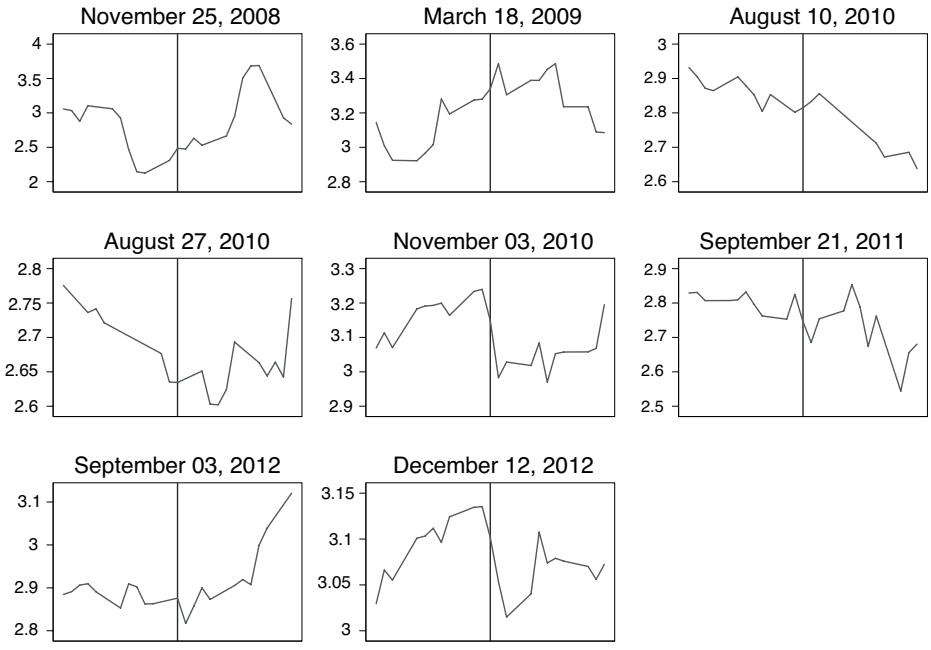
Figure 2.12 Market-based inflation expectations and monetary policy announcements



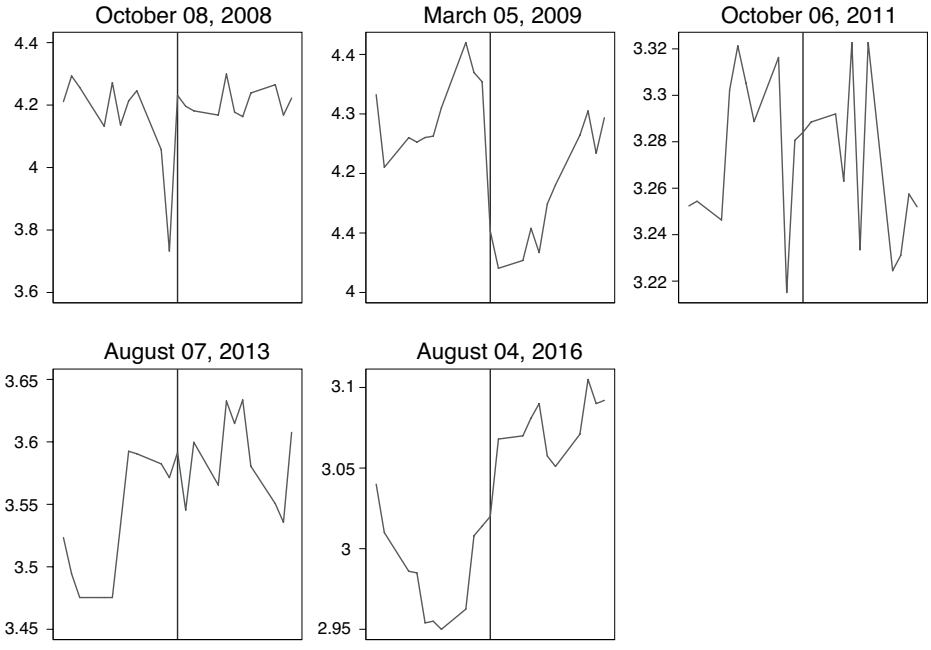
Notes: The black lines plot the median value of market based expected inflation (five-year over five-year inflation swaps) in a 20-day window around monetary policy announcements. The full list of events is in Figure 2.13.

Figure 2.13 Market-based inflation expectations and monetary policy announcements

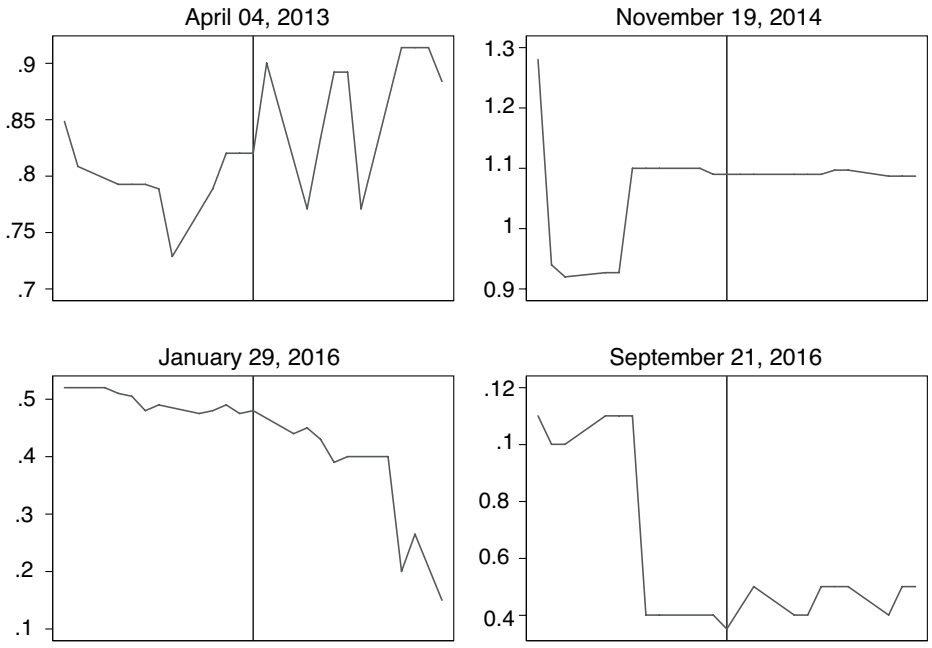
A: United States



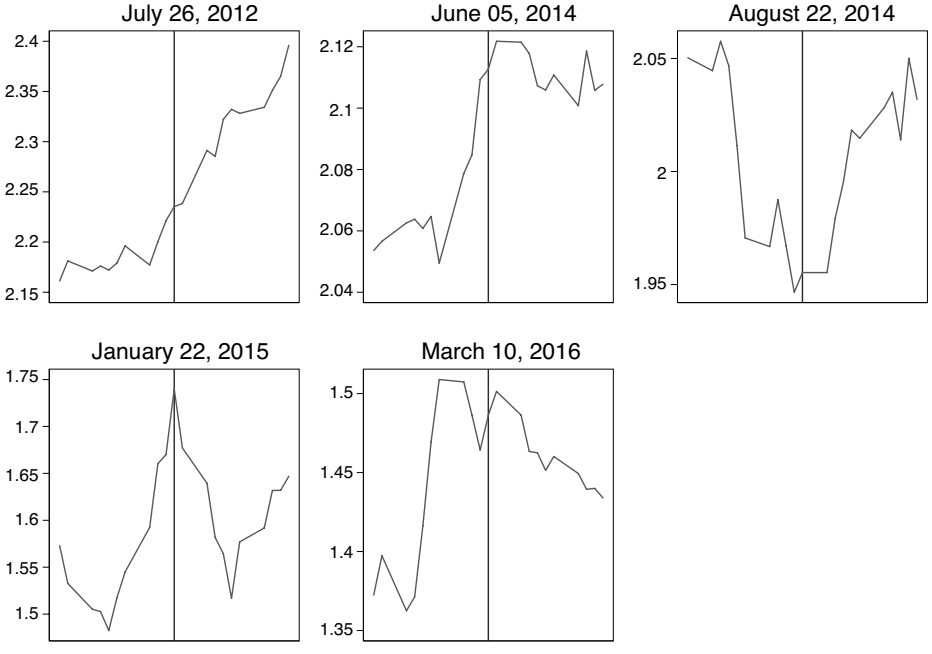
B: United Kingdom



C: Japan



D: Eurozone



Notes: The black lines plot the median value of market based expected inflation (five-year over five-year inflation swaps) in a 20-day window around monetary policy announcements.

So far, we have looked at the behaviour of the median respondent to inflation surveys. The success of policy communication can perhaps be better assessed by moving to the second moment of the distribution of responses of surveys. This measure of disagreement provides an indication of whether the majority of the population has its expectations anchored. A wide dispersion of inflation expectations may be a reflection of limited central bank credibility and possibly of a reduced effectiveness of monetary policy.

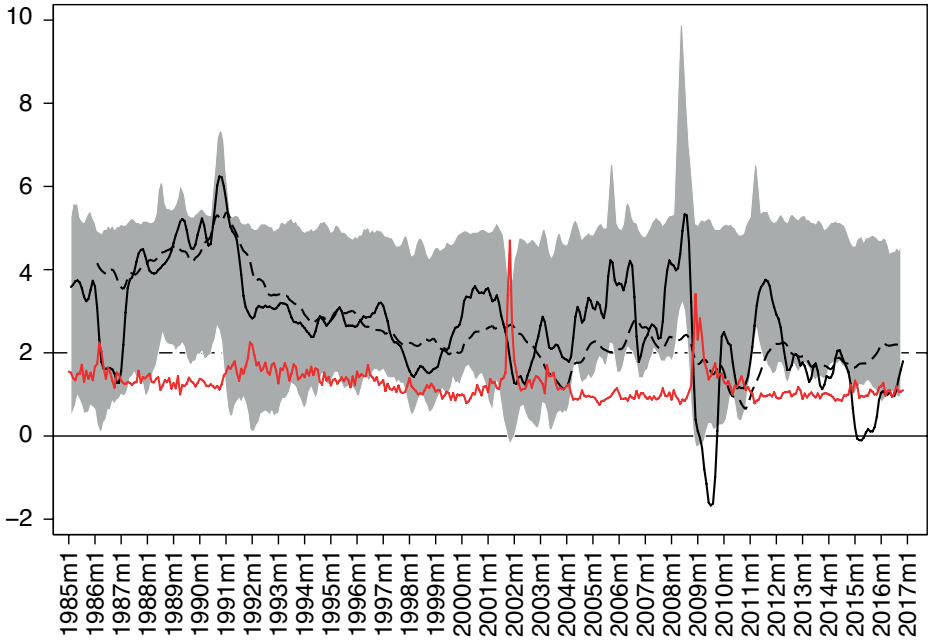
There are at least two other reasons why understanding the behaviour of disagreements over inflation expectations is important. First, a better understanding of the dispersion of inflation expectations is useful for discriminating between different models of expectation formation. Second, if uncertainty about future inflation has significant welfare costs (as suggested by Friedman, 1977) and an increase in disagreement about future inflation is associated with larger errors (in absolute terms, or in terms of mean squared errors), policies that can reduce or increase disagreements have welfare implications. Mankiw et al. (2004), using US data for 1948-2002, find that the dispersion of inflation expectations is positively correlated with the level of inflation and with sudden changes (in either direction) of inflation. Interestingly, they only find a weak link between the dispersion of inflation expectations and economic activity.

Figure 2.14 focuses on the US and shows the dispersion of consumers' and professional forecasters' inflation expectations 12 months and five years ahead. The figure show that there is more disagreement among consumers than among professional forecasters, and that disagreement among consumers decreases with the horizon of the forecast. The average width of the interquartile range for the one-year-ahead forecast is 3.9 percentage points, with a standard deviation of 0.58 and minimum and maximum values of 3.1 and 6.8. The average width of the interquartile range for five-year ahead forecasts is 3%, with a standard deviation of 0.34 and minimum and maximum values of 2.2 and 5.6.

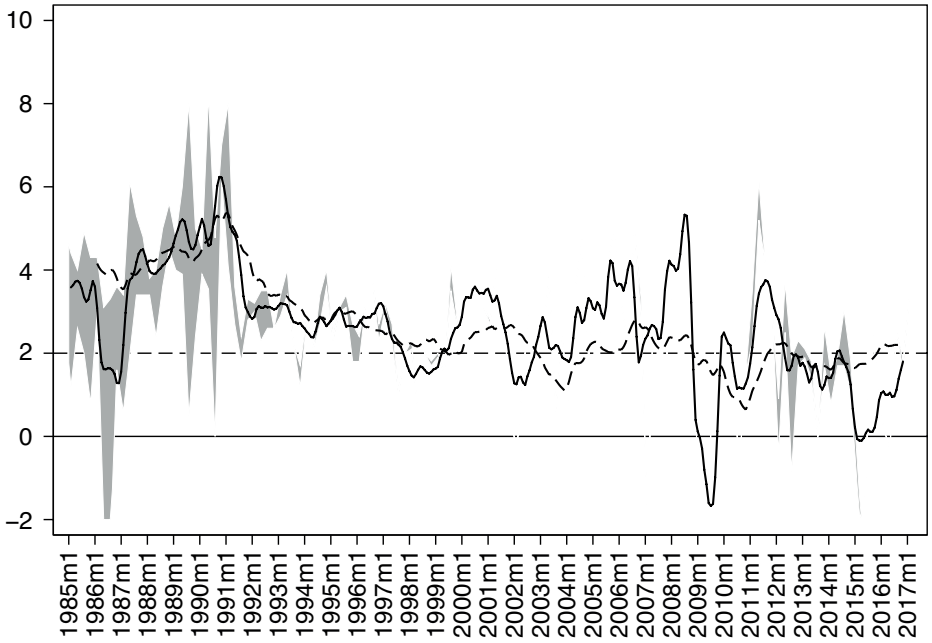
The opposite is true for professional forecasters. In this case, the dispersion of one-year-ahead forecasts was large in the 1980s but has become practically invisible since then. However, the dispersion of the five-year-ahead forecasts has been hovering at around 0.7 percentage points for the whole 1985-2016 period (the average is 0.7, with a standard deviation of 0.21 and a range of 0.3-1.4). It increased in 2008-11, but quickly reverted back down close to its usual level after the shock.

Figure 2.14 Dispersion of Inflation expectations in the US

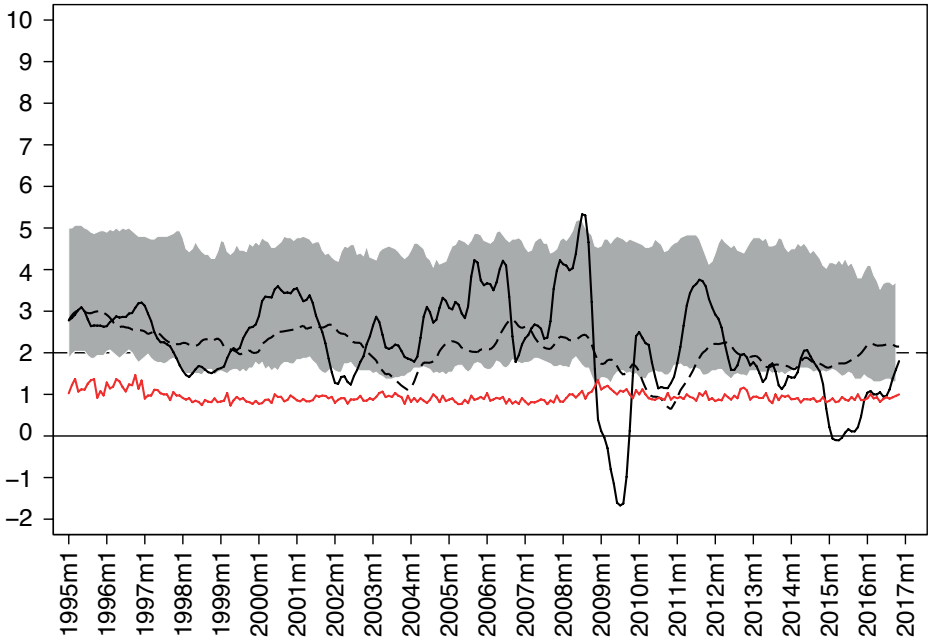
A: Consumers, 12 months



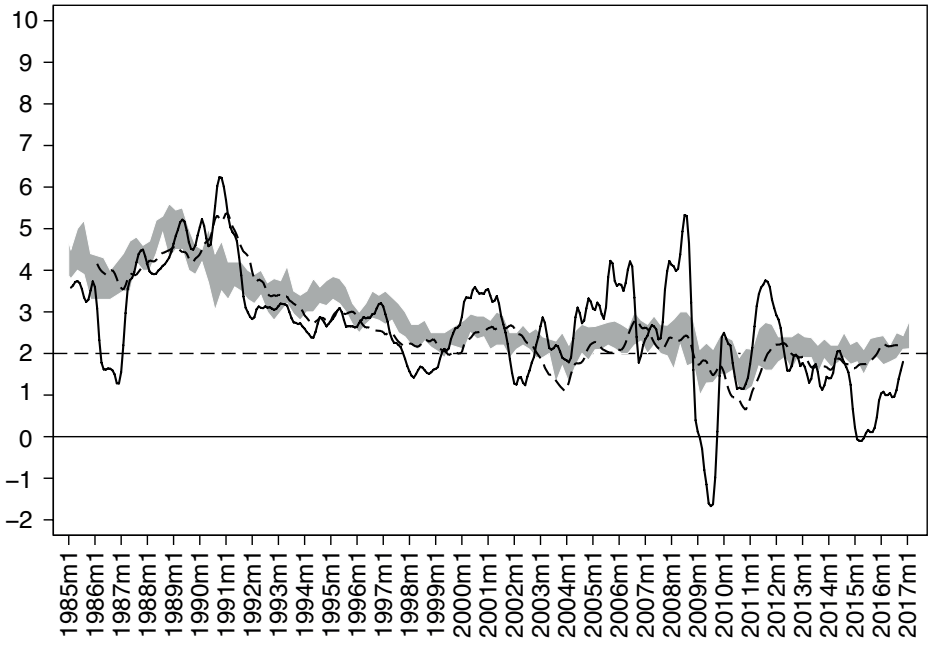
B: Professional forecasters, 12 months



C: Consumers, 5 years



D: Professional forecasters, 5 years



Notes: The black lines plot realised core inflation, the grey areas plot the interquartile range of inflation expectations (for 12-month inflation expectations of professional forecasters we use the max-min instead of the interquartile range), the red lines plot the coefficient of variation of inflationary expectations.

Disagreement may be the prelude to either high inflation or deflation. For instance, Paul Volcker's tight monetary policy first increased disagreement and only after lowered inflation expectations, as economic agents gradually adjusted at different speeds to the new policy regime. Next, we investigate whether disagreements about inflation in the US are correlated with the behaviour of inflation before and after the global financial crisis. The regression results show a negative correlation between the level of inflation and the dispersion of expectations in the post-crisis period, and a positive (albeit not statistically significant) correlation in the pre-crisis period. This change in the relationship between inflation and the dispersion of inflation expectations is not present when we look at the case of professional forecasters. The results are similar if we use core inflation instead of headline inflation.[8] These results suggest that if disagreement is a precursor to changes in expected inflation, then inflation may stay below target for a while.

When we look at the dispersion of five-years-ahead inflation forecasts for the US, we find that in the pre-crisis period there was a positive correlation between the dispersion of expectations of the level of inflation (bottom panel of Table 2.3) among professional forecasters' expectations. However, this correlation disappears in the post-crisis period. In columns 4 and 5, the sum of the inflation coefficient and the coefficient of inflation interacted with the post-2008 dummy is close to zero and not statistically significant. Again, the results are identical when we use core inflation.[9]

8 The results are in Table 2.3. The first column of the top panel shows that there is no correlation between US inflation and the dispersion of consumers' expectations for a 12-month horizon. The second part of the top panel of Table 2.3, instead, shows that there is a positive correlation between the dispersion of professional forecasters' expectations and the level of inflation. The second column of Table 2.3 shows that the dispersion of consumers' expectations is positively correlated with the square of the change in inflation, but that the square of the change in inflation is not correlated with the dispersion of professional forecasters' expectations. The third column shows that, conditional on average inflation and the square of the change in inflation, there has been no change in the dispersion of inflation forecasts since the global financial crisis. However, columns 4 and 5 show that in the post-global financial crisis period there was a change in the relationship between the level of inflation and the dispersion of consumers' inflation expectations.

9 We also examine the relationship between the dispersion of inflation expectations and the absolute deviation from 2% inflation. We find that disagreement about inflation is positively correlated with this absolute deviation from the 2% target. When we test whether there are differences between periods when inflation is above the target and periods when inflations is below 2%, we find that the relationship between inflation and disagreement among consumers is larger when inflation is below target (but the difference between the two regimes is not statistically significant) and that the relationship between inflation and disagreement among professional forecasters is larger when inflation is above target. These differences, however, only hold for one-year-ahead forecasts. When we focus on five-year forecasts, we find that the link between deviations from the target and disagreement about inflation is always larger when inflation is above 2%.

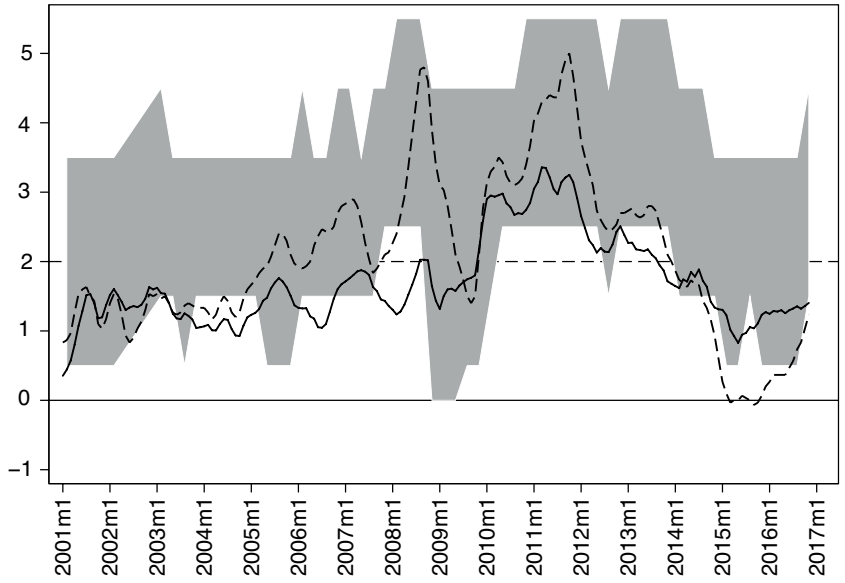
Table 2.3 Inflation and dispersion of inflation expectations

	(1)	(2)	(3)	(4)	(5)
Dependent variable interquartile range 1 year US inflation expectations					
Michigan Survey					
Inflation	-0.0108	-0.00475	-0.0225	0.0414	0.0547
	(0.0405)	(0.0393)	(0.0470)	(0.0554)	(0.0539)
Δinfl2		0.0757***	0.0754***		0.0783***
		(0.0264)	(0.0265)		(0.0298)
InflationD08				-0.268**	-0.287***
				(0.107)	(0.103)
Dinfl2D08					0.00836
					(0.0606)
D08			-0.101	0.382	0.421*
			(0.145)	(0.246)	(0.243)
Constant	3.924***	3.852***	3.924***	3.783***	3.685***
	(0.121)	(0.119)	(0.159)	(0.182)	(0.179)
Observations	128	127	127	128	127
Survey of Professional Forecasters					
Inflation	0.290***	0.285***	0.307***	0.377***	0.378***
	(0.0835)	(0.0836)	(0.1000)	(0.117)	(0.118)
Δinfl2		0.0225	0.0228		0.0445
		(0.0562)	(0.0564)		(0.0651)
InflationD08				-0.248	-0.248
				(0.226)	(0.226)
Δinfl2D08					-0.0721
					(0.132)
D08			0.126	0.568	0.641
			(0.309)	(0.519)	(0.530)
Constant	-0.0395	-0.0568	-0.148	-0.324	-0.378
	(0.249)	(0.254)	(0.338)	(0.383)	(0.391)
Observations	128	127	127	128	127
Dependent variable interquartile range 5 year US inflation expectations					
Michigan Survey					
Inflation	0.148***	0.130***	0.140***	0.218***	0.200***
	(0.0378)	(0.0266)	(0.0319)	(0.0556)	(0.0388)
Δinfl2		0.0341**	0.0342**		0.0374**
		(0.0159)	(0.0160)		(0.0180)
InflationD08				-0.186*	-0.170**
				(0.0941)	(0.0653)
Δinfl2D08					-0.00157
					(0.0362)
D08			0.0492	0.384*	0.378**
			(0.0890)	(0.221)	(0.156)
Constant	2.722***	2.709***	2.671***	2.512***	2.494***
	(0.105)	(0.0752)	(0.103)	(0.172)	(0.122)
Observations	109	108	108	109	108
Survey of Professional Forecasters					
Inflation	0.0588***	0.0626***	0.0803***	0.0916***	0.0983***
	(0.0148)	(0.0146)	(0.0172)	(0.0204)	(0.0201)
Δinfl2		0.0270***	0.0272***		0.0303***
		(0.00979)	(0.00969)		(0.0111)
InflationD08				-0.0571	-0.0651*
				(0.0394)	(0.0386)
Δinfl2D08					-0.00783
					(0.0226)
D08			0.101*	0.204**	0.227**
			(0.0530)	(0.0905)	(0.0905)
Constant	0.555***	0.529***	0.456***	0.437***	0.399***
	(0.0441)	(0.0442)	(0.0581)	(0.0668)	(0.0668)
Observations	128	127	127	128	127

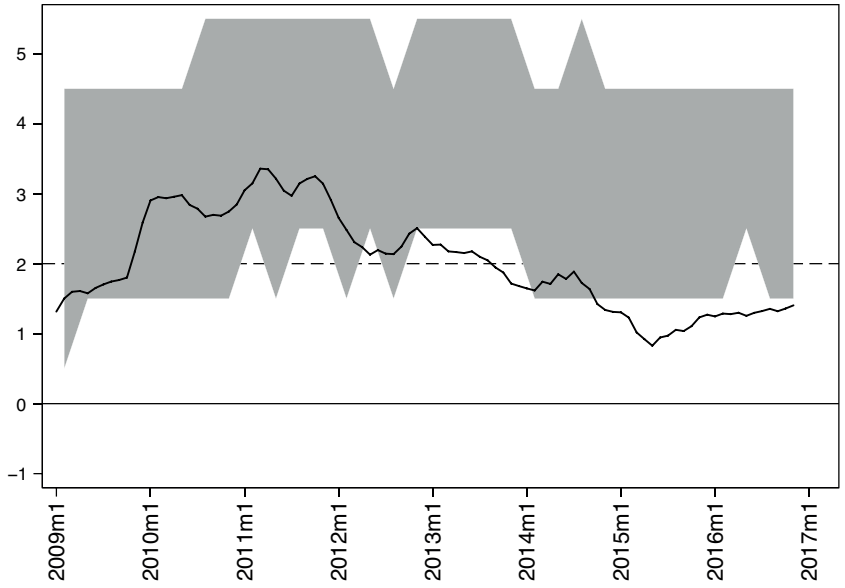
Figure 2.15 plots the dispersion of inflation forecasts for the UK and the Eurozone. In the case of the UK, we find that the dispersion of consumers' inflation expectations is slightly higher at a five-year horizon (which is the opposite of what we found for the US). This is also the case for the dispersion of Eurozone professional forecasters' expectations (which is in line with what we found for professional forecasters in the US).

Figure 2.15 Deviation from predicted inflation

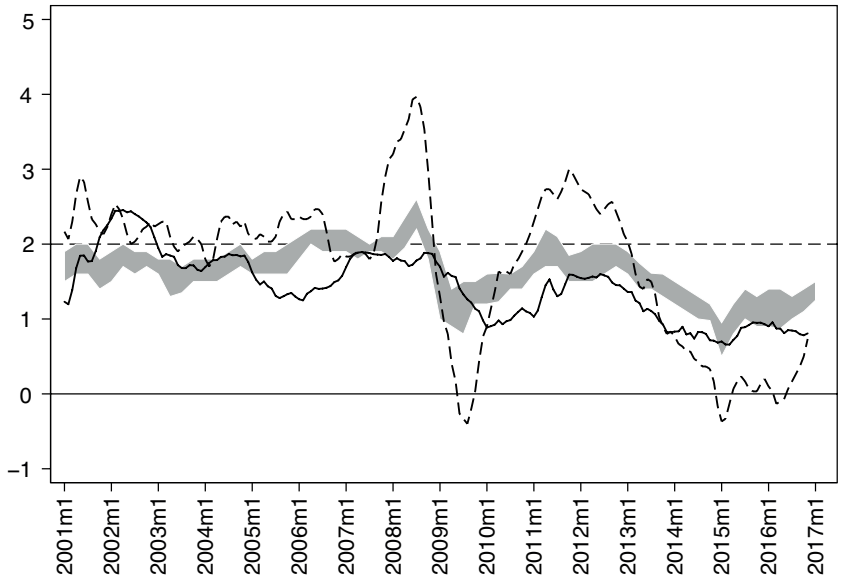
A: UK, consumers, 12 months



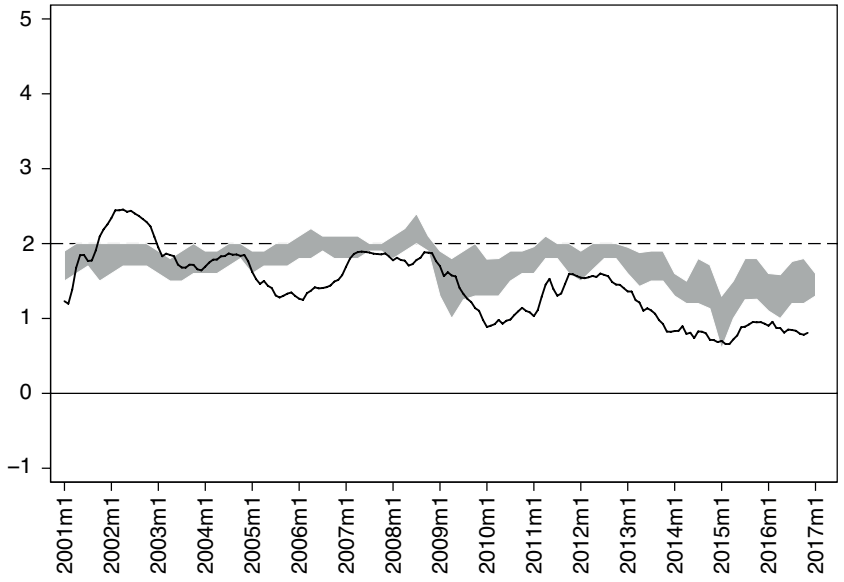
B: UK, consumers, 5 years



C: Eurozone, professional 12 months



D: Eurozone, professional 5 years



Notes: Deviation between actual inflation and predicted inflation. The model is estimated using pooled data for 19 advanced economies. The solid lines report median values and the shaded areas the interquartile range.

Table 2.4 Dependent variable interquartile of UK inflation expectations

	(1)	(2)	(3)	(4)	(5)
			One year ahead		
Inflation	0.113	0.0660	0.0677	0.349***	0.381**
	(0.0680)	(0.0707)	(0.0681)	(0.128)	(0.174)
$\Delta infl^2$		0.371*	0.320*		-0.106
		(0.192)	(0.187)		(0.391)
InflationD08				-0.318**	-0.372*
				(0.147)	(0.189)
$Dinfl^2D08$					0.433
					(0.448)
D08			0.357**	1.065***	1.059***
			(0.155)	(0.348)	(0.388)
Constant	2.611***	2.615***	2.428***	1.900***	1.854***
	(0.167)	(0.163)	(0.177)	(0.293)	(0.338)
Observations	58	58	58	58	58
R-squared	0.047	0.107	0.187	0.211	0.244
			Five years ahead		
Inflation	0.124**	0.116**			
	(0.0529)	(0.0544)			
$\Delta infl^2$		0.124			
		(0.162)			
Constant	2.885***	2.865***			
	(0.137)	(0.140)			
Observations	32	32			
R-squared	0.155	0.172			

Table 2.5 Dependent variable interquartile of Eurozone inflation expectations

	(1)	(2)	(3)	(4)	(5)
			One year ahead		
Inflation	-0.0249*	-0.0109	-0.00565	0.00624	0.00402
	(0.0134)	(0.0108)	(0.0124)	(0.0293)	(0.0258)
$\Delta infl^2$		0.123***	0.121***		0.0146
		(0.0185)	(0.0187)		(0.0758)
InflationD08				-0.0272	-0.00578
				(0.0347)	(0.0298)
$Dinfl^2D08$					0.115
					(0.0783)
D08			0.0212	0.0957	0.0190
			(0.0250)	(0.0721)	(0.0597)
Constant	0.397***	0.341***	0.324***	0.315***	0.318***
	(0.0265)	(0.0225)	(0.0308)	(0.0660)	(0.0540)
Observations	72	72	72	72	72
R-squared	0.047	0.420	0.426	0.083	0.445
			Five years ahead		
Inflation	-0.0998***	-0.0949***	-0.0856***	-0.0375	-0.0356
	(0.0121)	(0.0121)	(0.0139)	(0.0254)	(0.0283)
$\Delta infl^2$		0.0437**	0.0397*		-0.0121
		(0.0207)	(0.0208)		(0.0832)
InflationD08				-0.0709**	-0.0677**
				(0.0301)	(0.0327)
$\Delta infl^2D08$					0.0461
					(0.0859)
D08			0.0373	0.178***	0.161**
			(0.0278)	(0.0626)	(0.0655)
Constant	0.556***	0.537***	0.505***	0.406***	0.404***
	(0.0240)	(0.0252)	(0.0343)	(0.0574)	(0.0593)
Observations	72	72	72	72	72
R-squared	0.492	0.523	0.535	0.547	0.564

The top panel of Table 2.4 shows that over 2001-16, the dispersion of one-year-ahead inflation forecasts for the UK is not significantly correlated with the level of inflation, but that this correlation is positive for 2001-08 and essentially zero for the post 2008 period. The dispersion of inflation expectations at a five-year horizon is instead positively correlated with the level of inflation for the 2009-16 period (we do not have data prior to 2009). Data for core inflation show similar results.

Looking at the dispersion of professional forecasts for the Eurozone at a one-year horizon, we find no statistically significant effect of the level of inflation, but a positive correlation between dispersion and the square of inflation changes (top panel of Table 2.5). When we look at the dispersion of forecasts at a five-year horizon, we find a negative correlation between the level of inflation and the dispersion of forecasts (bottom panel of Table 2.5). However, this negative correlation is only statistically significant in the post-2008 period. Data for core inflation show similar results.

To conclude, data on disagreement show that inflation expectations were not quite as well anchored as the simple central tendency measure of expectations suggests, especially in the UK (where higher inflation led to higher disagreements, suggesting inflationary fears) and the Eurozone (where lower inflation led to higher disagreements, suggesting deflationary fears). There was significant disagreement, and market-based surveys responded sharply to policy announcements.

3 Refining theory and evidence on inflation

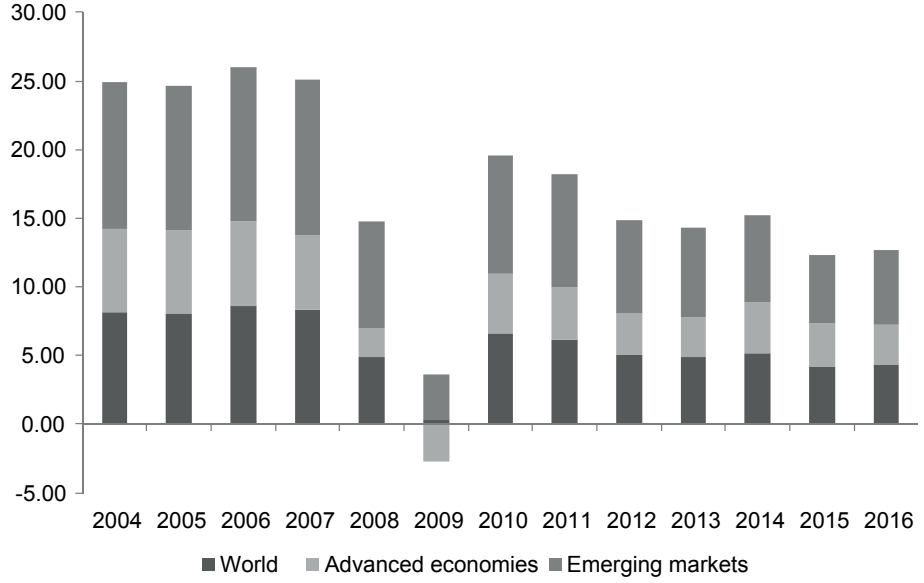
The previous chapter took a forensic look at the data on inflation and its drivers to help understand why inflation remained low and stable post 2010. The focus remained on relatively simple theories (what we sometimes refer to as 'Econ 101'). This chapter takes the analysis further by considering recent ideas developed by macroeconomic researchers and monetary policymakers which help in interpreting the events of the past decade.

3.1 Pure and persistent inflation: Commodity prices and global factors

As the previous chapter showed, commodity price inflation was a major reason why headline inflation stayed positive in most countries until 2014, and commodity price disinflation has been important in keeping inflation in check since then. Commodity price shocks are a prime example of a transitory relative-price shock. Hasenzagl et al. (2017) confirm their significance for recent inflation history using a time-series vector autoregression on a panel of data for the US – an approach which allows a more careful identification of different drivers of inflation than our simple calculations. They confirm our finding that commodity prices account for a large share of both the missing disinflation and the missing inflation after the financial crisis.

Commodity price inflation had been a major factor supporting inflation for most of the decade prior to the crisis – the Goldman Sachs Commodity Index increased at an average rate of 10% annualised during the period 1998-2008 (Figure 2.1). Aside from their direct stabilising effect on inflation, commodity prices may have also played an important role in keeping global demand elevated, thus reducing downward pressure on inflation, because they helped contribute to strong growth in emerging markets. The rise in commodity prices helped many emerging market economies keep both public finances and also inflation under control during this decade. Thanks to the improvements in their fundamentals and their policy frameworks during the post-1998 period, emerging market economies were able to deploy countercyclical policies to support growth after 2007. They were a major driver of the resilience of global growth in this period: in 2009, emerging economies contributed all of the world's GDP growth (measured in PPP terms), according to the IMF's measure (Figure 3.1).

Figure 3.1 Annual GDP growth, PPP (in percent)



Global factors played a further role in inflation after 2010. The increase in competition in global markets has probably meant that the law of one price is closer to holding for more goods. This means that if the nominal exchange rate is held fixed, or not allowed to vary much, domestic and foreign inflation must be closely aligned. If instead the nominal exchange rate is flexible, the combination of most advanced counties adopting a similar 2% inflation target and the existence of global financial cycles and shocks again means that domestic and foreign inflation are more closely linked. Even if an economy pursues an independent monetary policy and has its own inflation target, if that economy is large (like China) or consists of several less-developed countries working in the same direction, there will be greater linkage between its inflation and that of the rest of the world – subdued inflation in that economy transmits into subdued inflation in the advanced countries.

One way in which this reflects itself is through wage moderation. With more varieties of goods facing competition from Chinese and other emerging-market imports, labour unions in advanced economies are wary of making higher wage demands for fear that this will lead to a large decrease in domestic production and higher unemployment. This keeps domestic prices relative to foreign prices in line, attenuating inflation pressures in spite of slacker or tighter labour markets. So, international factors, beyond commodity prices, may have played an important role in keeping inflation low and stable, though the direct evidence for this is rather thin.[10]

10 Bianchi and Civelli (2015) use a time-varying vector autoregression model to test the inflation globalisation hypothesis, which suggests that global economic slack has replaced the domestic output gap in driving inflation. They find that global slack affects the dynamics of inflation in a number of countries but that this effect is not large enough to explain possible changes in inflation dynamics. Auer et al. (2017) discuss further reasons why global value chains may contribute to keeping inflation low.

3.2 The Phillips curve: Marginal costs and mark-ups

In Chapter 2, we showed that the Phillips curve changed slope and shifted with the crisis, so that forecasts that used pre-crisis estimates of the curve made large forecast errors. The 2007-10 US recession was the deepest since the Great Depression, but inflation fell only modestly: the annual change in the CPI was precisely the same (at 2.8%) in December 2009 as it was in September 2007 even though the civilian unemployment rate was 5.2 percentage points higher.

The modern Phillips curve replaces real activity with real marginal costs. It is because costs rise that firms want to increase prices and that inflation results. Marginal costs are often tightly linked to real activity, but not always. Both current and expected future marginal costs matter. Even though the current unemployment rate or other measures of slack are usually correlated with current marginal costs, they may not be correlated with future marginal costs. In particular, if the recession of 2008-10 was due to financial shocks, these same temporary shocks might have raised the marginal costs of financing by firms, but had little impact on their future marginal costs. This might be partly due to the aggressive monetary policies aimed at preventing a longer financial slump. As a result, the effect on current inflation may have turned out to be low (Del Negro et al., 2015).

Chapter 2 documented that Phillips curves became flatter after 2008, and that the coefficient on unemployment either declined or became insignificant in the post-crisis period. One reason may be the presence of downward rigidity in nominal wages. Figures 3.2 and 3.3 show the evolution of nominal wage growth and of unit labour cost (ULC) growth in the US, Eurozone, UK and Japan. They show a gradual but small reduction in wage growth, which remained positive during the period despite the large increase in unemployment. There were declines in nominal wages in some countries and sectors but, overall, wage inflation remained very stable. This rigidity of labour market institutions may have contributed to keeping inflation expectations better anchored.[11]

Focusing more on marginal costs, rather than real activity, suggests the relevance of mark-up shocks as an extra factor in the Phillips curve. Higher mark-ups imply that firms want to raise their prices relative to the cost of what they produce. With flexible prices this would have no effect on inflation, but would lead to lower output. With nominal rigidities, instead, higher mark-ups raise inflation and cause a recession. During a financial crisis, firms that are liquidity constrained will value internal funds, as it is expensive to obtain external financing. Therefore, even though lower demand would induce them to lower prices, the need for liquidity will compel them to hold prices (or even raise them) in order to prevent revenues from falling as much. These firms will lose customers and thus future sales, but when liquidity is constrained this future loss may be worth the short-term benefits in revenue and cash flow. Financial conditions on a global scale may also be an important determinant not just of mark-ups but also of marginal costs by affecting the cost of financing. This can mean that in a financial crisis when interest rates spike up, prices will not fall and

11 Wage rigidity may, however, have amplified the unemployment effect of the great recession (Bakker, 2015). There is also evidence that the acyclicality of average wages during the great recession was driven by changes in the composition of the labour force rather than by wage rigidity in specific sectors (Verdugo, 2016)

may even rise in spite of weak demand for goods (Gilchrist et al., 2017). This may explain why prices did not decline as much as might have been expected given the size of the recession. Figure 3.4 shows that at the peak of the great recession firms did not decrease prices.

Figure 3.2 Nominal wage growth (in percent)

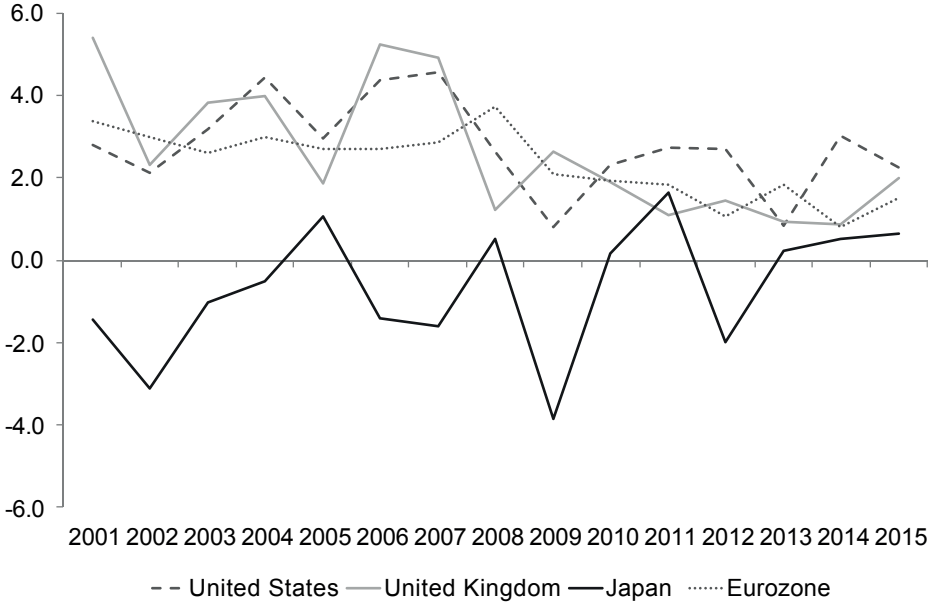
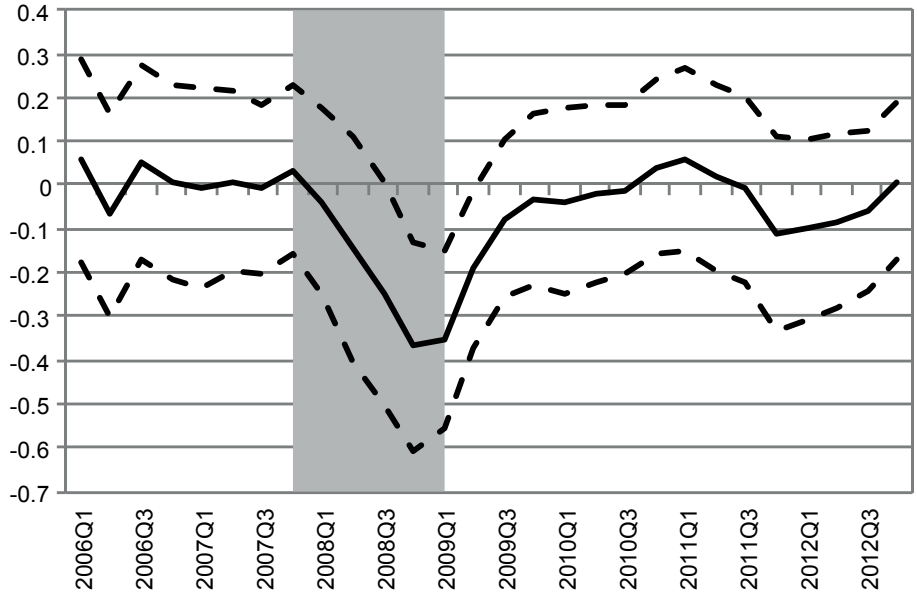


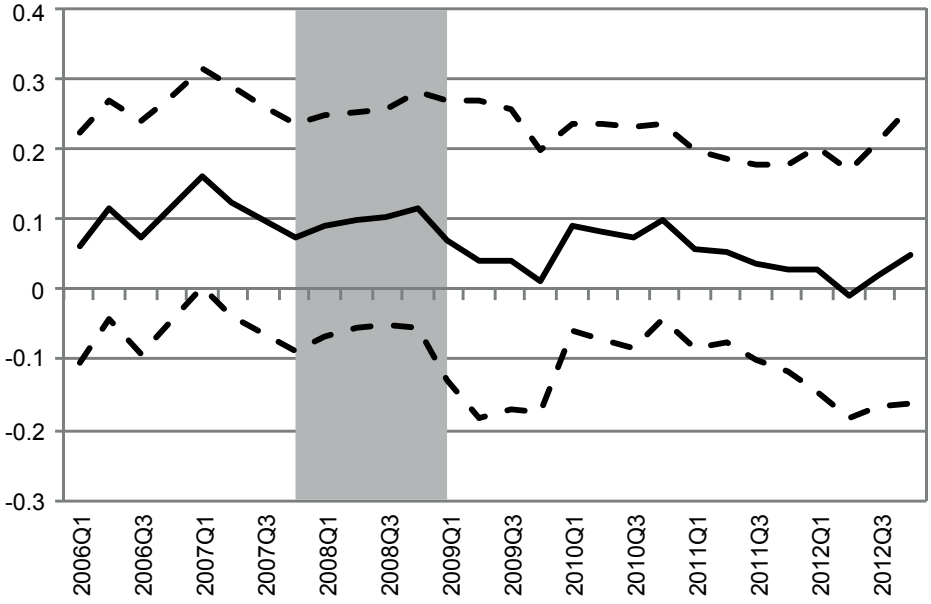
Figure 3.3 Unit labout costs (annual percentage change)

Figure 3.4 The cyclical behaviour of price adjustments

A: Probability of a price increase



B: Probability of a price decrease



Source: Figure 4 in Gilchrist et al. (2016).

Finally, modern theory does not predict that the Phillips curve must be linear. If there are kinks in wage or price setting by individual firms and workers, then the Phillips curve is instead predicted to be convex (Akerlof et al., 2000, Benigno and Ricci, 2011, Dupraz, 2016). On the side of workers, there is abundant evidence of downward nominal wage rigidity, whereby nominal wage cuts are infrequent, so that times when the growth of aggregate wages is smaller are times when the distribution of wage changes across workers is more bunched at zero; Fallick et al. (2016) provide evidence of downward rigidities for the US, and Izquierdo et al. (2017) for the Eurozone. This leads to a convex Phillips curve, because when inflation is lower, changes in prices are not offset by changes in wages but instead lead to large changes in hours worked. On the side of firms, if demand curves for individual goods are kinked because consumers are loyal to suppliers and only search for alternatives when prices rise significantly, this again leads to convexity of the Phillips curve. Altogether, rigidities in the structure of the economy may have contributed to keeping inflation more stable. These rigidities allowed the economy to trade a less volatile adjustment for a longer period of adjustment. This suggests that there may be an optimal level of flexibility in economic institutions, and that more flexibility may not always be better.

All in all, modern theory goes well beyond predicting a simple relationship between unemployment and inflation. Instead, aggregate demand and nominal rigidities imply that inflation is jointly determined with expected inflation, present and future marginal costs, and mark-ups in a possibly non-linear way. From this joint relationship, one can get different, and time-varying, correlations between inflation and real activity, even if the Phillips curve remains a useful tool with which to understand inflation dynamics.

In the case of inflation in the last few years, insofar as expected inflation stayed high, expected marginal costs remained high. Mark-ups increased as a result of the financial shocks. On top of this, the Phillips curve is convex. These were all factors behind inflation staying up despite large falls in employment and output in the wake of the financial crisis.

3.3 Interest rates: Fisherianism and inattention

Chapter 1 noted that in spite of interest rates being stuck near zero for more than seven years in most advanced economies, inflation never became unanchored. Even before that, the correlation between the level of nominal interest rates and inflation was weak, with inflation predicting nominal interest rates rather than the other way around.

As noted in Chapter 1, the Fisher equation, $i_t = r_t + E_t(\pi_{t+1})$, links nominal interest rates i_t at t that pay off at $t+1$, real interest rates r_t, and expected inflation between t and $t+1$, denoted by $E_t(\pi_{t+1})$. In the long run, expected inflation is approximately equal to actual inflation, so dropping the time subscripts to describe a long-run relation we have: $i = r + \pi$. Moreover, in the long-run, permanent changes in nominal variables are expected to have no effect on real variables, so we can take the real interest rate as fixed. Therefore, permanently higher nominal interest rates increase inflation by the same amount. This is the textbook Econ 101 Fisherian effect.

However, in the short run, people adjust their expectations slowly and imperfectly to news. They do not pay attention to every new event, but instead update themselves on what is going on from time to time. So, it is as if information is sticky, disseminating gradually over the entire population. Therefore, when central banks temporarily and unexpectedly raise nominal interest rates, expected inflation does not increase right away one-to-one. Roughly speaking, it is $E_t(\pi_{t+1})$ rather than the real interest rate r_t that does not change on impact. Therefore, when central banks raise nominal interest rates, this raises the real interest rate. Higher real interest rates contract current aggregate demand because households want to save more and spend less, and firms want to cut investment. This decline in aggregate demand puts downward pressure on prices set by firms. A higher real interest rate lowers inflation. Therefore, temporarily unexpected higher nominal interest rates lower inflation. In the short run, Fisher meets Keynes and higher nominal interest rates lower inflation (see Box 3.1 for more details).

The data on inflation expectations confirm this perspective. Chapter 2 showed that surveys of inflation expectations were quite sticky during this period, consistently overestimating both actual (current) and future inflation. While the strong anchoring of household inflation expectations played an important role in keeping inflation stable, it may sow the seeds of future inflation volatility. In models of inattention, periods of stable inflation lead agents to stop noticing inflation so that their expectations are both more anchored in the sense of less volatile, but also based on worse information. Following a large enough shock that makes people pay attention, inflation could suddenly change, in part precisely because of the previous stability.

A growing literature investigate what drives inflation expectations and what could trigger changes (see, for example, Orlik and Veldkamp, 2014; Armantier et al., 2016; Coibion et al., 2017; and Sundaresan, 2017). For instance, short-term inflation expectations (say, one-year ahead), seem to co-move with the price changes of specific items, but the size of the co-movement is in general associated with the share of the items in the consumption basket. There is also some weak evidence that expectations react to prominent prices, such as the price of gasoline. This may have helped keep inflation expectations from declining during the peak of the crisis, as headline inflation remained quite high.

Theories of sticky information (Mankiw and Reis, 2002; Carroll, 2003) suggest that information diffuses slowly through the population and that consumers may follow the lead of professional forecasters. Surveys of professional forecasters were also rather stable (recall Figures 2.7-2.9). Abstracting from the near-term forecasts, which are driven by the volatile components of inflation, the five-year-ahead forecasts were always showing a return towards the inflation targets (although with a small downside drift in the Eurozone). This could be due to the credibility of the inflation target, to the forecasting methods of forecasters (which have a bias towards returning to the steady state), or both. Either way, their stability further contributes to the stability of inflation expectations.

Recently, a small academic literature has tried to come up with conditions under which, even in the short run, the Fisherian effect may dominate. These typically include nominal interest rates being stuck at zero and kept there for a long time into the future (often indefinitely), and the use of a class of sticky price

models in which inflation is a purely forward-looking, jump variable. But once one takes into account that the low pegged interest rates are a temporary policy, and that there is inertia in inflation and expectations, these results become increasingly unlikely or go away entirely.

BOX 3.1 A note on the neo-Fisherian view

Even with flexible prices and expectations, there is an important distinction between permanent and temporary increases in nominal interest rates. This distinction is made clear by the modern focus on interest rate rules, as opposed to the level of interest rates per se. The simplest example of such a rule is one whereby the central bank sets the interest rate as:

$$i_t = \pi^* + \phi(\pi_t - \pi^*) + v_t.$$

The first component is an intercept corresponding to an inflation target. If it changes, it does so permanently. The second component is a reaction of interest rates to when inflation deviates from target, with a coefficient $\phi > 1$ as postulated by John Taylor. This plays the role of ruling out self-fulfilling beliefs where people expect higher prices and set higher prices, by imposing that such belief would explode into infinite inflation. The third component is a temporary shock to monetary policy, which could for instance include measures of real activity like real interest rates, output, or unemployment, perhaps as deviations from some natural or equilibrium level.

Combining the previous equations with the equation for the real interest rate, iterating forward, and imposing that inflation cannot be expected to explode, gives the solution for inflation:

$$\pi_t = \pi^* + \sum_{j=0}^{\infty} \varphi^{-j-1} \left(r_{t+j} - v_{t+j}\right)$$

A higher inflation target means higher interest rates forever, and higher inflation forever – the Fisher effect. But temporary increases in interest rates that are not justified by higher real interest rates (that is, a positive v_t) lower inflation. Confusing the two can lead to 'neo-Fisherian' proposals to raise interest rates in order to raise inflation, without carefully distinguishing whether the proposal is to announce a higher inflation target, or to temporarily increase the policy rate.

This equation also makes clear that financial shocks will affect inflation. If one adds risk premia to the Fisher equation, and term premia linking interest rates of different maturities, then the equation above would be modified by these premia terms. They would show up just as changes in r_t, and so affect inflation.

Most careful empirical work on the topic has found that higher nominal interest rates lower inflation. But in recent years the central bank policy rate has been at zero, or close to zero, in most advanced economies. Therefore, the link between inflation and nominal interest rate has become harder to test, since there is little variation in interest rates. This does not imply that central banks suddenly became powerless to control inflation, deprived of the use of their main policy tool. But it also did not mean that to raise inflation, central banks should just raise the nominal interest rate. Rather, it implied that they had to use unconventional monetary policies, in part to inform people about their future intentions for short-term interest rates.

Future changes in interest rates affect deviations of inflation from target in the future, affecting expected future inflation and influencing some interest rates today, which in turn has an impact on current inflation. By following rules, the central bank communicates paths for future interest rates and lets the 'no arbitrage' condition between real and nominal investments captured by the Fisher equation spread through inflation at all dates. This implies that even when interest rates are zero today, announcements of likely levels of interest rates tomorrow will have some effect on inflation today. This is commonly known as 'forward guidance'.

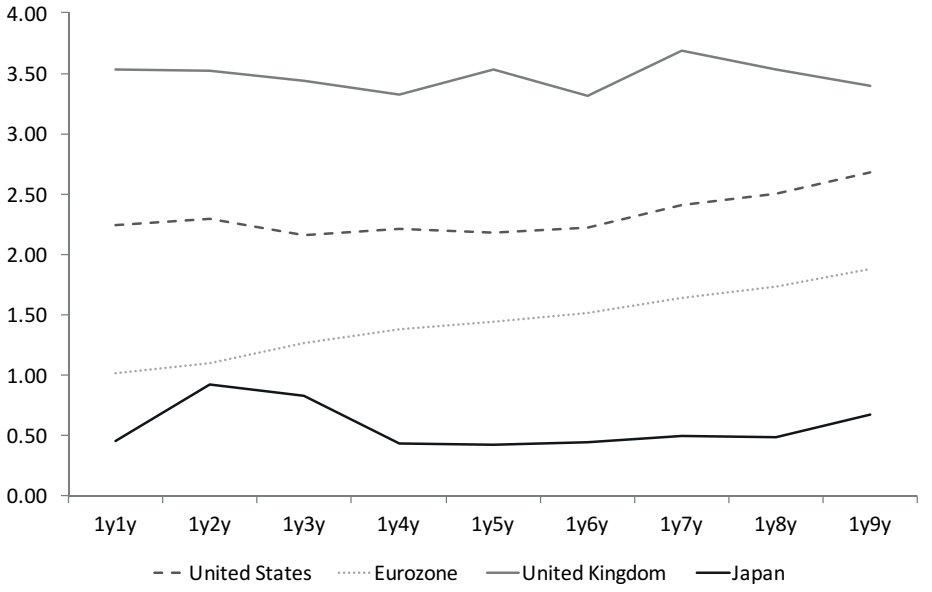
A recent literature has examined the response of inflation to news about future monetary policy (for a summary, see Swanson, 2017). This literature unanimously finds that higher nominal interest rates lower inflation. Forward guidance, and other policies, kept inflation under control by making and adjusting announcements about future interest rates. At the same time, because forward guidance influences inflation by relying on 'no arbitrage' conditions along the yield curve, financial shocks now affect inflation. If one adds risk premia to the Fisher equation, and term premia linking interest rates of different maturities, then these premia terms become a further driver of inflation.

Market expectations of inflation did not show much sign of getting stuck significantly below target in the US and UK. However, they showed more signs of being consistently under that target in the Eurozone, where the central bank's mandate deviates more from a clearly symmetric target and (more significantly) where policymakers were slower to embark on the kind of aggressive easing strategies adopted by the Fed and the Bank of England. But even in the Eurozone we did not see anything that really looked like a deflation spiral. The UK seems to be the place where inflation expectations were most solidly anchored, partly a result of the Bank of England's willingness to conduct very expansionary monetary policies while headline inflation was high, which may have reinforced the belief in its commitment to a symmetric inflation target.

Figure 3.5 shows a measure of the term structure of inflation expectations (as of April 2017) with market forecasts of inflation over the next ten years. It suggests that inflation expectations were well anchored in the UK. (The UK inflation swaps are indexed on the retail price index, a rate of change which is typically higher than the consumer price index; therefore, expectations of 3% retail price inflation are compatible with 2% consumer price index inflation). Expectations were somewhat well anchored in the US. (Prior to 2007, these US inflation swaps showed expected inflation at around 2.5%, which would be compatible with

personal consumption expenditure inflation of 2%). In both the US and UK, the expectation was for inflation (which was then near target) to stay fairly flat. Expectations seemed to be less well anchored, or at best anchored below the inflation objective, in the Eurozone.

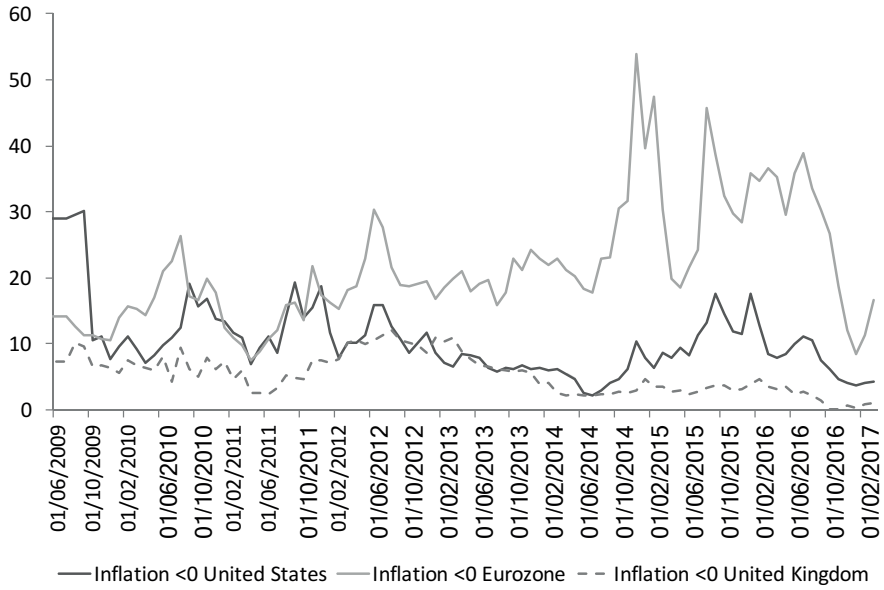
Figure 3.5 Term structure of inflation swaps (in percent)



Finally, looking at the tails, and not just the central tendencies of the distribution of expected inflation, gives an idea of whether inflation is seen as possibly suddenly getting out of hand. Figure 3.6 shows the market-implied probability (extracted from inflation swaps caps and floors) of average five-year inflation being negative in the US, the Eurozone, and the UK.[12] It shows that the implied probability of inflation being consistently below zero has been higher in the Eurozone, and reached worrisome levels during 2014, before the ECB embarked on its quantitative easing programme. It remained elevated even after quantitative easing was started, probably driven by the sharp fall in commodity prices in 2015. It also remained significant in the US. As commodity prices subsequently moved higher, the market-implied probability of deflation has declined.

12 The methodology used to extract the implied probability follows Kitsul and Wright (2012). We use daily quotes of zero coupon five-year inflation floors at strikes of -1% and 0% caps, and consider a strategy that consists in selling a 0% cap and buying a -1% cap. This is an Arrow Debreu security that pays $1 if inflation is below 0%, and zero otherwise. Let $p(0,n)$ denote the probability that $\pi(n) \leq 0$. A risk-neutral investor will pay $P = e^{(-r(n)n)}\, p(0,n)$ for this Arrow-Debreu security, where $r(n)$ denotes the continuously compounded interest rate for n years. Using the cost of constructing such a security, and given interest rates, we construct the implied probability of negative inflation.

Figure 3.6 Market-implied probability of five-year average inflation > 0 (in percent)



3.4 Quantitative easing: From monetarism to reservism

No central bank in an advanced economy now targets the growth rate of a monetary aggregate. Many, like the Federal Reserve, have even stopped constructing data on broader monetary aggregates. Instead, central banks today focus on setting interest rates. If, for any given interest rate, people demand more currency, the central bank simply supplies it. If they wish less currency, the central bank gives people back interest-paying reserves in exchange for their currency. Any change in the demand for currency is accommodated by the central bank by changing its supply, with little to no consequence for inflation.

Aside from currency, central banks control a different kind of money – reserves. These are deposits by banks at the central bank that earn an interest set by the central bank. They exchange one-for-one with currency, so they are the unit of account in the economy, and as such are default-free in nominal terms. When reserves are scarce, there is a demand for the liquidity they provide. The higher this demand is, the lower the interest rate paid on a given quantity of reserves can be. Before 2008, a central bank would issue or retire reserves in exchange for short-term government bonds in so-called open-market operations. This affected the market short-term interest rate and, through that, inflation. Changes in the quantity of reserves endogenously changed to accommodate changes in the demand for liquidity by banks in order to reach an interest rate target, so that the quantity of reserves, while an indicator of the stance of monetary policy, was not its causal lever.

The situation changed across the developed world after the 2008-10 crisis when the amount of interest-paying reserves increased by orders of magnitude. When reserves are abundant, the market is satiated with reserves, so the demand for them is horizontal. By controlling both the vertical supply of reserves and the

interest paid on them, which is what pins down where the horizontal demand for reserves is, the central bank now has access to two independent tools. The quantity of reserves, affected by policies such as quantitative easing, is a tool that can be used to promote financial stability or to provide liquidity as a public good, especially in response to a financial crisis. The interest on deposits at the central bank determines short-term interest rates and, through these rates, ultimately inflation. In the case of the Federal Reserve, this is the overnight reserve repurchases programme rate together with the interest paid on reserves. In the UK it is the Bank Rate set by the Bank of England, and in the Eurozone it is the main refinancing operations rate. Private overnight interest rates closely mimic these policy rates, which are directly set rather than targeted by the central bank.

The total amount of currency or credit in the economy, which are beyond the control of policymakers, are still useful indicators. Their movements reflect changes in households' and firms' desire for liquidity and for means of payment. This is the modern role of money and credit, as indicators, not as policy variables or as direct determinants of inflation.

In turn, broader monetary aggregates, which add to the monetary base several measures of the liabilities of the banking sector, are used today in a very different way compared with what is taught in Econ 101. Even if MV = PY is no longer useful, credit aggregates or financial indicators can be a useful gauge of wider forces that will affect inflation. Instead of the demand for liquidity, the focus is on its supply, and the role of the financial sector. Broader measures of money are then useful because they reflect the creation of private money, through the ability of financial intermediaries to take on risk, and because they measure the size of the balance sheet of broker dealers that affect credit and economic growth (Adrian and Shin, 2008; Brunnermeier and Sannikov, 2013). Such measures are more useful as indicators of financial stability risks than as predictors of inflation.

3.4 Central banks as fiscal agents

As with most modern macroeconomics, the modern study of inflation is deeply influenced by general equilibrium considerations. Macroeconomic variables are not affected by just one policy but by the joint interaction of monetary and fiscal policies. Modern theory identifies several of these interactions.

The fiscal stance can affect real activity. Public sector deficits or fiscal tightening may cause recessions and booms, and in doing so affect the extent of unemployment and the value of real interest rates. Through the Phillips curve, this will spill over to inflation, although given the flatness of the Phillips curve this effect may be small.

Fiscal policy may also affect the desirability of inflation, and so influence inflation expectations. If the public debt grows very large, and its maturity is not too short, then higher inflation becomes a tempting way to pay for it. When inflation rises unexpectedly, the real value of the debt falls and so the real taxes that must be raised are lowered. Investors in these bonds anticipate this temptation, so they will raise their inflation expectations, increasing the required return on bonds today. This feeds in to higher inflation right away.

This channel is potentially important for advanced countries, given their current high public debt. Moreover, given the fragile state of public finances in Europe, with limited ability to generate future fiscal surpluses to pay for outstanding debt, it is possible that fiscal policy will become the dominant factor in forcing an increase in inflation. In a situation where the fiscal authority is unable or unwilling to raise the primary surpluses needed to pay for the debt, monetary policy will have to fill the void. Either by printing currency to generate seignorage revenues, or by maintaining low interest rates to reduce debt servicing, higher inflation results.

In a situation where inflation is stubbornly low, fiscal policy may offer a way to raise inflation expectations and, eventually, inflation. If there is a fiscal expansion together with a commitment to not pay for it through future taxes or spending, then the government budget constraint implies that inflation must rise. By behaving irresponsibly in a fiscal sense, the government can make it inevitable that inflation must rise. No government has convincingly done so yet, and in fact austerity for the most part pushed in the opposite direction.

Losses and gains on the balance sheet of the central banks also have fiscal effects. One danger of having a large balance sheet is that it exposes the central bank to losses. The danger does not come from paying interest on reserves per se. After all, assets are being held against these reserves, and they will almost always pay at least as much interest as reserves do. The danger is also not necessarily from the size of the balance sheet: if the central bank issued reserves to solely buy short-term government bonds, then assets and liabilities would be roughly matched, and this would only substitute one government liability for another, with possibly second-order effects on the economy.

The danger is instead that by issuing overnight liabilities and buying long-term assets, central banks engage in maturity transformation and expose themselves to the associated interest rate risk. By issuing safe reserves to buy risky private bonds, they expose themselves to the risk that these securities may default. If the yield curve suddenly steepens, either because central banks start raising rates or because term premia go up, then the central bank can make large losses. If the private securities on which the Bank of Japan has started investing return less than expected or if some of the sovereign bonds that the Eurosystem has bought turn out to default, then then these central banks may make losses as well.

Insofar as these losses are automatically absorbed by the fiscal authorities, through either smaller dividends or recapitalisations of the central bank, then this is of little consequence. But if this fiscal support is lacking, then inflation may be affected in two ways. The first and more radical (but also less likely) of these is that the central bank could become insolvent, in the sense that it cannot honour the remuneration commitments made to the banks holding reserves. The price level would then jump up. The chances of this happening in advanced economies seem very remote. The second and more likely is that a central bank that must turn to the fiscal authorities to cover its losses will lose some of its independence. The large balance sheets we noted in Chapter 2, if they expose the central bank to losses, make it more likely that inflation targets will be raised or that fiscal dominance takes over in order to satisfy the fiscal authorities (Reis, 2017).

3.5 A preliminary assessment

This report has discussed many different perspectives on inflation to try to understand what has happened since the financial crisis. Since 2010 inflation has been low and relatively stable, slightly but significantly below its 2% target. Naïve accounts that merely look at unemployment, nominal interest rates, monetary aggregates, or commitment problems facing central banks and fiscal authorities cannot explain this outcome. Taking into account the role of commodity prices, the anchoring of inflation expectations, shifts in the Phillips curve, changes in mark-ups of prices over costs, the change in central bank liabilities from currency to reserves, and the impact of policy announcements makes the outcome less puzzling. In considering both the recent past and the future trajectory of inflation, the components of central bank balance sheets, and the fiscal consequences of central bank actions, are significant.

In the end, we have a more nuanced view of what determines inflation, but one that leaves many questions unanswered. What is the precise channel through which the Phillips curve becomes convex? What is the effect of globalisation on the link between marginal costs and inflation? Which parts of the distribution of inflation expectations can be used to assess the likelihood of future run-ups in inflation? How does people's inattention interact with inflation that is stable for very long? Through which channels does quantitative easing have an effect on the economy? How credible can policy be when it consists almost exclusively of announcements about the future? How safe is the independence of central banks as their fiscal role changes?

We consider some of these big questions as we turn to policy issues raised by recent events.

4 Good luck or good policies?

In previous chapters, we established that, at the conceptual level, many of the standard assertions about inflation have not been supported by the post-crisis experience. The behaviour of inflation has been puzzling: during the post-crisis period, one could identify both a 'missing deflation' and a 'missing inflation' episode. Inflation has been too high and too low relative to fundamentals, and overall low and stable but below its target. Despite the size of the shocks that hit the global economy, inflation after the Great Recession rarely dipped into negative territory and, when it did, it did not stay there for long. Was this the result of good luck, or good policies? At the same time, inflation has been lower and more volatile than the pre-crisis average. And, a decade after the crisis, inflation in the developed world is struggling to return to 2%. Has it been bad luck, or bad policies? Or a bit of everything?

The answer to these questions is critical to determine the path ahead. The post-2007 period not only witnessed major cyclical economic volatility, but also a period of deep and active experimentation and innovation in monetary policy (Ubide, 2017; Blinder et al., 2017). Central banks deployed a significant amount of monetary easing, cutting rates to zero and, in some places, to negative territory, deploying large asset purchase programmes, and adopting aggressive forward guidance strategies. There were differences across countries – dictated mostly by the different economic structures but also by institutional and political constraints – but a few features were common across the main central banks. Monetary easing initially focused on rate cuts and credit easing (mostly purchases of private assets and liquidity provision) to repair the damage to financial intermediation created by the crisis. Later on, this monetary easing transitioned into quantitative easing, a strategy focused on the purchases of large amounts of assets (mostly government bonds, but some central banks also purchased corporate bonds, equities and Real Estate Investment Trusts) deployed over long periods of time, aiming at reducing term premia and boosting asset prices. As the supply of available government bonds for purchase shrank, the Bank of Japan redefined the quantitative easing strategy from a focus on quantity targets to a focus on managing the slope of the yield curve, so-called yield curve control (i.e., the Bank of Japan's policy stance since November 2016 is defined by two interest rates: an overnight rate of -0.1% and a ten-year Japanese Government Bond rate of 0%).

Forward guidance reinforced quantitative easing by providing markets with a framework to evaluate the future path of policy in a context of never-tried-before policies. This forward guidance initially focused on calendar guidance but, as inflation struggled to return to target, evolved into state-contingent guidance. A key element of this forward guidance was providing a roadmap for the lift-off, communicating to markets that, when the time came to raise rates, the process would be gradual, that rates would probably spend a long period of time below

neutral levels, and that the neutral interest rate is likely lower than in previous cycles. This guidance was successful and contributed to avoiding a premature tightening of financial conditions that could have aborted the incipient global recovery when it started to gather strength.

This aggressive monetary easing was offset by a steady and significant tightening of fiscal and macroprudential policies. The balance of this policy mix was difficult to calibrate. There was no prior experience with most of the monetary policy actions. The macroprudential policies were patchy, deployed with different intensity in different jurisdictions, and with uncertain effect. And fiscal policies were coloured by the impact of the Greek default and tightened with little regard to the likely impact on growth. Monetary policy had to deploy an extra effort, to support demand and to offset the contractionary impact of these other policies. There is a vast literature that has tried to estimate the impact of these monetary policy actions (for a summary, see Ball et al., 2016; IMF, 2013). The weight of evidence suggests that monetary policy has been successful in affecting financial conditions in the desired way, and that the impact of this easing of financial conditions on growth and inflation has been positive, though the range of estimates is wide.

With this context, we now look at some specific outcomes of the policies adopted and assess whether they were driven by good or bad policies and/or good or bad luck.

4.1 Monetary policy and slack

Beyond having to offset the impact of other policies, monetary policy faced numerous uncertainties. The surprising stability of inflation documented in previous chapters made central banks think that most of the damage from the crisis was structural, and that the liquidity deployed initially during the crisis had to be carefully watched and its removal carefully prepared (Blinder et al., 2013). If inflation didn't decline much, the thinking went, it must be because the output gap wasn't large despite the depth of the recession. There were abundant concerns that the large amount of liquidity injected into financial markets could evolve into high inflation. In fact, central banks were, in 2010, already contemplating the exit (Bernanke, 2010). The Bank of England discussed raising rates in 2011, and the ECB hiked rates twice in 2011.

To some extent, central bankers had been lucky in their fight against deflation, whether they realised it or not. As documented in Chapter 3, the strength of commodity prices, and the widespread downward nominal rigidities in the face of what had been a very rapid increase in unemployment, were keeping inflation transitorily higher than what the Phillips curve may have suggested. Of course, it is also possible that it wasn't just luck. It is possible that the large monetary easing deployed by central banks was a main driver of high commodity price inflation, and therefore that the stability of inflation was the result of monetary policy, but through a different channel than what central banks had initially expected.

But, at the same time, monetary policy was not paying enough attention to the structural transformations that were happening in the real economy. The effect of globalisation, the rapid pace of technological development, the sheer size of the recession, and reforms introduced in some European countries had further

weakened the bargaining power of labour. As a result, while monetary policy focused on closing output gaps and potential inflationary spikes, the labour market had moved to a new post-crisis equilibrium, with more job creation and less wage growth. The effect has been a significant reduction in the estimates of the non-accelerating inflation rate of unemployment (NAIRU). For example, the Fed has steadily lowered its estimate of the NAIRU (published in the quarterly Summary of Economic Projections) from 5.6% in 2011 to 4.6% in 2017. The Bank of England has also been steadily lowering its estimate of the NAIRU, going from around 6.5% in 2013 (Bank of England, 2013, p. 34) to around 4.5% in May 2017 (Bank of England 2017, p. 20). It is not just the *amount* of slack that is bigger; it is possible that the *quality* of slack may have changed. Both the Fed and the ECB have discussed the possibility that the unemployment rate may not provide a complete description of the amount of slack in today's economy, and that more extensive measures of unemployment that include workers considered 'underemployed' provide a better description of the amount of available slack (Cœuré, 2017 a).

In hindsight, there was more slack than central bankers thought, and policy could have been more aggressive – or at least less cautious about the potential inflationary risks and more symmetric about the risks to price stability. Such excessive caution – no doubt clearer with the benefit of hindsight – may have played a role in the sluggishness of inflation in recent years. In the Eurozone, the mismeasurement of slack led to a premature tightening of policy in 2011 and to a delayed recognition of the intensity of the disinflationary pressures. In the US, it may have led to a premature beginning of the tightening cycle and to an overly tight fiscal stance. In the UK, it may have led to excessive concerns about wage inflation and the need for fiscal prudence.

4.2 Monetary policy and the symmetry of the inflation target

A lack of symmetry with respect to the inflation targets has been at times a feature of the monetary policy strategies adopted by some central banks. Often the inflation objectives have been interpreted, in practice, as ceilings rather than as midpoints. In 2016, the Fed amended its "Statement of longer run goals and monetary policy strategy" with the objective of stressing the symmetry of its inflation objective (Federal Open Market Committee, 2016). However, the Fed, in its Summary of Economic Projections, has never forecasted inflation above target. In some ways that is puzzling. The Fed's forecast is supposed to be done under optimal policies. After a long period of inflation below target, a flexible inflation targeter might aim for a period of inflation above target in order to stabilise inflation expectations at the target. In the long run, it is unlikely that inflation expectations will remain close to 2% if inflation doesn't average 2% over the cycle. If there is mean reversion in inflation, a negative shock that pushes inflation below target will slowly be absorbed and inflation (and expectations) will eventually go back to the 2% target, even without a symmetric target. However, mean reversion should not be taken for granted, and this process may be faster if the target is symmetric and the central bank allows for a temporary overshooting of the target.

The optimality of an overshooting of inflation is not just a theoretical quibble. In a speech in 2012, Janet Yellen, then vice chair of the Federal Open Market Committee, presented a scenario analysis comparing the suggested evolution of future interest rates under different versions of the Taylor rule and under the 'optimal control' rule – a rule that optimises the central bank's loss function with respect to its targets (Yellen, 2012). The optimal control rule implied a shallower path for interest rates, a later lift-off with respect to what was suggested by the Taylor rule, and a period of above target inflation, with inflation then returning to 2% from above. In other words, optimal policy may have implied a temporary overshooting of the inflation target.

The Bank of England has been closer to the spirit of the symmetry implied in a flexible inflation-targeting regime. Not only did it expand quantitative easing while inflation was significantly above target, but it also adopted a strategy, after the Brexit referendum, that explicitly incorporated a transitory inflation overshooting. The Bank of England's August 2016 Inflation Report presented an inflation forecast with an overshooting of inflation at the end of the forecasting period and no convergence to the inflation target. The Bank was *de facto* endorsing a transitory overshooting of inflation as an insurance against the potential deflationary impact of the Brexit shock (Bank of England, 2016). The Bank of Japan has also adopted the principle of symmetry in its yield curve control strategy. This strategy includes an explicit inflation overshooting commitment, in which the Bank commits itself to "expanding the monetary base until the year-on-year rate of increase in the observed consumer price index exceeds the price stability target of 2% and stays above the target in a stable manner" (Bank of Japan, 2016). It remains to be seen, though, what kind of behaviour the Bank will adopt when the time comes to implement the overshooting strategy.

The ECB has not faced the problem of symmetry yet, as inflation has been too sluggish to be able to forecast inflation above target. But its framework faces an additional element of asymmetry: the target itself is perceived as asymmetric. The ECB's definition of price stability is inflation "close to, but below, 2%". There is uncertainty about what "close to, but below" means. This uncertainty is likely to impact inflation expectations. This double asymmetry may explain why the term structure of inflation expectations is lower in the Eurozone than in the US or the UK (see Figure 3.6 in Chapter 3).

4.3 Monetary policy and hysteresis

We have argued above that central bankers were initially pessimistic about the amount the slack in the economy, and in some areas likely adopted policies that, in hindsight, were too tight. Have policymakers been hesitant to embrace the intriguing possibility that monetary policy can affect potential growth?

In the last few years, the possibility that large crises could hold down growth has gained relevance. The level of output appears to have been permanently (or at least persistently) affected by the crisis and the associated recession. The mechanism that could be leading to this phenomenon is labelled *hysteresis* (Blanchard and Summers, 1986) – the existence of path dependence on the natural rate of unemployment so that the longer unemployment stays elevated, the higher the proportion of the unemployment that will become structural. If such hysteresis is significant, it creates a problem for the theory underlying the

concept of the natural rate of unemployment. The natural rate, as introduced by Milton Friedman in 1968, was conceived as a structural feature of the economy and independent from monetary policy. This led to the belief that there is not a permanent trade-off between inflation and unemployment. In the short run, running the economy hot could lead to lower unemployment, but in the long run the natural rate would prevail and holding unemployment below the natural rate would only lead to accelerating inflation (not just high inflation, but higher and higher inflation). Blanchard (2017) refers to these two concepts as the "independence" hypothesis and the "accelerationist" hypothesis. These two hypotheses have important implications: monetary policy cannot affect potential growth, and booms must be followed by busts in order for inflation to be stable.

But what if these hypotheses are not correct? Fatas and Summers (2016) provide evidence of the permanent negative effects on growth of the fiscal consolidation strategies adopted after the crisis, supporting the argument of hysteresis effects at play. GDP forecast errors during the last decade have been persistently on the downside, and these forecasting errors have been autocorrelated. The authors document that the countries where the initial shock was larger are countries where the forecasting errors several years ahead have been bigger. As discussed above, this was interpreted initially as a supply-driven effect, against which monetary policy was ineffective. But the evidence is accumulating in favour of an alternative possibility: perhaps it is lack of demand that is creating a hysteresis effect. This is a challenge to the independence hypothesis and if that hypothesis is wrong, monetary policy, by boosting demand, can prevent a deterioration of potential growth. Some central bankers have started to recognise this possibility. Yellen (2016) has suggested that monetary policy should consider running a "high pressure economy" in order to offset the hysteresis effects.

The accelerationist hypothesis is also being challenged. As documented in Chapter 2, the sharp increase in unemployment has not led to lower and lower inflation. In other words, higher unemployment didn't lead to an acceleration of deflation. And the steady and persistent decline in unemployment in recent years has not led to an acceleration of inflation. The evidence seems to suggest that perhaps the accelerationist hypothesis is no longer borne out by the data. If this is correct, then the potential cost of a strategy that aims at transitorily overshooting inflation in order to stabilise inflation expectations at the desired target is small. After a period of overshooting, monetary policy would no longer have to engineer a recession to return inflation to target, all it would have to do is to stabilise growth at potential.

The combined effect of the failure of these two hypotheses is powerful. As Blanchard (2017) says:

> *When the accelerationist hypothesis fails, the central bank can increase output above potential output. When the independence hypothesis fails, hysteresis implies that an increase in actual output increases potential output. The interaction between the two implies that both actual and potential output increase forever.*

Central bankers may have been too conservative and too reluctant to challenge these hypotheses. They have been generally reluctant to embrace a temporary overshooting of inflation and may have been too ready to consider that growth was permanently lower and that there was nothing that monetary policy could

do about it. Not only could they have eased policy more forcefully, or at least kept the easing stance for longer, but they could also have been more explicit in demanding a more expansionary fiscal policy . Central bankers have never been shy in asking for fiscal adjustment when it was needed, but they have failed to be symmetric when a fiscal expansion may have been necessary to support the monetary policy efforts and, along the way, improve the fiscal sustainability outlook (Auerbach and Gorodnichenko, 2017).

4.4 Monetary policy and financial stability

Central bankers faced the biggest financial crisis since the Great Depression in a period in which the economic discussion was dominated by concerns about global imbalances, rapid credit growth and house price appreciation, and whether monetary policy was supposed to lean against the wind (see, for example, Borio and White, 2004).

The debate was not conclusive. Some argued that low interest rates had caused the financial excesses; others argued that weak regulation and supervision were the main culprits. Was it the quantity of credit, or the quality of credit? Whatever the answer, one thing was clear: given the sheer size of the recession, increasing interest rates was no longer an option and interest rates would have to remain very low for an extended period of time. Therefore, central bankers moved onto reinforcing the supervisory and regulatory framework in order to ensure that the quality of credit would improve – to make the financial sector more resilient. National financial regulations have been revamped, capital ratios redefined and increased, liquidity and leverage ratios tightened and improved, and monitoring – both at the national and international level – enhanced (for a detailed summary, see Yellen, 2017).

It is probably too early to determine if the policies adopted have made the global economy more resilient – the proof must wait for when the next financial shock hits. A priori, there seem to be net benefits from higher capital standards, once the potential trade-off between growth and stability is taken into account (Fender and Lewrick, 2016; Firestone et al., 2017). The evidence on whether these efforts at improving financial stability have hampered growth in the near term is not conclusive, though. Some studies suggest that higher capital reduces bank lending, while others suggest that higher capital supports lending (see, for example, Carlson et al., 2013; Gambacorta and Shin, 2016). And there seems to be some evidence, at least in the US, that the regulatory tightening has led to a reduction in the availability of credit for lower-rated borrowers and small businesses (Federal Reserve Banks, 2017).

It seems that, so far, this regulatory and macroprudential tightening has successfully allowed monetary policy to focus on growth and inflation, and that the long period of low interest rates has not generated any significant side-effects on financial stability (Draghi, 2017; Fischer, 2017). The debate remains open. Svensson (2017) makes a forceful argument that the alternative strategy of using monetary policy to lean against the wind (in other words, setting interest rates higher than they should be necessary to achieve the inflation target, in order to contain potential financial stability risks) entails costs – because a future crisis will hit an economy that is weaker – that substantially exceed its potential benefits of marginally lower probability of a crisis in the near term. Juselius et

al. (2016) argue that leaning against the wind leads to higher output over the long run. But, for now, it seems that the separation of mandates – with monetary policy focused on growth and inflation, and macroprudential, regulatory and supervisory policies focused on financial stability – is working well.

4.5 Monetary policy and central bank independence

Central bank independence has always been considered a critical element of monetary policy. Because monetary policy operates with long lags, achieving its objectives requires a longer-term perspective that may be at odds with the shorter-term preferences of politicians. This worry became prevalent during the inflationary episodes of the 1970s, as political interference was seen as the main reason behind the boom-bust dynamics that led to a volatile economy and higher inflation. The recommendation to endow monetary policy with operational independence was part of the fight against high inflation, and it has been generally accepted by politicians.

But should this quest for independence be symmetric when the problem is that inflation is too low, rather than too high? When interest rates are zero and the central bank has to engage in asset purchases, the risk of losses on the central bank balance sheet increases. These losses have a quasi-fiscal nature. The profits that the central bank generates are typically transferred to the government's budget on a regular basis. Therefore, if the central bank loses money, these losses will also affect the government's finances. And here comes the source of the debate: is it right to delegate the management of monetary policy to unelected officials (the central bankers) when they are likely to generate profits, even if they may decide to trigger a sharp recession to lower inflation, but restrict their independence when central banks risk losing money in order to restore growth and inflation to their mandated levels?

The answer is not as straightforward as it may seem. The focus on near-term fiscal losses could lead to interference with the operational independence of central banks. For example, Tucker (2016) describes central bankers as "co-managers of the state's consolidated balance sheet", and questions whether the exercise of discretionary power by unelected technocrats is compatible with society's democratic values. Although this is conceptually correct – the balance sheet of the central bank is just one element of the consolidated balance sheet of the government – if the focus of monetary policy shifts from doing whatever it takes to achieve its mandate (operational independence) to minimising the near-term losses in its profit and loss account or the potential distributional impact of some of the central bank actions (like negative interest rates, or credit easing), the effectiveness of monetary policy will be reduced. In other words, the short-term preferences of politicians would be interfering with the longer-term objectives of monetary policy.

This is ironic. A major argument in favour of independence in the design of anti-inflationary mandates is that it reinforces the credibility of the central banks. Does this imply that the credibility is less necessary at the time of designing anti-deflationary mandates? Unlikely.

Political interference with the operation of monetary policy may indeed have hampered the credibility of the efforts of central banks to restore price stability, may have been (at times) a deterrent to the adoption of optimal policies, and may be a reason behind the 'missing inflation'. The political pressure on the Fed has been relentless. Taylor (2016) provides a good example of the standard criticisms of Fed policies, arguing "not only they haven't been effective, they have been counterproductive." Warsh (2016) cautions against the perceived expansion of power at the Fed. This pressure may have been a reason behind the Fed's reluctance to adopt a more aggressive policy stance intended to achieve a temporary overshooting of inflation.

The design of the ECB's quantitative easing programme, based on the capital key rather than on the more effective market weights, responds directly to these political constraints, and limits the ECB's ability to achieve its inflation objective. The political criticism of the ECB has been fierce in Germany, with recurrent legal challenges before the German Constitutional Court and frequent complaints by government officials about the ECB's policies. This may affect the credibility of monetary policy and potentially introduce a downside bias in inflation expectations.

The Bank of England also faced intense political pressures during the Brexit referendum campaign, but was able to fend them off successfully. Despite accusations of being overly negative on the potential impact of Brexit, it adopted an aggressive package of policies as an insurance against it which may have helped cushion the negative impact of the vote to leave the EU. The Bank of Japan has been spared, to a very large extent, this problem. In fact, government support for the Bank's policies has been explicit and the coordination between monetary and fiscal policy has been explicit and effective.

4.6 Summing up: Good policies, or good luck?

This discussion highlights that it has in fact been a mixed bag of good and bad policies, as well as good and bad luck. Monetary policy deployed a tremendous and effective effort and has been able to restore growth and support inflation. The resilience of commodity prices and the presence of downward rigidities was a strike of good luck for policymakers in their fight against deflation in the aftermath of the crisis, but it may have led central banks and governments to mismeasure the output gap and adopt policies that, in hindsight, were too tight and may have contributed to the current sluggishness of inflation, especially in the Eurozone and, to some extent, in the US and the UK. The reluctance to embrace the symmetry inherent in flexible inflation targeting, and to consider the possibility of powerful hysteresis effects, may have led to monetary policy that was too tight and may be hampering the efforts to reach the inflation objective. The Bank of England's readiness to tolerate transitory (even if persistent) overshooting of inflation, and to explicitly embrace the symmetry of the inflation target in its design of policies, may have contributed to the better anchoring of inflation expectations in the UK. The approach of using monetary policy to support growth and inflation, and macroprudential, regulatory and

supervisory policies to support financial stability, seems to have worked well so far and it is an example of good policies. Finally, the attacks on central bank independence have hindered policy efforts to return inflation to target in recent years, especially in the US and the Eurozone.

Looking forward, we face a dilemma. From an historical perspective, having stabilised inflation somewhat below 2% looks like an impressive achievement, compared to the deflation of the 1930s or the inflation of the 1970s. But, from the modern perspective of price stability defined as inflation at 2% over the medium term, it is a source of worry if this implies that, when the next recession hits, policymakers will have less room to lower real interest rates and cushion the shock. With this dilemma in mind, the next chapter discusses the policy implications derived from the experience of the last decade.

5 Inflation and the policy framework: The future

It was a mix of luck, good policies, and some economic rigidities that helped keep inflation relatively stable during the post-2007 period. But inflation has still been lower and more volatile than in the years leading up to the crisis. Moreover, inflation expectations have moved down to a lower level, at least in the US and particularly in the Eurozone, where the initial hesitancy and excessive caution of monetary policy, and the headwinds created by fiscal policy, have taken a toll. In most developed economies, growth has been below average since the financial crisis and slack has been slow in falling. The low level of interest rates raises questions about the ability of economic policies to support demand in future recessions, and therefore to keep inflation at target.

All in all, the macroeconomic performance record of central banks since the financial crisis is patchy; one can view the past decade as being one where inflation has been stable (a positive interpretation) or as stubborn (a negative interpretation). Even if one takes the more positive view on the inflation outcomes, seeing them as stable more than stubbornly below desirable levels, perhaps the welfare outcomes were less good because policies that kept inflation fairly steady came with the neglect of real activity or financial stability.

We take the view that the inflation outturns should be viewed – on the whole – as being pretty good rather than – on the whole – as being pretty bad. Given the severity of the financial crisis, the scale of the subsequent recession, the prolonged disruption in the supply of credit, and the high volatility in commodity prices, for inflation in nearly all developed countries to barely go negative and to stay only a few decimal points below target (and very recently, to move back to close to target) is a good outcome. Who knows whether, if inflation had stayed negative for a more significant period, it could have ended in a downward spiral. The example of Japan suggests it is certainly not inevitable; there, a long period of inflation at or just below zero has not generated an unstable downward spiral in prices. That inflation rates persistently around zero or mildly negative can be stable certainly appears consistent with recent experience. Whether or not that is a general stability property of modern developed economies cannot be reliably proved from the evidence of the last ten years, which represent really just one episode. But the facts are clear: developed economies did not descend into deflationary spirals. Had they done so, real outcomes – output and employment – would almost certainly have been far worse. So, the relatively favourable view of the inflation outcomes that we take implies that those policies that delivered fairly stable inflation did help prevent worse real outcomes.

Furthermore, the decade 2007-17 has seen a continuation of something that long pre-dated the crisis of 2007-08: the erosion of bargaining power of labour and the highly elastic supply of goods from rapidly developing countries, most notably China. These were forces that had been at work at least since the late

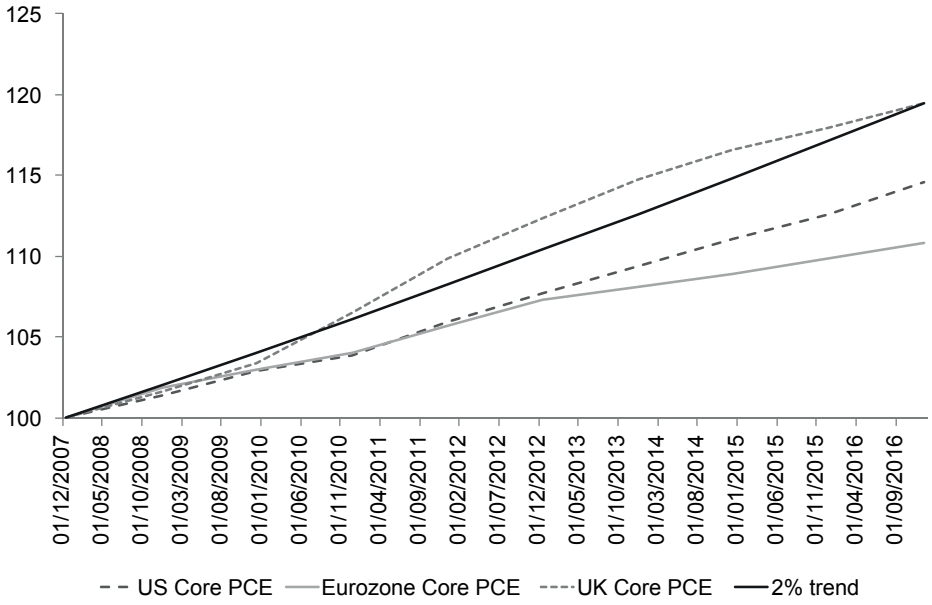
1990s. They continued after the crash. In the decade before the crash – despite steady growth, relatively low unemployment and rapid expansion in credit and some asset prices – consumer price inflation in most developed countries hardly got above 2%. So, to have seen inflation not fall much below 2% – when these powerful underlying global forces remained at work, but superimposed on them were a dramatic slowdown in economies, a rise in unemployment and major disruption to the financial system – is a remarkably good outcome from the perspective of inflation.

The contrast between this recent experience and what happened in many economies in the years after the 1929 crash is stark. Hence, we are inclined to the more positive interpretation of outcomes (that inflation was 'stable') rather than the more negative one (that it was 'stubborn').

Should one nonetheless view the record in developed economies since 2007 as something of a failure, because a monetary-fiscal mix should always exist that can get inflation up? That seems a harsh judgement. The decade 2007-17 did not look like 1929-1939 – when there really were policy failures – even though 2007-08 did look worryingly like 1929-30. The claim that monetary policy in developed economies was far too timid is not very convincing. Soon after the crisis was at its worse in October 2008, there were dramatic cuts in central bank policy rates, massive provision of lending to the banking sector, some major recapitalisation of banks, and large-scale asset purchases. Much policy was directed at the source of the problem, which lay in the banking sector. The enormous expansion of central bank lending to banks, which pre-dated asset purchases, was a lender of last resort operation. The extension of acceptable collateral and term loans at low rates to the banking sector was almost without precedent. As the previous chapter discussed, yes there was some good luck, but there were also good policies that were partly responsible for the good outcomes.

Looking forward in time, instead of backwards, the starting point is challenging: as Figure 5.1 shows, the level of core prices reveals that inflation has been persistently below target in the US and the Eurozone, though not in the UK. There is therefore no room for complacency. Nobody knows what combination of factors the future will deliver. Good luck may turn into bad luck. Economic rigidities, which may have been helpful in recent years, may play a perverse role in the future. The political backlash against negative interest rates, asset purchases, and central banks in general may dent the credibility of monetary policy and hamper its effectiveness in boosting demand. But the opposite is also possible. With spare capacity still present in many economies, the global expansion could last a long time. Overheating, and old fashioned inflationary worries, could return. Despite the long period of low interest rates, there are no clear-cut signs of financial vulnerabilities (risk premia on equities, for example, do not look unusually low); but those signs may yet emerge, even if inflation remains low.

Figure 5.1 Core price level versus 2% trend (index: 2007 = 100)



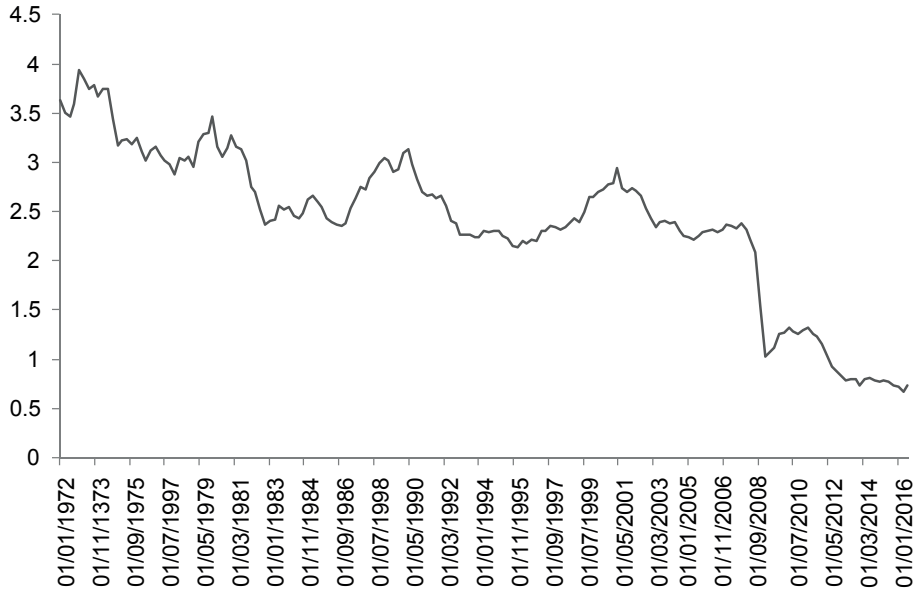
What changes in the policy framework might best address these very different sorts of risks? We consider some possible changes and assess them in the light of what has happened over the past ten years – starting with raising inflation targets. We consider what would make each potential strategy pay off well, and what would make it go badly. So, in keeping with our overall message, there is a degree of luck that will affect which policies, ex post, turn out best. Ex ante, it is as well to be aware of what makes different strategies work and to be nimble in adjusting to information about what kind of a world you are in. That way, you make your own luck.

5.1 Would a higher inflation target be warranted?

The evidence presented in Chapter 2 shows that for the best part of the last few decades, inflation has been low. In addition, there has been a relentless trend towards lower neutral real interest rates (r^*). Figure 5.2 shows the simple (non-weighted) average of the estimates of r^* for the US, the Eurozone, the UK and Canada (from Holston et al., 2016). The average r^* was 0.7% in 2016Q4, ranging from 1.5% in the UK to -0.35% in the Eurozone.

If this trend of low inflation and low r^* were to persist, there is an argument for raising the inflation target – say, from 2% to 3-4% - in order to lessen the risks of deflation when the next recession hits (Blanchard et al., 2010; Ball et al., 2016; Ubide, 2017). This effect is further enhanced by the decline in term premia that have made long-term real interest rates lower. If we enter the next recession with low long-term rates, the room to ease policy will be more limited.

Figure 5.2 Average r* in the US, the Eurozone, the UK and Canada (in percent)



In an environment of low neutral interest rates, higher average inflation softens the downward rigidity of real rates and allows monetary policy to better cushion recessionary shocks, increasing future average growth. Kiley and Roberts (2017) illustrate this benefit with simulations using the FRB/US model of the US economy. They suggest that if it were to be hit with the distribution of shocks experienced over the period 1970-2015, and assuming neutral real interest rates below 2% and an inflation target of 2%, the economy would, on average, have an output gap of about 1%. In other words, because of the downward rigidity of real interest rates, created by an effective lower limit on the policy rate, monetary policy with an inflation target of 2% is not expected to be able to fully offset future recessions.

The benefit of a higher inflation target has to be compared to the potential costs. One cost is that with higher inflation may come higher variability of inflation. Nakamura et al. (2016) show that price dispersion didn't increase during the higher inflation of the 1970s, however, suggesting that these costs may be small. A second cost is that the credibility of inflation targets may suffer, as the public will think that, if changed once, it can be changed (often) again. In this regard, it is perhaps encouraging that in New Zealand (which increased its inflation target from the original 0-2% to the current 1-3%) and Japan (which has gradually transitioned from a target of zero inflation to the current 2% with a commitment to overshoot), there has been little disruption or obvious loss of credibility. But this is not the only credibility issue – raising the inflation target after a sustained period when inflation has undershot the old (lower) target creates a risk that people may believe the new target is even less likely to be hit than the old one.

A central question about raising inflation targets is whether there are alternative policies that achieve the same goal. Perhaps other types of monetary policy, most obviously QE and changes in the terms of loans from central banks, can compensate for inability to lower policy rates. Another alternative is forward guidance and a commitment to a policy which remains loose for a sustained period after episodes of below target inflation (with the objective to compensate for the inability to ease policy enough through lower rates today). Kiley and Roberts (2017) find that the gains from higher inflation targets to lessen the problem of the effective lower bound on policy rates become much lower when monetary policy is anticipated to remain very expansionary after inflation has risen back towards the inflation target:

> *Commitment strategies in which monetary accommodation is not removed until either inflation or economic activity overshoot their long-run objectives are very effective in both the DSGE and FRB/US model. While the commitment strategies we examine implicitly include thresholds for inflation and real activity to determine the exit from the ELB [effective lower bound] , we find that such thresholds are insufficient to achieve the full gains from commitments in the model's we analyze. Rather, such a policy must be combined with additional commitments to make up foregone accommodation. In particular, we find that under a shadow-rate policy—in which the federal funds rate is not allowed to rise above the ELB until the shadow rate has returned to the ELB—the effects of the ELB are essentially eliminated…. If commitments to overshoot can be made credibly, the costs associated with the ELB shrink dramatically.* (Kiley and Roberts (2017).

But these policies that they find eliminate the costs of the effective lower bound on interest rates, and make any gains from raising the inflation target disappear, are a form of forward guidance that is Odyssean – that is, one which is time inconsistent and which, we argue below, has significant practical problems of implementation. Quantitative easing does not pose the same problems of time consistency, though the evidence on its effectiveness in boosting demand and raising inflation at the effective lower bound on interest rates is mixed and not uniform across countries.

One way to assess the merits of a higher inflation target is to ask what would be preferable – inflation averaging around 4%, or nominal interest rates sometimes falling to -2%? These are two alternative ways of achieving an additional 2 percentage points of decline in real interest rates relative to a world where inflation averaged 2% and where nominal interest rates remained non-negative. Understanding which is more disruptive requires a deeper understanding of the cost of negative interest rates. Negative interest rates seem to be difficult for the public to understand, and may be difficult for financial institutions to sustain over long periods of time, especially by those with investment restrictions. We have now seen policy rates reduced to negative territory by several central banks, though not very far into negative territory and only fairly recently. Problems that might build up over the course of several quarters may not yet have emerged. But, clearly, zero is not an absolute barrier that cannot be passed. Furthermore, there is no technical limit to further expansion of central bank asset purchases and to increases in the size of central bank balance sheets – though there may

be political problems in some countries. So, the view that the zero lower bound is a limit to expansionary monetary policy is clearly not right – and this is very relevant to whether it is worth paying some cost of having, on average, higher inflation in exchange for more scope to cut interest rate in exceptional times.

The degree to which interest rates can be cut below zero, the effectiveness of quantitative easing, and the feasibility of a central bank committing to a monetary policy strategy that is not time consistent is likely to vary across countries. That is one reason why there is likely to be different optimal inflation targets in different countries. The damage done by negative inflation to real outcomes, and particularly to employment, depends on the degree of downward nominal wage rigidity at very low inflation rates. That also varies by country. There is evidence than in the US it is substantial, though possibly not constant. Fallick et al. (2016) conclude:

> *On the whole, we interpret our results as indicating that the wage-setting process in the US is characterized by a significant degree of downward nominal wage rigidity. (…) Thus, the parametric estimator suggests that the degree of nominal wage rigidity has been lower in recent years than in earlier decades, but does not suggest that the labor market distress since the onset of the Great Recession is responsible for that decline.*

In contrast, for the UK, Nickell and Quintini (2003) find that the proportion of individuals in the UK whose nominal wage falls from one year to the next is large. They conclude that:

> *…while there is a statistically significant distortion in the distribution of real wage changes caused by nominal rigidities around zero wage changes, the macroeconomic impact of this distortion is very modest.*

Finally, both Babecky et al. (2009) and Izquierdo et al. (2017) find significant heterogeneity in the degree of wage rigidity across European countries. Downward wage rigidity is also not constant – it seemed to decrease significantly in the wake of the financial crisis in those countries where declines in GDP were large (for example, in Greece, Cyprus and Spain). Izquierdo et al. (2017) noted that downward wage rigidity between 2010 and 2013 declined in a group of countries that included Slovenia, Spain, Greece and Cyprus.

In the end, whether a higher inflation target will be needed or not will depend, to some extent, on luck. Will productivity growth rebound, and will neutral interest rates increase, creating more room to ease policy? Will future shocks resemble those of the Great Moderation, or will they be Lehman sized? Because of these uncertainties, one strategy would be to establish a process of periodic revisions, say every five or ten years, to the inflation target (as it is done in Canada, for example). This would force a regular evaluation of the cost and benefits of existing inflation targets, in light of the accumulated new evidence.

There is another reason that periodic review of inflation targets is appropriate, and it also means that central banks in different areas may want to set different targets. Even in the last decade, there is growing academic work showing that even from a cost of living perspective, biases associated with new goods and

substitution may have got worse, so associating an unchanged numerical target with price stability at all times is not right (for example, Aghion et al., 2017). There is no reason why 2% is the right answer – for all periods and for all economies – to the question: "What should the target rate of inflation be?"

5.2 Should central banks have large balance sheets?

Central bank balance sheets look very different now from what they were in 2007. They have grown enormously – a fivefold increase relative to GDP for the Fed and the Bank of England, and not much less for the ECB. The Japanese central bank balance sheet has been on an upwards trajectory for much longer (see Figure 2.11).

Moreover, central bank balance sheets are likely to remain very large for a long period. With the system of payment of interest on excess reserves, central banks can operate monetary policy with any balance sheet size. (Indeed, the concept of 'excess' reserves becomes redundant). The scary crisis episode of the failure of the interbank market has led central bankers to conclude that, for financial stability reasons, a world with far higher reserves than used to be thought adequate may be optimal. To the extent that the current high levels reflect a desire by commercial banks to hold more reserves (and rely less on the interbank market), it looks like something that central banks should allow as part of their role in creating the infrastructure for efficient financial intermediation. A large balance sheet gives the central bank the tools to target financial stability with close to zero effect on inflation (Miles, 2015).

A commonly heard worry is that large balance sheets create an inflationary threat – all of a sudden, the reserves could 'escape' the central bank and become loans that the central bank may be unable to control. There is little support for this claim in the data. In the previous regime, commercial banks operated with minimal reserves but could borrow (or at least thought they could borrow) as much as they wanted to in the overnight market at the policy rate. Therefore, they had unlimited reserves 'on demand'. If the central bank considered that the borrowing was leading to excessive lending, then it could raise rates. The current situation is similar, with the only difference being that the reserves are already there and sitting on the balance sheets of the banks. If the central bank considers that there is excessive lending, it will raise rates. There is no need to shrink reserves to make monetary policy changes effective.

That prompts the question as to what level of reserves should a central bank wish to have – essentially, the same question as to what is its normal optimal balance sheet size. One answer is that the optimal level of reserves is that level which commercial banks wish to hold. If reserves pay the policy rate set by the central banks, then the cost to commercial banks of holding them is (at least close to) zero. Since that is also the effective cost to the central bank of creating reserves, then the Friedman optimal money rule would suggest that the freely chosen level of reserves by commercial banks faced with remuneration at the short-term interest rate is the best outcome. There is every reason to think that this level is dramatically higher than it was pre-crisis.

At the same time, there is a strong case to be made that the central bank balance sheet should be at least as large as is necessary to saturate the market for reserves – that is, to drive the overnight private rates down to the interest paid on reserves so that liquidity is no longer scarce. It is only after this point that the indifference argument in the previous paragraph applies. Some estimates put the figure needed for the US Fed to achieve that in the range $600 billion to $1 trillion (Reis, 2016).

This technocratic answer to the question of optimal central bank balance sheet size ignores real-world political issues – specifically, the political opposition to what some see as the rise of overmighty central banks that have accumulated vast quantities of assets and are significantly beyond public accountability. That political position may be based on a view that the central bank wants to allocate resources – buying and selling assets in a way that reflects decisions on overall credit allocation in the economy. But we stress a different issue which is that commercial banks should have available a facility to hold as much as they want of a good (very liquid, safe deposits that can be used as the ultimate means of settlement) at its true cost of production. If that is why central bank balance sheets remain much larger than they were in the years before the financial crisis, it is wrong-headed to interpret that as central banks wanting to take on a permanent role in allocating credit.

This counter to the view that central banks with much bigger balance sheets have become overmighty is stronger if their balance sheets are, on average, neutral. But what is a neutral balance sheet? Arguably, it is holding largely short-dated, domestic currency government bonds. There is a case for that because even if the central bank is confident that the great bulk of reserves will be held for a long time, so that there is little risk of having to sell assets at short notice and thus crystalising capital loss, you could still find that coupons on long bonds are insufficient to pay a stream of interest on reserves as the policy rate moves higher than people had thought.

A central bank might yet want to skew its holdings to longer-term assets for periods when its policy rate is stuck near the effective lower bound (ELB), as in recent years. So, policy could be to unbalance assets (in an interest rate mismatch sense) when they are being used partly to make policy more expansionary than is possible with changes in the short-term policy rate. Assets would then return to a more neutral composition after the policy rate was away from the ELB.

Hence, the major issues raised by large central bank balance sheets are not on the side of liabilities, but on the side of assets. The real issue about central bank balance sheets is not their size, but really the composition of assets. If the central bank balance sheet was entirely made of short-term government securities backed by reserves, then this would come close to generating no risk. Currently, the major advanced countries' central banks hold very large quantities of longer-dated bonds. This policy was adopted to bring down longer-term rates, but it is not clear that such bonds are a natural portfolio to hold in ordinary times. They expose the central bank to maturity risk. By having short-term reserves fund long-term bonds, the central bank will realise losses if the term premium suddenly and unexpectedly rises. Large losses may compromise the independence of the central bank vis-à-vis the fiscal authorities, through a reduction in the dividends

paid by the central bank or, in an extreme scenario, a need for a recapitalisation. This loss of independence or concerns about the solvency of the central bank would plausibly increase expectations of inflation, disturbing the stable nominal anchor of the past few years.

Starting with a large balance sheet, so that reserves are plentiful, but shifting the portfolio to short-term bonds would significantly reduce this risk. The central bank balance sheet does not affect inflation directly, and removing the income risk from its balance sheet would also protect its independence and solvency. A harder question is whether this maturity shift of the balance sheet (a reverse operation twist) should be done quickly once the policy rate has moved away from the ELB, or very gradually so as to minimise its short-term impact on bond markets.

One final point is important. Large central bank balance sheets did not come about because of a need to finance fiscal deficits, and there is no case to be made that that is what they should become. The great expansion of central bank balance sheets has not been a strategy to support a size of government which cannot get the backing of taxpayers. To the extent that fear of this is part of the political uneasiness about large central bank balance sheets, it should be set to rest.

5.3 What is the role of forward guidance?

All central banks communicate with their stakeholders, and there has been a clear trend towards more frequent and transparent communications over the last decades. Gone are the days when central banks were opaque institutions that engaged in constructive ambiguity. So, at one level it is hard to be against some form of guidance on why a policy has been set and what will guide decisions about how is it set in future; no-one sees much merit in the advice of former Bank of England Governor Montagu Norman, which was to "never apologise; never explain".

Forward guidance is a subset of central bank communication. It relates to the specifics of the central bank's forecasts for the economy, and of the policy reaction function. When interest rates are positive, forward guidance plays a secondary role – it aims at both improving and speeding up the transmission of monetary policy. The better markets understand what the central bank is planning to do and how it will react in different scenarios, the faster and more efficiently monetary policy will affect the economy.

When interest rates are close to zero, forward guidance can play a more active role. At the zero bound, the central bank may need to switch to a reaction function that is different from that used when interest rates are positive. For example, it may want to give more weight to the inflation or the unemployment gap; or it may want to communicate that, even if the reaction function for 'normal' times remains unchanged, the central bank considers that interest rates will have to remain below what the standard reaction function would recommend for an extended period. This could happen in a situation where the central bank is constrained by the lower bound, cannot completely offset that by other policies, and therefore aims to make up for the suboptimal amount of easing by keeping interest rates lower for longer.

In those situations, forward guidance can convey useful information about the economic outlook and about the path of interest rates. A central bank can provide such information about both sides of the policy rule – that is, about what it will do with inflation below target and subsequently when inflation may rise above its inflation target. Guidance can also be state contingent ("we will change rate in this way if this set of circumstances comes about") or time contingent ("we will change rates in this way at this time").

In some ways, central banks have always given forward guidance – the question is whether it should be very explicit and a commitment to future action, or whether it should leave substantial discretion.

Odyssean forward guidance is a commitment to a future policy path which is time inconsistent – once tomorrow is today, following the path will (given that the past is fixed) not be optimal. Some policies that have been recommended when inflation is below target and the policy rate at its effective lower bound are explicitly time inconsistent. One form of Odyssean guidance that is particularly useful when current nominal interest rates cannot be cut to their desired a level, for instance because of a lower bound constraint, is to keep the policy rate at below what would be optimal under discretion once the ELB constraint no longer binds. The anticipation of higher inflation at that point can help boost demand in the earlier period when the ELB does bind. In the absence of other policy levers (such as effective quantitative easing), that time-inconsistent path might be optimal.

In practice, the obstacles to the effective implementation of time inconsistent (Odyssean) forward guidance are severe. In a monetary policy committee (MPC) whose membership changes, how can the members of the committee at one point bind the decisions of different members at a future point? This is not just a theoretical possibility. In August 2013, the MPC at the Bank of England offered a form of forward guidance. Within two years, a majority of the members of the committee had left the committee.

Is it credible that a policy committee (even made up of a consistent group of people) would stick to a policy that – in the light of what they later know – is clearly suboptimal? This is not a question of time inconsistency, because the knowledge later gained might have made the Odyssean (time-inconsistent) policy very different had it been known earlier. And it is not side-stepped by saying that the commitment should be, for example, to set the policy rate a given amount below an updated policy rule, because the knowledge gained might be precisely about what that given amount should have been. This problem is more severe the longer the period over which the commitment is to follow a particular rule different from the discretionary rule updated at each point in the light of the latest information. For Odysseus, that time period was actually rather short – it was the time it took to row past the rocks on which the Sirens sat. For central banks, it could stretch several years into the future.

Other forms of forward guidance preserve future discretion by not making commitments to policies that might come to seem suboptimal. There are many forms in which such guidance could be given. Some central banks (such as the Sveriges Riksbank) show the path of the policy rate which the committee expects (but clearly does not commit) to set in future, and the forecast for the economy conditional on it. The Fed has shown individual FOMC members estimates of their best guess as to where the policy rate should be in the future. The Bank of England gives no explicit forecasts from MPC members of where they think the

policy rate is most likely to go; instead, forecasts are shown for the probability distribution of inflation and output conditional on market expectations for the path of interest rates. But the MPC has made it clear when it believes that the outcomes for inflation and output generated by the market expectations for future rates do not coincide with what it believes are acceptable.

There are strengths and weaknesses to these different forms of guidance central banks currently give. Guidance on how policy will be set, what it is trying to achieve, how trade-offs between risks and trade-offs between objectives are balanced, and on the outlook for the drivers of inflation are all valuable. They become particularly useful when inflation is away from its target, and when current policy may be a long way from what has been normal and may also be constrained. That is the world we have been in since the financial crisis.

The case for forward guidance which constrains future discretion (Odyssean guidance) is less powerful. One such form of limited discretion is to commit to a particular policy rule. But no policy rule could be comprehensive enough to reflect the appropriate response to news (on data and on the changing structure of the economy) and also be useful and understandable to outsiders. The theoretical case for commitment in a very low inflation world where the ELB can bind is that without it, people would not expect policy to remain very accommodative when the inflation environment is different and prices are rising at more normal rates. Those central banks that have a range of other policy tools – such as QE or special lending schemes to commercial banks – that can be effectively deployed when the policy rate is near the effective lower bound will see less need for such commitments on future policy rates that constrain future discretion.

All in all, central banks are right to maintain some discretion and not to make commitments to follow rules that are too specific. The world is too complex and unexpected events happen too often to make that desirable. But the more discretion central banks have, the more guidance they need to give on their strategy, not less.

5.4 Has monetary policy been too focused on inflation?

Does the recent record on inflation, employment and growth – seen in the light of the financial crisis that came before – suggest that focusing monetary policy on an inflation target is too narrow and inflexible? The issue here is not so much that of whether a price level target is better than an inflation target (after all, if the target for inflation is averaged over many period, the difference between the two is slim), but rather whether a broad range of other factors besides what is happening to prices should explicitly be part of central bank targets.

Looking at the period since the financial crisis, it seems that inflation targeting has been sufficiently flexibly applied by most central banks that it has not in fact been a straitjacket. Furthermore, while inflation has been persistently under the 2% target in most advanced economies, it is not at all clear that it has been in a danger zone where deflation and debt spirals are just around the corner. Is there any evidence that in the periods when inflation hovered around zero, economies were on the brink of depression-type downward spirals? How damaging has it been that inflation has, until recently, been hovering about 1% in most developed

economies rather than at 2% targets? Since this has essentially been a single episode (albeit one that has lasted almost ten years), it is not realistic to expect that the data will answer these questions – one observation is rarely enough to settle any substantive economic question.

Clearly in very many economies, aggregate performance since the 2007-2008 financial crisis has been poor (in the UK, for example, GDP is now around 15% below a continuation of the trend the UK seemed to be on before 2008). Would that have been much better had inflation been close to 2% rather than averaging closer to 1%? And would the problem have been much reduced had central banks not pursued (flexible) inflation targeting pre-crisis? One (perhaps simplistic) view is that the huge policy error pre-crisis was that regulators didn't seem to worry about banks with a leverage of 50 times, and that when you have banks with 98% debt and 2% equity, you are sitting on a mountain of dynamite smoking a cigar. In 2007, the dynamite exploded in the US. In 2008, it exploded in the UK and a bit later it exploded across the rest of Europe. The explosions might have everything to do with too high leverage – a view forcefully put by Admati and Hellwig (2013) and many others – and little to do with inflation or inflation targeting. At the same time, the worries in some quarters that the monetary policy focus since 2007 on preventing deflation would generate large financial vulnerabilities haven't materialised (at least yet). Perhaps the parallel tightening of financial regulation has contributed to containing those risks. If so, it would support the view that financial stability risks are better addressed primarily with regulatory and macroprudential policies.

Primarily does not mean solely; there could be occasions when tools available to address overall financial stability risks (capital requirements, limits on lending of various sorts, rules on what are unacceptable risks for financial intermediaries) are not enough. They may be too unreliable, or too slow-acting, or just too weak if financial risks are very large and build up suddenly (or are only recognised late). So, it is likely that in some cases the blunt instrument of changes in monetary policy – raising interest rates (the policy that gets in all the cracks) – may need to be used to help control financial sector risks. Clearly that would mean monetary policy could not always be set solely by reference to an inflation target.

Might the occasions when financial stability risks should be a very material consideration for monetary policy be very frequent? Might they be so frequent that the heavy emphasis in monetary policy on controlling inflation is simply misplaced? We are not convinced that it is. In part, this is because our interpretation of the causes of the financial crisis that started in 2007 does not make the way in which monetary policy was set in the years that led up to the crisis the central factor. By the standards of the 1970s and 1980s, nominal interest rates in the ten years up to the financial crisis were low and stable; *average* short-term *real* interest rates were not so clearly low. The main factor behind the crisis were that perceptions about what were acceptable risks changed and bank pricing of loans became much more favourable to risky borrowers. Risk spreads over the rates set by central banks on many types of risky loans fell, and loans were made to people who in the past would not have been granted credit at any price. All this happened in a world where there was a belief that banks could have off-the-scale gearing and virtually no equity. That was the problem, not that inflation and nominal interest rates were low and stable relative to recent decades.

Looking forward, it is critical that inflation targeting should have some flexibility. In scenarios where the Phillips curve remains very flat, it is possible to envision a repetition of the missing deflation of the 2008-10 period. In those cases, the flexibility embedded in inflation targeting should allow monetary policy to prioritize the closing of the output gap, as the cost in terms of inflation credibility is likely to be low.[13]

Our conclusion is that flexible inflation targeting remains a sensible strategy. It clearly should not preclude expansionary (contractionary) policy when inflation is temporarily above (below) target.

5.5 What is the role of fiscal policy in managing inflation?

As discussed in Chapter 3, the major inflationary episodes in modern history have been driven by fiscal policy failures. Inflation is the result of a combination of economic policies, of which monetary policy is just a part. During the Great Moderation, monetary policy was the main policy lever, but that was possible, in large part, because fiscal policy was well behaved and the shocks to the economy were small. The tightening of fiscal policy in many economies during the 2010-15 period has been an important headwind for monetary policy.

At a minimum level, if central banks are to be held responsible for inflation outcomes, fiscal policy must be chosen so that plans for fiscal surpluses are consistent with paying down the existing debt. This prevents agents from expecting inflation to be necessary in order to pay for the debt. Moreover, for the central bank to remain independent and use its tools , the fiscal authorities must back the central bank in the sense of not demanding an exogenous stream of positive dividends from it, which would force it to use inflation to generate seignorage revenues. Third, even if this stops well short of the full extent of policy cooperation, fiscal deficits that stimulate real activity can help to push up inflation in situations where monetary policy faces limits to its tools.

These three desiderata come into question when the effective lower bound on the policy rate binds. Seemingly irresponsible fiscal plans can raise inflation expectations if they seem to be stuck too low (Sims, 2016). Likewise, having fiscal policy interfere and dictate monetary policies, as in the case of Abenomics, may rightfully compromising the independence of a central bank that became associated with too low inflation, and in doing so it can raise inflation expectations. Finally, fiscal deficits can be particularly useful when the short-term interest rate cannot be cut and will not move, as the crowding-out effects of fiscal policy on investment will be minimal.

Related to this, fiscal policy may play a larger role if r* is lower. A cooperative fiscal policy, if well designed, could help to increase productivity growth via public investment and raise equilibrium real interest rates via an increase in the supply of safe assets, boosting the potency of monetary policy (DeLong and Summers, 2012; Furman, 2016; Ubide, 2016). Moreover, in a scenario where the

13 The experience of the Bank of England is a good example of exploiting this flexibility. In 2011, inflation in the UK exceeded 5% yet the Monetary Policy Committee kept monetary policy at an ultra-easy setting (its forecast that high inflation was temporary was seen as credible).

ELB is hit often, more active and effective automatic stabilisers may play some of the stabilising role for inflation that monetary policy cannot provide. In a world with a lower r^*, monetary policy may have less room for stabilising the business cycle, and so fiscal automatic stabilisers perhaps should be enhanced.

5.6 Final thoughts

Whether we need to change policy frameworks or seek new instruments depends on what the outlook for inflation is. That outlook should be sensitive to how one interprets the low inflation of recent years. The evidence suggests that shocks to pure inflation are rarer today, but they are persistent. Hence, the decline of pure inflation that we observed after 2010 may last for a substantial period, with important implications for the future conduct of monetary policy. If downward nominal wage inflexibility has been a factor, then real wages may still be too high in many countries and wage pressure will be very subdued even as unemployment falls to low levels. More generally, if we have a very flat Phillips curve, we may also want low rates for a long time. And commodity prices may be flat or falling for a period, which will give a very different cost environment for developed countries than we saw over the period 2005-2014.[14]

But should we rather worry about inflation overshooting? Some central banks have been reducing their estimates of the natural rate of employment – and will keep policy rates low until wage inflation picks up. Might that be waiting too long? That risk also depends on the costs of keeping policy rates low. What are those costs and do they vary substantially across countries? Does macroprudential policy need to change to manage consistently low interest rate environments? Does it need to be embedded in the central bank? Does it work at all? On all these issues, there is very significant cross-country heterogeneity among the main advanced economies and monetary areas (the US, the Eurozone, Japan, the UK).

An important source of concern is whether central bank independence is seriously under threat. If it is, and if central banks lose the ability to pursue inflation targets without political interference, it is possible that the next 20 years will be the opposite of the last 20 years – a period when inflation has been low and stable and (recently) with inflation undershooting targets. In particular, the large expansion of central bank balance sheets risk may undermine independence, as some politicians perceive an overreach of central banks with huge scope to make profits or losses and direct credit in a way that is not subject to much outside control. This report has made the case that a large central bank balance is, at least in principle, consistent with efficient credit allocation, and that it may even be necessary for stabilising credit conditions since having commercial banks rely less on interbank flows (which proved unreliable in stressed circumstances) is sensible. At the same time, to guard the independence of the central banks, more frequent revisions to their mandates and a further push towards transparency and accountability seems inevitable and desirable.

All in all, central banks achieved something which was not at all guaranteed in the aftermath of the financial crash and which, in the first half of 2009, seemed very far from likely – and that was to avoid a protracted period of negative inflation. Such price falls might well have turned a bad recession into a deep

14 Brainard (2017) and Cœuré (2017b) discuss the policy implication of persistently low inflation.

depression. We will never know for sure. This is not a source for complacency, as part of this good outcome was due to luck. But to restrict the scope for central banks to respond to similar severe negative shocks on the grounds that recent inflation outcomes look, with the benefit of hindsight, relatively benign does not seem to us a good gamble to take.

Discussions

The Geneva Report: Principles and facts

Comments by the discussants

Katrin Assenmacher, *European Central Bank*

The report presents ample evidence on inflation across time and across different economies, as well as an assessment of various drivers of inflation. Despite an increase in inflation volatility since the financial crisis, inflation has not matched predictions from a Phillips curve relation, suggesting that the parameters of the Phillips curve have shifted over time. It may also be that the way that slack is measured matters.

The report focuses on the monetary base and its components, i.e. currency in circulation and reserves. Broad monetary aggregates, which comprise currency and deposits held in banks, are missing. This is surprising for two reasons. First, the quantity theory relates to money held by households and firms. Second, the Great Recession was triggered by a major financial shock that caused severe problems in the banking sector and hampered the transmission of monetary policy measures to economic activity and inflation. In the Eurozone, M3 growth fell markedly following the outbreak of the financial crisis, despite an increase in M0. A similar contrast between M2 and the monetary base was observed during the Great Depression. In their 1963 book, *A Monetary History of the United States*, Milton Friedman and Anna Schwartz argued that the Fed failed to increase money supply enough to prevent M2 from falling by a third between 1929 and 1933. Rather than dismissing monetary theories of inflation completely, the report might reflect on possible consequences for broad money growth and inflation when the output gap closes and interest rates start to rise.

Finally, the report should compare the behaviour of key macroeconomic variables after the financial crisis with developments during the Great Depression because policy responses during the Great Recession were shaped by historical experience. Ben Bernanke, then governor at the Fed, said on the occasion of Milton Friedman´s 90th birthday in 2002: "I would like to say to Milton and Anna: Regarding the Great Depression. You're right, we did it. We're very sorry. But thanks to you, we won't do it again." Following the Great Moderation, economists believed they knew how to design monetary policy to achieve low and stable inflation. This belief was shattered with the financial crisis. Because the 1930s seem a suitable reference period, it would be nice to assess whether and what we have learned from history.

Olivier Jeanne, *Johns Hopkins University and CEPR*

The Great Recession ushered in an era of unprecedented challenges for monetary policy, and unprecedented policy responses. The report provides an excellent review of what has been learnt about the Phillips curve and the determinants of inflation during this period. Yet, hyperinflation concerns resulting from large increases in the monetary base are somewhat of a straw man. Even in 2010, monetarist economists understood that the price level is not proportional to the monetary base. The concern rather was about avoiding deflationary spirals. The policy debate was about the best way of avoiding the Japanese situation. The main lesson in that regard is that the deflationary spirals predicted by models with accelerationist Phillips curve did not materialise. The behaviour of inflation can be explained with non-linear Philips curves that become flat when inflation is low. The report focuses exclusively on what has been understood and what has been learnt, and not enough on what is unknown and might be more important for policymaking. Two issues, in particular, require more clarity: the slope of the Phillips curve and inflation expectations.

Inflation forecasts based on the Philips curve estimated prior to the crisis would have suggested deflation in response to the increase in unemployment observed during the crisis. However, deflation did not materialise. A solution to the puzzle could be a non-linear Philips curve, but why did the Philips curve become non-linear? The literature discusses downward nominal rigidities, but why do nominal wages become rigid at a certain level of unemployment and not another one? The implicit assumption is that there are different kinds of nominal frictions in the steeper part of the Philips curve as opposed to the flatter part. In that case, there must be a transition between the two different kinds of nominal frictions. This transition is not a phenomenon that we understand well.

Blanchard et al. (2015) show that the coefficient of unemployment in the Philips curve decreases over time, indicating that inflation becomes less sensitive to unemployment. Yet almost all of the decline in this coefficient occurred in the 1990s, well before the crisis. We do not yet have a clear understanding of why inflation became less sensitive to unemployment in the 1980s and 1990s.

The bigger question is whether the Philips curve is the right framework at all for thinking about the monetary policy. Katrin Assenmacher too has just raised this question. The Philips curve assumes that there is a short-run trade-off between inflation and output. This view discounts the hysteresis phenomenon, according to which output in the long run could be influenced by inflation in the short run. If this is true, it raises a fundamental question about the current mandate of central banks. It also implies that the Philips curve is not the right framework for thinking about monetary policy. The report does not address the issue of hysteresis.

The experience since the crisis suggests that inflation expectations are better anchored. This implies that in the Philips curve, the coefficient on long-term expected inflation (as opposed to lagged inflation) has steadily increased over time and long-term expected inflation has become more stable. This is good news, as the monetary authorities can be more flexible in the short run without compromising their long-term credibility. But the monetary authorities can exploit this flexibility only to the extent that they feel secure in the anchoring of long-term expectations. This is not the case: we do not understand well how

long-term expectations are anchored, or how the anchor could be lost. We need to improve our understanding of how exactly, and why, long-term inflation expectations are anchored.

The missing foundation of long-term inflation expectations is at play in the debate about raising the inflation target. Existing models suggest that moving the inflation target from 2% to 4% should not affect the credibility of independent central banks. However, central bankers and most academics do not believe that it is the case. If we cannot ascertain what the impact of raising the inflation target on long-term expectations would be, we simply do not understand how expectations are determined. More generally, most people don't obsess about inflation the way macroeconomists do, and inflation has not done anything scary or interesting for about three decades. Yet there could be circumstances under which inflation would become salient, perhaps beyond a critical threshold. We need to construct and test with empirical data a rich set of competing models of how long-term expectations are determined. Without such an understanding, we lose the benefit of the flexibility provided by stable long-term expectations.

The report provides an excellent review of the literature organised around the missing inflation/deflation puzzles. It also gets the reader close to what is known today among macroeconomic researchers and monetary policymakers, but which has not seeped through sufficiently to economics classes. However, we also need to outline what we do not know and the policy implications of what we do not know. In that sense, focusing on the missing deflation puzzle may excessively narrow the perspective.

Floor discussion

Has the world of inflation changed?

Charles Goodhart, *London School of Economics*

The report suggests going back to 2010, but we need to take a longer perspective. During the last 60 years, the analysis of inflation has sequentially emphasised three quite distinct focal points:

1. The 1950s to mid-1970s: the conditions in the labour market, with particular reference to the bargaining powers of employers and trade unions.
2. Late 1970s to 1990s: the development and growth of one or other of the monetary aggregates.
3. The 1990s onward: the deviation of output from the NAIRU, and crucially the determination of inflationary expectations.

While there were always good reasons for these shifts of focus, they tended to accompany a dismissal, or a failure to appreciate, the continuing elements of validity in the prior conventional analysis.

The report does not discuss the effects of demography, technology and globalisation in weakening the power of labour vis-à-vis capital and management, and thereby putting downwards pressures on prices. For example, private sector trade unions have collapsed. Indeed, the words “trade union” or “bargaining power” never appear in the text.

Back in the early 1960s, Dennis Robertson was vilified and castigated for arguing that the NAIRU might have moved above 2%, perhaps as high as 3%. But the NAIRU is believed to have risen from then, perhaps to 4% or 5%. The report seems to assume that the position of the NAIRU is known, fixed and constant. It is none of these, and perhaps the current weak bargaining position of labour means that the NAIRU has dropped sharply recently, maybe back to a Robertsonian 3%.

And in an age of globalisation, migration and out-sourcing, why are economists still running country-specific Phillips curves?

Turning to money and inflation, the report never discusses how extraordinary the present monetary circumstances are. Prior to 2007 it was thought that, whereas deflation should be of concern for a central bank with politico-economic problems, reflation should be dirt easy for a money-creating central bank. Central banks have created base money *à outranc*e, but inflation has remained stubbornly low. Why? In so far as the report has an answer, it is that everyone was liquidity-satiated at current low rates of interest. Did no one really want to borrow now? Is it consistent with liquidity satiation for companies to keep mark-up high because of a need for liquidity? My own answer is that the transmission mechanism via the commercial banks was put under such pressure that it broke down. As noted by Katrin Assenmacher, commercial banks, like trade unions, are conspicuous by their absence from this story. As an account of expectation formation, the report is good, even excellent, but it does not go far enough.

Are markets confused?

Leslie Teo, *GIC Singapore*

Focusing on the relationship between market-based measures of inflation expectations and realised inflation, four observations may be helpful. First, market-based measures of inflation expectations are not very good forecasts of future inflation. Second, however, they do about as well as other approaches such as survey measures, a constant ('inflation target') or no change, or a random walk. Third, while the markets frequently analyse market-based breakeven inflation, and take this to be an estimate of future inflation, breakeven inflation seems to be also driven by both inflation risk premia and 'unusual demand' (some structural issues with the demand of inflation protected securities). Finally, investors, particularly long-term investors, are concerned about inflation despite it being not priced in currently. However, traded inflation markets are not necessary large, liquid, or the most efficient means to protect against inflation. These observations are consistent with the report and other analyses from reputed institutions such as the San Francisco Fed and the ECB.

Market forecasts do not show a strong correlation with realised inflation both using short-term and medium-term forecasts, as depicted by the case of the three-year forward two-year breakeven rate. However, the data also suggest that at least in the medium term there is evidence that inflation is anchored. Market participants believe that the central banks are credible so that inflation is expected to be around the inflation target. In the shorter term (one to two years), there is evidence that current actual inflation is a good predictor of one- and two-year ahead inflation. Therefore, broadly, the report is right to conclude that markets do show some anchoring and that, in the short run, current inflation is a good predictor of realised inflation.

The assumption that the breakeven inflation is a good measure of expected inflation needs to be treated with caution. Breakeven inflation is a good measure if inflation risk premia and any liquidity premia are not correlated. However, the correlation is relatively high, suggesting that perhaps inflation risk premia are changing over time. It follows that, first, slower-moving trends in breakevens might capture changes in inflation expectations so that higher-frequency measures may be misleading; and, second, that deflation risk might be being priced in.

There is some evidence of a stronger link between inflation risk premia and equity returns post-crisis (implicitly assuming inflation expectations do not change week to week). However, before the crisis, there was almost no relationship between weekly changes in the S&P500 and ten-year breakeven inflation. From July 2007 to the Taper Tantrum, weekly changes were well correlated, indicating that inflation risk premia were factors for both markets. Since the Taper Tantrum, the relationship still holds (albeit weaker, it seems).

In the market for Treasury Inflation Protected Securities (TIPS), 40% of participants are price-insensitive holders. This is partly because market participants are trying to prepare for inflation. Of known market participants, foreign official holders represent the largest share, while the Fed's SOMA holds just under 10%. Both are price-insensitive holders. Over the five years (2011-2016) for which we have data across all segments, the "Other" share was around 30-35%. This could comprise managed accounts for pension and insurance companies.

Finally, many investors have never seen in their careers an environment (the 'Great Moderation') so favourable to investing. In the 1970s, with frequent inflation upside surprises and worse stagflation, the environment was much more challenging. Many investors worry about this lack of experience, and hence they are always on the watch out for what is changing, as typical portfolios do very badly if we see a return of inflation.

Of course, technical arguments about the inflation process – the quantity theory of money or Fisherian arguments, or even the Philips curve – are of interest to investors, but what really worries them over the long term is the risk of structural changes which have underpinned anchored inflation expectations. Are we at the height of central bank independence? What is the impact of populism? What do high levels of debt imply? They are also concerned with income inequality, fiscal dominance and technological progress. These concerns lead to the bigger question: is what we have witnessed over the last three decades sustainable? Could there be an (either on the upside or downside) inflationary surprise? Conventional instruments – gold, commodities, ILB – may not offer the necessary protection. This is why investors are considering real assets such as real estate and infrastructure. Long-term investors in particular are seeking out such assets.

In conclusion, the markets are not confused but they are in a beauty contest, with the objective not of picking the most beautiful person but the person everyone else thinks is beautiful. In other words, they are not in search of the truth (in this case, future inflation per se).

Are we in for a big surprise?

Patrick Honohan, *Trinity College Dublin and CEPR*

The report is about the fact that inflation has been remarkably stable through the crisis – indeed, even more stable than the Phillips curve would have predicted. Are we in for a big surprise? The short answer is no, but we need to be looking for potential tail events. After all, the crisis itself was a tail event.

The authors rightly emphasise that Friedman's dictum about inflation being monetary is at best a statement linking two endogenous variables. Yes, money is implicated always and everywhere, but it is itself endogenous to fiscal pressures and fiscal pressures don't come out of the blue. They are mediated by political and economic institutions that are themselves subject to analysis. Four (not exhaustive) dimensions along which one might search for sources of a big inflationary surge are:

1. Will over-indebtedness cause a corrective inflation?
2. Will excesses of monetary policy expansion inevitably work themselves out in inflation?
3. Could populism cause high inflation?
4. Will China cause inflation?

First, engineered inflation has not been employed at all to resolve the crisis of over-indebtedness in nominal obligations. In late 2008, it seemed that inflation-indexed government bonds TIPS were grossly under-priced. That assessment seems to have been wrong. Clearly a move to sustained higher inflation would have been matched quickly by nominal interest rate increases, but a one-off surge would have eased the over-indebtedness problem and a return to low inflation should have been achievable. Only Britain seems to have tried this, to a very limited extent.

Second, institutional arrangements (particularly in the Eurozone, a mix of over-indebted and OK countries; Fed QE removes or postpones official indebtedness consequences) seem to be at the heart of this. But deeper down a generation of public discourse demonising inflation has sustained these institutional features. This is one reason why we cannot attach much weight to the possibility of a return to welfare state/populist types of inflation that characterised former decades before the anti-inflation consensus emerged.

What about the proactive use of expansion to fund social programmes leading to inflation in the style of the 1970s? While Keynesian voices rightly point to excessive caution in this dimension, this kind of social democratic inflation *à la* 1970s is in abeyance at the very least. Even if central banks lose independence – as may indeed be the case – that alone will not remove the anti-inflation consensus.

What about a renewed Eurozone crisis resulting in exit or fragmentation? Clearly real exchange rates would change in such a scenario, but would high or hyperinflation be a necessary outcome? Not necessary, but it is not implausible if it occurred amid political and social chaos like Varoufakis' plan X or the True Finns' analysis. New currency regimes established in such an atmosphere might not be well prepared or accompanied by robust institutions and policy frameworks.

What about the monetary overhang? The authors address this concern and rightly dismiss it. The size of the monetary authority balance sheet is a very imperfect measure of stance of policy. The quality of what is in both sides matters. For example, often we see the two peaks of the Eurosystem size of balance sheet

as indicating monetary policy contractions. But there were two quite distinct phases in the evolution of balance sheet size. First there was a relatively passive phase when the ECB just made sure bankers' precautionary demand for liquidity was satisfied. When that demand shrank, the balance sheet size shrank (2012-13); it is not right to interpret this as a measure of monetary policy contraction. (There was a tightening – wider country-specific spreads and slight increase in Eonia). Later came the proactive QE – exchanging short-term for long-term liabilities (to flatten the yield curve and take credit risk out of the market). That is why the ECB balance sheet shrank between the two distinct phases, it was not a tightening!

Third, could populism overturn the anti-inflation consensus? Only if the business interests of the political leaders are aligned to inflation. Political opportunities are generated by high inflation only if controlling groups find it in their personal interest, for example in 1989 in Argentina. What about the Trump deficit? We had a Reagan deficit, but Reagan had a Volcker. We don't know who Trump's Volcker will be.

Fourth, will China cause inflation? We have to look at the cultural determinants of inflation, including religion. Not a very active topic these days, and simplistic formulations do not work well in regressions. Still, it is striking how many Islamic countries experience low and stable inflation despite mixed growth and inequality records. The 21st century will be the century of East Asia. China has known hyperinflation in the last century, but both that experience and the political turbulence created by the inflationary surge of the late 1980s (leading, it is said, rather directly to Tiananmen Square) rather emphasise the political and cultural biases that are now likely to dampen any driver of inflation from China. Still, as one China analyst said more than a decade ago, whatever China can produce will get cheaper and cheaper, and whatever China cannot produce will get dearer and dearer. This is about relative prices, but it is also about commodity price surges. The commodity price surge of 2008 was exceptional and would have generated a secondary inflation spike in 2009-10 had it not been for the financial crisis. Likewise, the decline in commodity prices in 2012 may have played a larger role than the regressions allow in the slowdown of inflation 2012-16. This aspect deserves to be teased out a bit more.

So, are we in for a big surprise? The most probable outcome is just a return to normality with some waves of inflation in different countries as they hit various economic and political roadblocks and find themselves using inflation to get around them. Yet, we need to look broadly outside the narrow box of Philips curves and monetary policy.

General discussion

Ricardo Reis disagreed with Katrin Assenmacher's comment that the inflation rate has been volatile since 2008. Core inflation post-2010 was more stable than during the Great Moderation, or at least equally stable. He acknowledged that focusing on headline inflation and including the years 2008 to 2010 results in higher volatility. However, an important contribution of the report is to point out that, excluding commodity prices, inflation has remained remarkably stable. Even headline inflation has been relatively stable since 2010. The issue is not a volatility puzzle but a stability puzzle. Regarding the focus on M0, Reis pointed out that the report focuses on policy instruments and how are they related to

performance. The data show that M3 and M0 are not related. While acknowledging that M3 can be a useful indicator in many different ways, he highlighted that M3 has not been a reliable measure of upcoming inflation, especially over the last few years. Finally, Reis thought saw some irony in arguing that the Philips curve is not a reliable framework while the money multiplier is. Money multipliers have shifted much more than the Philips curve. Responding to Charles Goodhart, who asked the authors to consider more theories, and to Katrin Assenmacher, who suggested that the authors should indicate which theories are right, Reis acknowledged that the authors struck the wrong balance or are stuck in between. He emphasised that the authors did not dismiss monetarism but felt that it was important to dismiss observers suggesting that the adopted policies could be disastrous purely based on the evolution of M0. Finally, he noted that Goodhart's comment about the inconsistency in banks being satiated but firms are not part of the argument put forward by the authors. Focusing on reserves, it is clear that banks were satiated but firms were not. This is perfectly consistent with the view that the credit system broke down so that the transmission of monetary policy through reserves market had not worked.

In response to Oliver Jeanne's comment that hyperinflation concerns resulting from large increases in monetary base were a straw man, **Ugo Panizza** reminded the audience that in November 2010 a group of well-respected economists, including authors of textbooks and professors in top universities in the US, wrote an open letter to Ben Bernanke arguing that quantitative easing would lead to high inflation.

Anthony Smouha noted that current developments in labour markets and working practices, including the impact of technological progress, are disinflationary factors. This trend could continue unless there is a political breakdown which he thought no one can exclude.

Charles Bean felt the analysis was somewhat deficient in failing to recognise that inflation was not simply the result of shocks, but also reflected central banks' own policy response to the evolving economic environment. Central banks had been gradually learning about the shifts and shocks to the Phillips curve and then incorporating this into their decisions; as an example, he mentioned discussions in the Bank of England's Monetary Policy Committee about weak wage growth, the flattening Philips curve, and the role of migration. So, the stability of inflation, far from being the puzzle that the authors suggested, simply reflected the fact that central banks had been doing their job fairly successfully! But this did not mean their performance had been as good as it could have been. He reminded the audience of the 'Qvigstad criterion': an optimal monetary policy requires the expected inflation gap and the expected output gap to have opposite signs. But since 2008 – and in violation of the Qvigstad criterion – we observed the juxtaposition of persistent spare capacity with persistently below-target inflation in each of the US, Eurozone and Japan, implying that policy should have been more expansionary in all three jurisdictions. The UK alone appeared to have met the Qvigstad criterion, but only as a by-product of the serendipitous take-off in inflation that followed the large depreciation of sterling between 2007 and 2009. The question, then, is why had monetary policy not been even more expansionary than it was? There were several possible explanations, including underestimation of the extent and persistence of the recession by policymakers, overestimation of the impact of their unconventional policy measures, and concerns about financial imbalances that inhibited any further stimulus.

Building on Charles Goodhart's comments on the importance of the global dimension for the Philips Curve, **Luigi Buttiglione** emphasised the impact of China. As a market practitioner, he claimed that China is by far the main determinant of global economic trends, including of inflation. Buttiglione mentioned that the deflation scare of 2013-2015 was originated especially in China's own deflation, as suggested by both PPI and commodity price dynamics. Similarly, the recovery of the global inflation in the last year and half was boosted especially by China.

Jan Toth agreed with Katrin Assenmacher's remarks and raised three further issues. First, he suggested that broader monetary aggregates like M2 or M3 have a better explanatory power than narrower aggregates. In lower inflation economies only, credit growth even beats M2 or M3, and in any case does better than M0. Since most of the money is created by the private sector, it is critical to understand the willingness of commercial banks to lend. Consequently, we should focus on the asset side and not so much on the liability side. Second, the report suggests inflation expectations are stable. However, in the case of the Eurozone during the pre-Trump period, we can see downward pressures on the 5Y5Y. While QE built some momentum, it did not last as indicated by the 5Y5Y. This indicates that inflationary expectations were not fully stable, at least in some regions. Finally, in terms of the discussion on the Philips curve, the nature of inflationary shocks matters. Since the big shocks were commodity driven, for advanced economies these were positive surprise shocks. Given the synchronous downturn in advanced economies during the crisis, these inflationary shocks provided a lot of stimulus and were automatic stabilisers for economic growth. This potentially explains the reason why we do not 'see' a steeper Philips curve.

David Miles noted that such factors as the labour markets – including unionisation, demographics, migration – and the rise of China already exerted a powerful influence before the financial crisis. These factors did not just come into play after the crisis. Nor did they explain why inflation did not go into negative territory but, instead, stayed close to its target. **Angel Ubide** observed that the equity risk premium was and remains elevated, above pre-crisis levels in most markets. He added that higher debt levels do not necessarily imply greater financial instability or excessive risk taking. On the long-term structural factors missing from the discussion, Ubide pointed to a lower natural interest rate, or r-star. The authors also did not want to explore this in greater detail as this was part of last year's Geneva Report.

Patrick Honohan agreed with Charles Bean and alluded to the complicated governance structure in the Eurozone which produced a bias in the period 2013-2015 that allowed the central bank to slip into a lower inflation because it has no unemployment mandate. On the wider front, Honohan was struck by the contrast between the wide range of inflation expectations by consumers and the narrow range exhibited in the financial markets. The markets seem to not realise that central banks could lose independence or could be given a different mandate.

Patrick Zweifel reported on research by market participants on the determinants of inflation. First, in many countries, and especially in the UK and Japan, the Philips curve is much more stable when core inflation excluding VAT is utilised. Second, net foreign assets help explain well the current levels of inflation across countries (but it is not sure how much of this remains true over time), which is similar to Goodhart's comment about the need to look at a migration-

augmented Philips curve. Finally, during the post-crisis period productivity has been really low, which has kept inflation much higher. In the same spirit, **Carlo Monticelli** raised concerns about overlooking the role of on asset price inflation. He also wondered whether the concept of monetary neutrality might help the comparison of 'Econ 101' predictions and actual data.

Edmond Alphandéry opined that the monetary and financial history of last ten years has been mired in fear: fear from politicians of being accused of not holding accountable those who had been at the heart of the financial crisis, and fear from central banks of not preventing the economy from falling into the kind of depression which afflicted the world in the 1930s. These fears led not only to overreactions in bank regulations (Basel III), which contributed to restraining the supply of credit by banks, but also to monetary overprotection which induced huge increases in central banks' balance sheets. We then had to cope with the damages caused by the impact of credit rationing on economic activity in the Eurozone in the first place, as well as with the consequences of huge increase in liquidity on currency movements: the appreciation of the dollar vis-à-vis the euro, coupled with credit restriction, has been a major factor of aggravation of the euro crisis.

Stefan Gerlach suggested that the question posed in the report's title – good luck or good policies? – is premature since central banks across the world have been unable to raise inflation to their objectives. While the Fed has almost succeeded, the ECB is only half-way there, and the Bank of Japan has not managed to do so after two decades of trying. The SNB also has some way to go. The report shows that 'pure inflation' was extremely stable until 2009 in the US and 2010 in the Eurozone and then fell by a half. Hence, the relevant questions are: "Is it bad luck or bad policies?" and "Why doesn't it move?"

Yi Huang asked if the authors had measured any effects of spillovers from QE in advanced economies to low income countries, especially emerging markets. He was keen to understand what kind of distortions in emerging markets were at play and, in particular what happened to capital controls and capital flows? Finally, he brought attention to the new literature that provides real-time surveys from online markets.

Edmond Alphandéry contrasted structural changes in the Philips curve and structural changes in the demand for money. He observed that the debate focused on the former. Yet, the current puzzle – huge money expansion and no inflation – means that there has been some upwards shift in the demand curve for money. Both central bank base money and bank money seem to have experienced this shift. He suggested looking at three potential drivers of demand for money. The first is a self-perpetuating mechanism. With low inflation, the opportunity cost of holding money is low, which helps sustain the demand for money and therefore low inflation (this could prove to be unstable in case of sudden increase in the velocity of money which may lead to spike of inflation). The second is demand for safety: money is an appealing safe asset in a low inflation period, which leads the balance between supply of and demand for reserves to be obtained even with the creation of a greater amount of base money. The third is a structural driver: with an expanding financial system, we may be experiencing an increasing transaction demand for money, which may require more liquidity. Such an assessment could help guide monetary policymakers on central balance sheet management. If the demand for the safe assets provided currently by central

banks proves to be lasting and self-perpetuating, then from a macroeconomic and financial stability perspective, central bankers should be careful about the pace of shrinking the size of their balance sheets.

Claudio Borio agreed with Charles Bean and Stefan Gerlach that the key question is why, despite all central bank efforts, it is very hard to get inflation up. In this context, he believes that long-term structural factors such as the role of technology and globalisation, including the entry of erstwhile communist countries into the trading system, need to be considered. The idea is that global factors, in general, have risen in importance relative to domestic factors. At least to some extent, the issue can be considered in the context of the traditional Philips curve by looking at the relationship between global and domestic output gaps. But it goes well beyond that and it runs deeper. The essence is the increased contestability of markets and what has happened to the pricing power of both labour and capital. This makes it much harder to obtain the wage-price spirals of the past and implies a breakdown of the Philips curve at the global level.

Katrin Assenmacher clarified that she did not say that the price level is proportional to M3, but that it is important to look at the banking sector to understand the transmission of monetary policy. She added that she is agnostic about the relevant aggregate – money or credit. To some extent, during the times when monetarists were developing their theories, there was not much difference between the asset and liability sides of banks' balance sheets. This of course has changed a lot with the evolution of the financial system. The Great Depression was taken as an example that money can develop quite distinctly from reserves, which has implications for lending rates – the disconnect between policy instruments and lending rates. Policy has dealt with this disconnect before and the report should look at that episode to understand the lessons learnt.

Patrick Honohan emphasised the importance of local factors in determining inflation – with examples such as Venezuela and Brazil – and how local institutions respond to global impulses. He added that these global impulses have had a downward bias. However, when the recession threatened economies with low inflation, there was a positive impulse from commodity prices. This partly is the reason why the Philips curve does not explain the inflation during that period. This is why looking at the patterns of inflation across the world is an interesting issue to explore.

David Miles acknowledged that the disruption in the financial system is absolutely crucial to our understanding of how expansionary a given setting of monetary policy was. This disruption lay at the heart of the recession and of the breakdown of credit supply and investment. It has affected real activity and expectations. Yet, when focusing specifically on the inflation process, these channels are not overlooked by focusing on the link between employment slack and inflation. The mechanism by which the financial sector had its effect on inflation was through the impact on activity and employment. **Charles Goodhart** agreed, but argued that activity and employment cannot be seen within a single-country context. In a globalised world, competition is much wider. Quite how we could deal with it is not clear. What are the relevant effects of unemployment in the Eurozone relative to the unemployment in the UK on the UK's Phillips curve? He considered again the question of why inflation did not go down much more. Short of a clear answer, he raised three potential explanations. First, China was enormously important. Its expansion, leading to a rise in commodity prices, held things up dramatically. Second, the best thing central banks did was QE1 in

the US and the UK. This massive increase in liquidity stopped the liquidity crisis. Finally, by indicating that they were going to keep inflation to target, central banks did a lot to stabilise expectations.

Ricardo Reis indicated that attempts in the literature to include global factors in the Philips curve resulted in a general finding that a lot of the effects work through existing inflation expectations. Any misspecification from ignoring global factors would be in a 'system versus single equation' sense and not in an omitted variable sense. The report does discuss the correlation in policy rates and interest rates across countries as a proxy for channels of globalisation. Responding to Olivier Jeanne on how inflation is so anchored and how do we think about it in terms of modern models of expectation, he explained that households will rationally stop paying attention to inflation when it is stable. This could create a certain illusion that inflation expectations are well anchored, but it could be unanchored in the sense that less people are relying on information regarding inflation. This could result in the widening spread of expectations, which is what is found in the data. Thus, anchoring in modern models is more fragile than we would think. Addressing Patrick Honohan's comment about debt, Reis mentioned that the maturity of the debt held in private hands in the US is at its lowest in decades. If you focus entirely on private investors (taking the Fed and other government agencies out), the duration of the overall portfolio is around two years. Essentially, the market is not expecting inflation, but is also not holding debt of duration more than two years. Responding to Reis, **Luigi Buttiglione** pointed out that the impact of globalisation has increased exponentially since the mid-2000s. The contribution of global factors has increased dramatically according to r internal work conducted at his institution.

Charles Wyplosz added two observations on globalisation and technology. First, the argument about labour market contestability is taken care of in the report, as demonstrated by Olivier Jeanne in his presentation, showing that the coefficient on unemployment in the Philips curve decreased during the 1990s. Second, labour markets may have profoundly changed to the point that the measure of unemployment used in the Philips curve is not the right one.

Jacques Delpla raised a question about the measurement of inflation. CPI data are taken for granted. However, there was the Boskin Commission Report in the US which analysed CPI and suggested inflation might be overstated by half a percentage point. In early 2017, a paper by Philip Aghion and co-authors analysed how creative destruction may distort the CPI (Aghion et al. 2017). They find that the US CPI is overstated by about 1.1%, with a slightly lower effect in the Eurozone countries. **Stefan Gerlach** noted that if the Philips curve flattens, central banks' incentives also change, which can affect the volatility of inflation. A textbook example would be that if a central bank is engineering a recession to contain inflation, a flatter Philips curve would require a larger recession. If the central bank was worried about both output and inflation, it would seek to stabilise inflation less in order to avoid having to cause a large and costly recession. Thus, a flattening of the Philips curve will have consequences for both inflation volatility and economic activity. **Ugo Panizza** responded by stating that the example would hold up if the Philips curve were to flatten throughout. However, we observe that the Philips curve flattened at very low levels of inflation. Ugo Panizza also added that the issues considered in the Boskin Report are long-term structural issues of mismeasurement of inflation, whereas this report focuses on short-term responses to a massive shock. Ricardo Reis added that the report takes

a narrow focus, taking as given the mandate of stable CPI inflation as defined by the CPI in most advanced economies. The issue of optimal inflation target was partly discussed in last year's Geneva Report.

In response to the observation that central banks are 'doing too much', **Angel Ubide** mentioned that he cannot reconcile this remark with the observation that inflation is low given central banks' price stability mandate. We seek price stability because we believe in 'divine coincidence' – that price stability provides maximum sustainable growth. If Olivier Jeanne's comments about hysteresis are right, the right mandate for central banks then would mean maximum growth and not price stability.

The Geneva Report: Policies

Comments by the discussants

Agnès Benassy-Quéré, *University of Paris I and Council of Economic Advisers*
The report suggests that we did not witness a deflationary spiral in the aftermath of the crisis, and that this was the result of a combination of good (monetary and fiscal) policies, good luck (commodity prices) and nominal (downward and mark-up) rigidities. She intended to challenge some of these conclusions, starting with the absence of a deflationary spiral. While inflation did not dip into negative territory, at least not for a prolonged period, comparing nominal GDP growth rates with ten-year nominal interest rates in major advanced economies tells an interesting story. In the pre-crisis period, these rates were equal in the US and the UK. Nominal interest rates were slightly higher than growth rates in the Eurozone. Between 2010 and 2015, nominal growth was again higher than the interest rate in the US and the UK, but not so in the Eurozone where the interest rate was actually higher than GDP growth. If low inflation and low GDP growth in the Eurozone are a consequence of deleveraging, concerns of deflationary pressures are not unfounded. Furthermore, in 2014 commodity prices plunged, which exerted downward pressure on CPIs. The disaggregated picture tells us that prices grew faster in the service sector but, in the Eurozone at least, industrial prices grew at a rate very close to zero.

Moving on to downward price rigidity, it is important to account for country heterogeneity in the Eurozone. This is crucial given that public debt of each country is serviced with taxes that are indexed not on the Eurozone CPI but on individual country CPIs. For example, Ireland experienced two years of deflation in 2009 and 2010 but also recovered very quickly. This raises the question as to whether a quick, violent adjustment of prices is a better process, since it may not move expectations as the private sector has no time to adjust to a new normal. In this sense, nominal rigidities may not be a blessing. In the case of Germany there seems to be upward nominal wage rigidity too. A flat Philips curve might not be good news for intra-Eurozone adjustments if downward rigidities affect expectations.

Early on during the crisis, the fiscal stance in the Eurozone was aligned with monetary policy, which prevented deflation. However, during the period 2012-2013, although the output gap and inflation went down, Eurozone governments jointly carried out a strong fiscal consolidation. The consolidation efforts in 2011

and 2012 were driven largely by Germany and the Netherlands, two countries that were not obliged to do so according to the Stability and Growth Pact (SGP) rules. In 2013, it was mostly driven by the countries that had to adhere to the SGP rules. Fiscal policy did not support monetary policy in these years.
Four policy implications drawn by the report warrant comments:

- **Inflation target.** Since there is a high likelihood that neutral real interest rates will remain low, ideally higher inflation targets would be appropriate. However, the idea inevitably raises important questions regarding central bank credibility. The report cites New Zealand as an example of a country successfully raising the inflation target. New Zealand increased its inflation target in two steps: the upper bound in 1997, and the lower bound in 2002. While the increase appears to be broadly credible, recent data suggest that inflation is slipping below the lower bound. What is the best means, and when is the best time, to raise the target?
- **Central bank balance sheets.** Benassy-Quéré agreed with the report that large central bank balance sheets are benign when they reflect the demand for reserves and there is limited risk of inflation. However, she felt that maturity risk was a concern, since it forces central banks to hold the bonds to maturity. She also expressed concerns with price distortions and scarcity of collateral if the central bank carries out quantitative easing over a long period. With regards to the recommendation that central banks could shorten the maturity, she emphasised that it ought to be in line with forward guidance.
- **Forward guidance.** The report argues that forward guidance is secondary when interest rates are above zero, however, central banks may still wish to affect the yield curve. This is not a new observation, but central banks used to focus earlier on the short end of the yield curve, while now they focus more on the long end.
- **Mandate.** The report argues that inflation targeting is not a straitjacket and allows for flexibility. Yet, the suggestion that financial stability should be addressed by macroprudential policy is not as straightforward as it seems, since the two policies may sometimes point in opposite directions.

Fiscal dominance is not the only threat to central banks' independence. In fact, there are several circumstances when the central bank needs to coordinate with other policies. At the zero lower bound, monetary policy must be coordinated with structural policies (product and labour market reforms, which may put downward pressure on prices). During a credit boom, it needs to coordinate with macroprudential policies. However, the Eurozone still lacks an adequate coordination mechanism; monetary, fiscal and macroprudential policies are organised separately. For example, the European semester is a completely separate process from macroprudential policies. Another example concerns country-specific recommendations at the end of the semester. Within the European semester, the Commission produces country-by-country recommendations, with little concern about the aggregate impact of all the recommendations.

Furthermore, the Eurozone is striving for an aggregate budgetary policy without a budget. The question then is whether it will ever work. The difficulty is that since sovereign debt is still national, there is a need to look at country-level data when designing euro-wide policies.

Mathias Hoffmann, *University of Zurich*

The report is a forensic investigation of missing inflation. Yet, a striking correlation is missing or is only mentioned tangentially. The global financial crisis was a major asset price bust. While there was no deflation during that bust, there wasn't much inflation during the preceding asset price boom either, and none since the crisis. This calls for a reconsideration of the role of asset prices in explaining missing inflation. This issue is related to the classic (pre-2008) literature on whether monetary policy should target asset prices. At the time, the discussion was largely driven by a concern for financial stability. But with hindsight, it could also be reframed to consider why the pre-2008 asset price boom has not been inflationary.

Asset price movements (in particular, real estate prices) simultaneously affect the demand and the supply side of an economy. Positive demand shocks increase inflation. Positive supply shocks decrease it. If asset price shocks affect both demand and supply at the same time, the result could be that inflation is flat, but the output effects are additive. A strict inflation-targeting central bank may then decline to act, leaving to individual countries the task of dealing with the output effect. This may create serious tensions if the monetary union is not an optimum currency area, which the Eurozone is not. Indeed, in a recent reassessment of their classic 1993 paper, "Shocking Aspects of European Monetary Unification", Bayoumi and Eichengreen confirm that the United States remains closer to an optimum currency area than the Eurozone, and they ascribe this pattern of divergence in the Eurozone to persistent asymmetries in the financial sector (Bayoumi and Eichengreen, 2017).

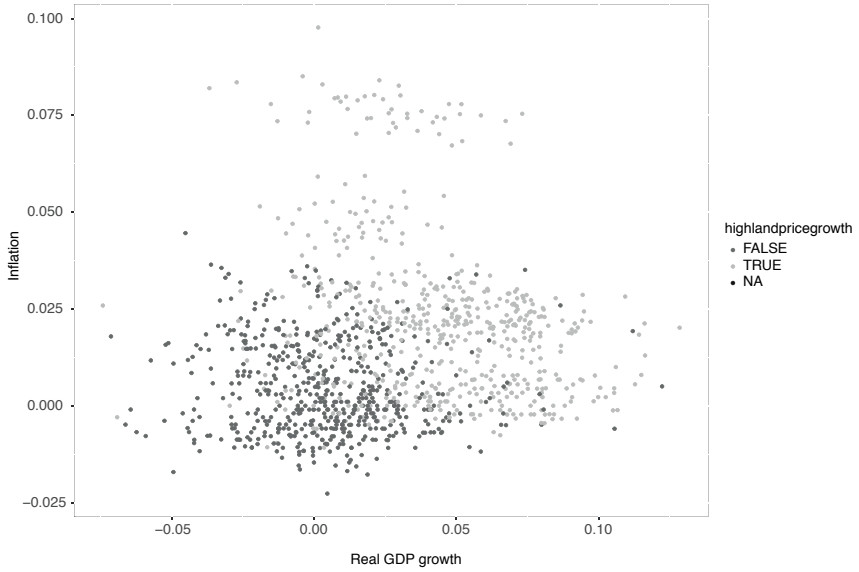
Japan is an ideal laboratory for booms and busts in real estate in the 1980s and 1990s. Land prices rose sharply in the 1980s and collapsed in the 1990s (see Figure 1). These swings represented a huge shock to the bank lending supply. In a scatter plot of prefecture-level GDP growth and CPI inflation for the period 1980–2005, we can observe a roughly positively sloped relationship, as expected from the Philips curve. However, segmenting these observations by pre-1990 boom years and post-1990 bust years one slope does not fit anymore – the correlation becomes negative (potentially distorted by some extreme observations) for the boom years while remaining positive for the bust years.

Figure 1 Japanese land price and lending growth in 1980s and 1990s

A: Land prices

B: Lending growth

Figure 2 Japan: Prefecture-level GDP growth versus CPI inflation, 1980–2005



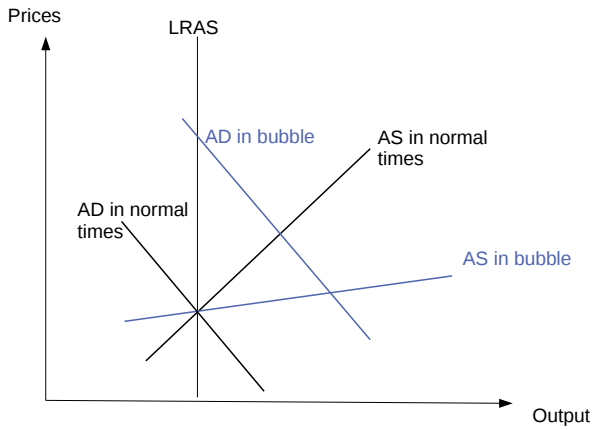
For the period 1980-2005, an asset-price augmented Phillips curve identified using local land price growth interaction terms shows that the Philips curve becomes flatter higher during a land price boom (see Figure 2). The coefficient for the interaction term between land price growth and output is negative. A level effect also indicates that higher land price growth goes hand in hand with higher average inflation (a positive coefficient for the standalone land price term). These results seem to reflect the fact that land is important collateral used by manufacturing enterprises. Since this evidence is from prefecture-level data, it could be argued that the flattening of the slope is specific to the 1980s, since aggregate inflation came down, and that the negative relationship is spurious. However, the result still holds over the period 1988-1994, when inflation had already stabilised.

This empirical evidence – that the Phillips curve flattens during asset price booms and becomes steeper during asset price downturns – suggests that the role of asset prices in driving inflation dynamics deserves scrutiny. If firms are financially constrained and hold a portfolio of collateralisable assets, then (expected) asset price increases reduce expected future marginal costs since they make it less likely that the firm will be credit-constrained. In the new-Keynesian framework if firms reset prices periodically à la Calvo, firms would not set prices quite as high as they otherwise would.

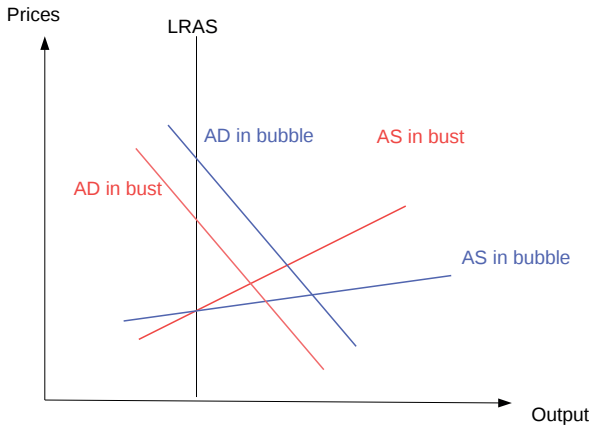
At least until 2009, good policies meant that, around the globe, inflation expectations were anchored. The result was a flattening of the Philips, or aggregate supply (AS), curve. In the presence of an asset price boom, the aggregate demand (AD) curve shifts out and the AS curve rotates down. If the AS curve only rotates because inflation expectations are anchored, the outcome is a non-inflationary boom. The ensuing asset price bubble bust causes the AD curve to shift inwards and the AS curve to rotate up. In the end, we observe a boom followed by a bust with inflation initially flat and then declining.

Figure 3 Philips curve: Asset price boom and bust

A: Asset price boom: AD shifts out, AS rotates down



B: Asset bubble bursts: AD shifts upwards, AS rotates up



This illustrates the need to improve our understanding of the link between asset price movements and inflation. This calls for an integrated view of the role of asset prices as determinants of financial constraints for financial and non-financial firms. True, a convincing model of asset prices within a macroeconomic framework has probably been the hottest prize for a while.

Floor discussion

Are central banks too good or behind the curve?

Arnaud Marès, *European Central Bank*

Governance is one important point to discuss that was not raised in the report or in the general discussion so far. The report seems to assume that central bank independence – i.e. the central bank being solely responsible for achieving price stability – will prevail. Central bank independence may not be as secure in the future as it was before.

That inflation expectations have been well-anchored was not due to good luck – it was hard earned. There were clearly a few moments when inflation expectations were more loosely anchored, times when market participants doubted the central bank's willingness and ability to raise inflation. For the ECB, it was in 2014, before it engaged in asset purchases and when market participants thought it would never dare to do so. If the ECB dares to buy government bonds, it will not be allowed. If allowed, it will not find bonds. And finally, if the ECB finds bonds, then it will not work anyway. The ECB was able to demonstrate that it was allowed to undertake asset purchases, it could find bonds and that, on the whole, it worked.

The ECB was thus able to regain its credibility, but at a cost. The cost is possibly a partial loss of legitimacy. Asset purchases are inevitably distortionary, almost by construction. The implication is that there is a clear distributionary effect. Asset purchases interfere with the distributional allocation of resources. Therefore, there is a fiscal component to this. The ECB blurred the boundaries between monetary and fiscal policies. Two conclusions can be drawn. The first is that the ECB should not undertake asset purchases if the mandate of the central bank is to achieve price stability under the constraint of not interfering with other aspects of policy. But that is not what the law states. The law states that, to deliver its mandate, the ECB has to *minimise distortions* to other fields of policy. In fact, that is the view the ECB has taken. Second, regarding the good luck or good policy question, on the ground it felt like the ECB was unlucky. In addition to the initial shock of the financial crisis, there was also a self-imposed recession in Europe for well-known reasons. The ECB had to deal with market fragmentation along national lines and with a fiscal policy stance that was unable or unwilling to provide much support to the central bank for two or three years at least. In addition, there was also a significant transition of the banking system. While this is normal after a crisis, it was compounded by the regulatory agenda rolled out in the aftermath of the crisis. While making the system stronger and more resilient in the long term, this had contractionary or restrictive effects in the short run.

Is the success down to monetary policy alone? No, it is also due to other policies that were carried out by the ECB on the margins of monetary policy. These actions include all the work done to repair the financial fragmentation and the efforts to get the banking system more quickly into a position to transmit the monetary policy impulses from the ECB. An example is the use of the Asset Quality Reviews (AQR) imposed on banks to provide greater traction for monetary policy. A conscious choice was made to make AQR the core of the comprehensive assessment of bank balance sheets. Two positive outcomes were expected from this exercise. First, AQR would provide increased transparency on the asset side of balance sheets, thus increasing the likelihood of finding again a clearing price.

This would allow banks to proceed to asset carve-outs if they choose to do so, and therefore to accelerate the transition into balance sheet structures that they needed. Second, it would reduce the opacity premiums that were weighing on the price-to-value ratios of banks and, in turn, facilitate their ability to raise the required capital. While AQR was a micro-supervisory exercise, the associated incentives had macro effects that helped on the margin. The cumulative impact of these policies was to help the ECB regain traction on monetary policy.

The independence of central banks like the ECB should be thought of in terms of 'independence and interdependence'. Interactions between the various elements of policies matter a great deal for the likelihood of success or failure. Realistically, it is reasonable to assume that the next time we face a negative shock, monetary policy might not have normalised to such an extent that we will be able to use the interest rate policy alone. Indeed, we may have to rely again on the unconventional measures used this time. If we do rely on unconventional measures, then the distortionary effects discussed earlier might be sub-optimal. Monetary policy might work, but at a cost to welfare over time. This in turn may contribute to raising tensions in the political realm.

Another word of the caution is that while we have managed to avoid deflation, we have not demonstrated that our tools would have been sufficient to emerge from a deflation. Perhaps they would be, but this has not been empirically established. Going forward, this is an argument to err on the side of caution and to adopt more pre-emptive, rather than reactive, policies. We also need to emphasise that monetary policy alone is not sufficient. Perhaps we do not need full coordination, but it is increasingly important to at least recognise that monetary policy may not succeed alone.

Huw Pill, *Goldman Sachs*

The question at hand – are the relatively good outcomes we have seen on price developments over the last five or six years the result of good policies or good luck? – would be judged to be a leading question in a court of law. Asking the 'good policies or good luck' the question is indicating that there has been a good outcome. To some extent, there is ambiguity in the report – and perhaps ambiguity across the authors – about how good an outcome it is. We have avoided disinflation and hyper-inflation. However, in the Eurozone context, Angel Ubide asked how comfortable we should be with core inflation stuck very persistently at 1%, when the definition of price stability points to 2%. The report suggests that we got good outcomes because of some luck, but also because general policies have been good. Arnaud Marès suggests we were not lucky but in fact unlucky, and policies must have been really good. While Marès' view deserves sympathy, a contrarian view has merits too. Indeed, there is a danger of complacency from within the profession. As indicated by Ricardo Reis, many observers may believe that inflation is dead. In the spirit of a famous exchange between Zhou Enlai and Richard Nixon, the right answer to the question addressed by the report is "too early to tell." And it will be for a long time yet. We should think about it in terms of a setup of a regime as discussed by Marès, and not just an outcome in a very narrow window. That regime does not consist just of monetary policy but of a whole array of other policies.

The flexible inflation targeting world we had in its first 10 or 15 years was one where things looked pretty clear cut. But the experience with the financial crisis suggests that a lot of the apparently clear division of functions which made central bank independence something relatively simple has begun to breakdown. Agnès Benassy-Quéré's comment on whether macroprudential policy is really a totally independent instrument is an illustration of the same. This institutional uncertainty is particularly relevant to the Eurozone, with its inadequate institutional structure. Discussions in the UK about governance of QE and the reliance by the Federal Reserve on a set of legally questionable devices to get the non-standard policies through go in the same direction. Central banks have been marching very much at the margin of their independence. This in turn raises questions about legitimacy that Arnaud Marès pointed to. Thus, the key question here is: how do we institutionalise the new regime so that it is applicable to a broader set of circumstances?

The contrarian view starts with the observation that it is not surprising that central banks are doing a good job. Central banks are powerful institutions led and staffed by very able people. The stable inflation mandate has been ingrained for many years in now central banks (for 20-25 years in Anglo-Saxon central banks, and for 70 years in German-speaking central banks). Central banks realise that stable expectations are their key mandate, which they have delivered, as documented in the report. However, as Charles Goodhart hinted at, central banks had more ambiguous objectives in the post-war period. Thus, the first question should be what their mandate is. Second, in successfully achieving low inflation over the last few years, what are the side effects of central bank policies? This is the flip side to the positive developments suggested by Arnaud Marès in terms of how other institutions are helping to achieve positive outcomes. During the great moderation, inflation was squeezed out but at the expense of shifting irreducible vulnerabilities that exist in the economy into commercial and investment bank balance sheets. Through the addition of regulation and macroprudential policies, vulnerabilities may have been squeezed out of the financial system too. Where do they go next? Perhaps into the political system and its populist dynamics. This is an important concern for market participants who worry that such a regime switch may end up in an inflationary environment driven by fiscal policy, or in a deflationary environment driven by a breakdown of institutional structures. This is a tail or non-linear risk, better characterised by Knightian uncertainty. It is a form of uncertainty which is very difficult to price, and we should not draw much comfort from financial measures of inflation expectations.

Three aspects of the report merit further scrutiny. First, the success of changing the inflation target will ultimately depend on the credibility and legitimacy of the institutions that do it. Hence, the question of where credibility comes from needs to be answered. Second, although fiscal dominance sounds a reasonable question to raise, it has remained a taboo. Taboos remain taboos in society for deep reasons, and should not be taken lightly. Finally, how do we decide what the structure of an optimal central bank balance sheet should be? Initially, the ECB's objective was to have a narrow balance sheet. We could now be headed to a regime where central banks have wide balance sheets and they hold and actively manage large portfolios of assets that they believe are systemically important for the transmission of monetary policy. Central banks with large portfolios are better able to act easily in a pre-emptive manner than those that need to build up balance sheets and build portfolios when problems arise.

General discussion

David Miles thought that outcomes have been generally good overall. Given the massive scale of the crisis, inflation held up relatively well even if it has been persistently a bit under target. This is by no means a judgement of what is happening in the economy as a whole, but a narrow evaluation of inflation outcomes. He disagreed with Huw Pill's point that the low inflationary period during the Great Moderation might have caused instability to morph from nominal inflation into bank balance sheets. The real problem was the very permissive regulation that allowed capital and equity to be driven down to extraordinarily low levels relative to balance sheets and enormous leverage. **Angel Ubide** took a slightly different view when he opined that policies were good but maybe not good enough. He agreed with Arnaud Marès and Huw Pill about the importance of looking at the whole regime. We need to understand how to build a regime that delivers credibility even when it involves fiscal and supervisory policies.

Referring to the title of the report, **Alexander Swoboda** recalled a discussion from 2000 of whether the Great Moderation was a result of good luck or good policies or structural changes in the economy. He suggested that the report should also consider structural elements.

Gaston Gelos pointed out that a very benign (and probably somewhat simplistic) interpretation of the inflation experience since the global financial crisis would be that central banks' hard-earned credibility had paid off. Despite the factors that were already weighing on inflation (such as globalisation and demographic developments), the enormous shock implied by the crisis did not result in a de-anchoring of inflation expectations because central banks were seen as credible – a big success. He also suggested that the formation of inflation expectations remain to be better understood. Many years ago, he and co-authors found that fiscal expectations mattered significantly for inflation expectations in emerging markets. Possibly, fiscal expectations also played a role in keeping inflation expectations stable in the post-crisis environment.

Ivan Adamovich agreed with Huw Pill on the need for greater clarity about what large central bank balance sheets mean. He also raised a few questions about the report. First, the argument that the track record of large balance sheets shows that they don't produce problems is not a valid one. As is well known in finance, past performance is not an indicator of future performance. The second alluded to Arnaud Marès comment about the absence of distortionary impacts of central bank actions on the financial markets. The nature of these distortions is not clear and needs to be further explored. For example, there could be a crowding out of private money from the system, which would not be a good development. Third, central bank asset purchases could either directly or indirectly finance public debt. This might be a good idea for a short time, but surely it is not a good idea for a long period of time. The report should discuss what the implications of large balance sheets are for the financing of public debt. Finally, the public does not really understand what large central bank balance sheets do and what their effects are. This could open the door to populism. He concluded by stating that there should be greater clarity over whether central bank balance sheets are too big.

Signe Krogstrup drew attention to the implications of large central bank balance sheets for financial market structures. What kind of institutions should have access to central bank balance sheets? Historically, it has been banks, but is that still an optimal policy? Do we need a rethink if we switch permanently to a system where central banks have large balance sheets? For financial stability, there are many other institutions that could benefit from having this access. For example, corporates also had funding constraints during the crisis, not to mention households.

Ricardo Reis acknowledged that interdependence is an important issue. It is a lesson about the general macroeconomic equilibrium, since you cannot talk about an issue without considering how it affects other issues. It is also a lesson about political institutions, involving among other aspects accountability. While interdependence is important, ultimately there is a general consensus that central banks control inflation in the long run. In terms of the performance, for example, over an 18-year period the ECB has delivered 1.9% inflation on average. Was it conceivable that a central bank would be that close to its target over nearly 20 years? Thus, the report assigns 'good' as opposed to 'bad' as a suffix to luck or policies in the title. Regarding central bank balance sheets, Reis added that it is critical to separate out different dimensions. First, if a large amount of reserves and liabilities is matched by three-month government bonds – the central bank is exchanging one government liability issued by the central bank for another one issued by the treasury – the central bank is funding a fiscal deficit, which is a fiscal issue. Second, if – as in the case of the US or the UK – the central bank acquires a lot of long-term government bonds, then the central bank loads on interest rate risk. Holding these assets to maturity means that losses could materialise if overnight rates increase. What does such maturity transformation by the central bank imply for the role of the banking sector? Third, should the central bank load on non-government risk and acquire private assets? This could lead to the crowding out of private capital. Finally, as they purchase short-term bonds, central banks crowd out the private provision of liquidity. The extent to which this is desirable depends partly dependent on the mandate. Many central banks, along with their price stability mandate, are given the mandate to prevent liquidity shortages or to supply safe assets. From that perspective, they may need a large balance sheet that purposely crowds out private money creation. Would that change institutions radically? Is that a good idea or no?

On the optimal size of central bank balance sheets, **David Miles** added that one answer could be that central banks would pay interest on reserves and let private banks decide how much reserves they want to hold. Post-crisis private banks may consider that interbank markets may not be reliable and may choose to hold large amount of reserves. In this case, neutral assets that can be held by central banks are short-dated government bonds with no risk of generating gains or losses for the central bank. If with such an approach central banks end up with large balance sheets, then this reflects the value placed by commercial banks upon the liquidity provided by the central bank. This is hard to describe as 'distortion'. On the question on tier 1 capital, David Miles offered a personal view. He believes many banks across Europe now have tier 1 capital to the order of about 10% of risk-weighted assets. This is much higher than it was in the past. However, tier 1 capital relative to unweighted assets is significantly lower because risk-weighted assets are much lower than unweighted assets. Thus, in terms of leverage, it probably allows 95% of assets to be financed through debt of one

form or another, and 5% through equity. That still is an extraordinarily high leverage ratio. Although the tier 1 capital is lot higher than before, it may not yet be at the optimal level.

Charles Wyplosz mentioned that we are all miffed that it took so long for central banks to bring inflation up. We know how to bring inflation down, but not how to bring it up. Could that be the reason why we were worried for last few years? Was it fear of deflation? What is the problem with deflation? Is it only debt deflation that is a problem? In that case, what is the solution? Switzerland has had negative inflation for two or three years and there have not been many complaints. History could shed light on the demerits – or otherwise – of deflation. Finally, Wyplosz recalled that the last time a crisis of such a magnitude occurred, it was soon followed by a very important and innovative literature – basically, the birth of macroeconomics. Many questions are being asked now, with a view to doing better next time. Is fiscal–monetary coordination essential? Are distributional issues critical to avoid political fallouts? Is expanding balance sheets the way forward? The answers seem slower in coming than last time.

Dirk Niepelt questioned whether more expansionary fiscal policy would have stimulated growth. In the presence of high default and denomination risks, such a policy could have pushed up effective real interest rates, with contractionary effects. Incidentally, a risk-induced rise of the real interest rate could also have fed back into inflation dynamics. This could offer an explanation for why inflation did not immediately and strongly respond in the crisis. On policy coordination, Niepelt emphasised that under full commitment and absent politico-economic frictions, it is always optimal for fiscal and monetary policies to be coordinated. But overwhelming empirical evidence suggests that lack of commitment is key and politico-economic frictions are widespread. In light of this, second-best arrangements will surely want to maintain the separation of both policy areas.

Responding to Charles Wyplosz' comment about how we can do better, **Patrick Honohan** suggested that it would be worthwhile to consider how the four major central banks rank in terms of relative success in delivering their mandate. ECB perhaps ranks third (good in 2008 and 2009, but not so good in 2013-2015) and Bank of Japan last. The question then is why. Honohan suggested that credibility has been critical. Credibility is relatively more important than the tools employed, as is the ability to maintain credibility over time.

Carlo Monticelli asked if the authors would have changed the title or the broad conclusions of the report had the analysis been run on Japanese policies in response to the major shock that took place in the country following the burst of the bubble.

Jan Toth mentioned that the 20-year average inflation for the Eurozone is 1.7%. Before the crisis, the energy component of the consumer basket contributed 0.5% to inflation. Hence, we needed about 1.5% inflation from the core component. Energy prices are now unlikely to provide such a large contribution because of technological innovations on the energy front. Thus, the core components need to provide close to 2% of inflation. However, since the crisis the core has remained stable at around 1%, providing a low inflation environment. It would be great to see in the report what could have been done better; specifically, any suggestions on the relative effectiveness ranking of non-standard measures such as QE, forward guidance and negative interest rate policy. On coordination with fiscal authorities, he pointed out that it could have implications for central bank independence. The argument could be that that a central bank that has one

clear mandate cannot be independent if it needs help with its mandate. Toth suggested that central banks could adapt communication in two areas. First, be vocal on debt sustainability by producing reports on the issue. This could ward off concerns of fiscal dominance. Second, in order to avoid a low real interest rate environment, central banks should support actively structural reforms.

Jacques Delpla was interested in Olivier Blanchard's suggestion of increasing the inflation target to 4%. The 2% target is meant for normal times. For the second time in our history we have a low inflation target (the previous being the gold standard) and there are concerns of tail risks, including populism now akin to fascism in the 1930s. Is it better to have low inflation during good times, or is it better to have a buffer against tail risks that are not only economic but also political?

Olli Castrén suggested that it is important to realise that the counterparty to large central bank balance sheets is the fiscal liabilities that were created at the early stages of the crisis. Hence, it is not completely fair to claim that fiscal policies did not react to the crisis. They reacted forcefully at the early stages when the banking sectors and some cyclically sensitive industries, such as automobile production, were bailed out by governments in several countries. The resulting surge in government debt reduced the fiscal room later on, forcing the central banks to step into territory that really did not belong to them before. In this context, he asked the authors if they agreed that the large central bank balance sheets today were a reflection of the large fiscal liabilities created earlier. On Charles Wyplosz's comments about the risk of negative inflation rates, he mentioned that in a world with large fiscal liabilities, deflation creates serious problems in terms of debt sustainability. How will this issue eventually be solved? Would this have to lead to a gradual monetisation of fiscal debt with central banks continuing to reinvest their assets for ever, or can the central banks be sure that reducing their balance sheet stocks will not lead to sharp increases in government bond yields and fiscal unsustainability?

Michaël Malquarti saw the conference yielding a relative consensus that deflation has been avoided and that this is the result of good policies. This general feeling of satisfaction, albeit quite contained, is to be contrasted with the view, which emerges at the end of the day, that current policies are potentially problematic on other levels, especially politically, and that over the mid-to-long term many uncertainties remain. More generally, this prudent 'mission accomplished' statement on the inflation front is somewhat at odds with the feeling of dissatisfaction that we observe in the wider public, especially on the employment and purchasing power front, as if reaching inflation targets is to some extent irrelevant and actually missing the point. He suggested a title for the next conference: "Everything else and the great discontent: Bad mandate or bad system?"

Responding to comments on Japan, **Angel Ubide** pointed out that the authorities achieved what they wanted to achieve. Japan spent a decade and a half targeting 0% inflation, and they achieved 0% inflation. They decided to shift into positive inflation with 'Abenomics' in 2013 with three legs: monetary expansion, coordinated with fiscal expansion, coordinated with income policies. We should not forget that the Abe administration was involved in wage negotiations explicitly over the last three or four years. This policy cooperation has successfully shifted inflation expectations from -0.5% to where they are now. Can it be done? Yes. Are we willing to do what it takes, meaning explicit fiscal

and monetary coordination? Ubide then asked whether large balance sheets have a long history. Large balance sheets are about excess reserves. Having excess reserves is better for financial stability than having no excess reserves. The Reserve Bank of New Zealand did that several years ago and it has been very successful with no side effects. However, the countries that we consider first did QE. Then, they changed monetary policy instrument to interests on reserves. The conclusion is that excess reserves are good for financial stability and that they make no difference whatsoever to managing inflation once central banks pay interest on excess reserves. The narrative on how to get there is important.

Ugo Panizza observed that even now, after seven years, there are people who think that high inflation is lurking around the corner. We have not seen it so far and markets are not pricing it ten years ahead. Yet price stability should not be taken for granted. Responding to Dirk Niepelt's comment on why should we coordinate monetary and fiscal policies, he mentioned that the decision is a matter of trade-offs. In theory coordination would be effective, but in practice there are political failures associated with fiscal policy. If the weights attached to this trade-off change, we could consider changing the decision. Panizza also pointed out that the suggestion by Patrick Honohan to rank central banks based on their performance is a good idea but could be unfair. The Bank of England would rank first when you look at the outcomes, but their task can be thought of as easier. Compared to the US, the UK is a smaller economy and exchange rate movements made the job easier.

David Miles did not believe that is quite right that that large central bank balance sheets came about because the fiscal deficit had gone up. The central banks expanded the balance sheet in reaction to a banking crisis, a recession and reaching the effective lower bound. They would not have expanded their balance sheets as they did if there had been an equivalent increase in fiscal deficits.

Charles Wyplosz observed that there seems to be a general consensus among the conference participants that central banks performed better than governments. He does not believe recommendations such as central banks sending signals about fiscal policy are the right response. Independence is a two-way street. Fiscal policy rules and independent councils are a better way to go because they hold governments explicitly responsible for their actions.

Jean-Pierre Landau reminded the audience that, twice in ten years, the Japanese government raised taxes when the economy was recovering. Both times the Japanese economy plunged back into deflation. The fiscal theory of the price level states that future expected fiscal policies anchor inflation to public debt. This is in line with the Japanese experience. Perhaps, the fiscal policy regime – the expected reaction function of the fiscal authorities – matters for inflation. **Angel Ubide** responded that the report clearly acknowledges that inflation is not only about monetary policy. Inflation is about economic policies and the policy mix. He added that the fiscal policy of price level is not even needed to justify that fiscal policy affects inflation. It is not about behaving irresponsibly but about adopting the right fiscal policy stance for the cyclical situation of the economy. For example, if the economy has a big output gap and the interest rates are zero, fiscal contraction is not ideal. That suggestion need not come from the central bank, but there should be agreement among all stakeholders for central bankers to talk with the government. **Jean-Pierre Landau** clarified

that, while it is generally accepted that the reaction function of central banks is extremely important in anchoring inflation expectations, it is less well recognised that the reaction function of fiscal authorities is equally important.

References

Admati, A. and M. Hellwig (2013*), The Bankers' New Clothes: What's Wrong with Banking and What to Do about It*, Princeton, NJ: Princeton University Press.

Adrian, T. and H.S. Shin (2008), "Financial Intermediaries, Financial Stability, and Monetary Policy", in *Maintaining Stability in a Changing Financial System*, proceedings of the Jackson Hole Economic Policy Symposium, Federal Reserve Bank of Kansas City, pp. 287-334.

Aghion, P., A. Bergeaud, T. Boppart, P. Klenow and H. Li (2017), "Missing Growth from Creative Destruction" (available at http://www.klenow.com/missing-growth.pdf).

Akerlof, G., W. Dickens and G. Perry (2000), "Near-Rational Wage and Price Setting and the Long-Run Phillips Curve", *Brookings Papers on Economic Activity* 31(1), pp. 1-60.

Armantier, O., G. Topa, W. Van der Klaauw and B. Zafar (2016), "An overview of the Survey of Consumer Expectations", Staff Report No. 800, Federal Reserve Bank of New York.

Auer, R., C. Borio and A. Filardo (2017), "The globalisation of inflation: the growing importance of global value chains", Working Paper No. 602, Bank for International Settlements, Basel.

Auerbach, A. and Y. Gorodnichenko (2017), "Fiscal Stimulus and Fiscal Sustainability," paper at "Fostering a Dynamic Global Recovery", A Symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole WY.

Babecký, J., P. Du Caju, T. Kosma, M. Lawless, J. Messina and T. Rõõm (2009), "Downward Nominal and Real Wage Rigidity – Survey Evidence from European Firms", Working Paper No. 1105, European Central Bank, Frankfurt am Main.

Bakker, B. (2015), "Employment and the Great Recession; The Role of Real Wages", Working Paper No. 15/229, International Monetary Fund, Washington, DC.

Ball, L. and S. Mazumder (2011), "Inflation Dynamics and the Great Recession", *Brookings Papers on Economic Activity* 42(1), pp. 337-405.

Ball, L., J. Gagnon, P. Honohan and S. Krogstrup (2016), *What Else Can Central Banks Do?*, Geneva Reports on the World Economy 18, Geneva: ICMB and London: CEPR.

Bank of England (2013), "Monetary policy trade-offs and forward guidance," London, 13 August.

Bank of England (2016), "Monetary Policy Summary and minutes of the Monetary Policy Committee meeting ending on 3 August 2016," London, 4 August.

Bank of England (2017), *Inflation Report, May 2017*, London.

Bank of Japan (2016), "New Framework for Strengthening Monetary Easing: Quantitative and Qualitative Monetary Easing with Yield Curve Control", Tokyo, 21 September.

Bayoumi, T. and B. Eichengreen (1993), "Shocking Aspects of European Monetary Unificaton", in F. Torres and F. Giavazzi (eds), *Adjustment and Growth in the European Monetary Union*, Cambridge: Cambridge University Press, pp.193-229.

Benigno, P. and L. Ricci (2011), "The Inflation-Output Trade-Off with Downward Wage Rigidities", *American Economic Review* 101(4), pp. 1436-1466.

Bernanke, B. (2010), "Federal Reserve's exit strategy", testimony before the Committee on Financial Services, U.S. House of Representatives, Washington, D.C. (available at https://www.federalreserve.gov/newsevents/testimony/bernanke20100210a.htm).

Bianchi, F. and A. Civelli (2015), "Globalization and Inflation: Evidence from a Time Varying VAR", *Review of Economic Dynamics* 18(2), pp. 406-433.

Blanchard, O. (2017), "The US Phillips Curve: Back to the 60s?", Policy Brief 16-1, Peterson Institute for International Economics, Washington, DC.

Blanchard, O. and L. Summers (1986), "Hysteresis and the European Unemployment Problem", in S. Fischer (ed.), *NBER Macroeconomics Annual, Volume 1,* Cambridge: MIT Press, pp. 15-78.

Blanchard, O., G. de l'Arricia and P. Mauro (2010), "Rethinking Macroeconomic Policy", *Journal of Money, Credit and Banking* 42, pp. 199-215

Blanchard, O., E. Cerutti and L. Summers (2015), "Inflation and Activity: Two Explorations and their Monetary Policy Implications", in *Inflation and Unemployment in Europe: Conference proceedings*, ECB Forum on Central Banking, Frankfurt: European Central Bank.

Blinder, A. (1997), "Is There a Core of Practical Macroeconomics That We Should All Believe?", *American Economic Review Papers and Proceedings* 87(2), pp. 240-243.

Blinder, A., D. Kohn, T. Jordan and F. Mishkin (2013), *Exit Strategy*, Geneva Reports on the World Economy 15, Geneva: ICMB and London: CEPR.

Blinder, A., M. Ehrmann, J. de Haan and D. Jansen (2017), "Necessity as the Mother of Invention: Monetary Policy after the Crisis", *Economic Policy* (forthcoming)

Bobeica, E. and M. Jarocinski (2017), "Missing Disinflation and Missing Inflation: The Puzzles that Aren't" Working Paper No. 2000, European Central Bank, Frankfurt am Main.

Boivin, J., M. Kiley and F. Mishkin (2010), "How Has the Monetary Transmission Mechanism Evolved Over Time?", in B.M. Friedman and M. Woodford (eds), *Handbook of Monetary Economics, Volume 3*, Elsevier, pp. 369-422.

Borio, C. and W. White (2004), "Whither monetary and financial stability? The implications of evolving policy regimes", Working Paper N. 147, Bank for International Settlements, Basel.

Brainard, L. (2017), "Understanding the Disconnect between Employment and Inflation with a Low Neutral Rate", speech delivered at The Economic Club of New York, 5 September.

Brunnermeier, M. and Y. Sannikov (2013), "Redistributive Monetary Policy," in *The Changing Policy Landscape*, Proceedings of the Jackson Hole Economic Policy Symposium, Federal Reserve Bank of Kansas City, pp. 331-384.

Cagan, P. (1956), "The Monetary Dynamics of Hyperinflations", in M. Friedman (ed.), *Studies in the Quantity Theory of Money*, Chicago, IL: University of Chicago Press, pp. 25-117.

Carlson, M., H. Shan and M. Warusawitharana (2013), "Capital ratios and bank lending: A matched bank approach", *Journal of Financial Intermediation* 22(4), pp. 663-687.

Carroll, C. (2003), "Macroeconomic expectations of households and economic forecasters", *Quarterly Journal of Economics* 118(1), pp. 269-298.

Cochrane, J.H. (2017), "Michelson-Morley, Fisher, and Occam: The Radical Implications of Stable Quiet Inflation at the Zero Bound", in *NBER* Macroeconomics Annual 2017, forthcoming.

Cogley, T. and T. Sargent (2002), "Evolving Post World-War II U.S. Inflation Dynamics", *NBER Macroeconomics Annual* 16, pp. 331-388.

Coibion, O. and Y. Gorodnichenko (2015), "Is the Phillips Curve Alive and Well after All? Inflation Expectations and the Missing Disinflation", *American Economic Journal: Macroeconomics* 7(1), pp. 197-232.

Coibion, O., Y. Gorodnichenko and R. Kamdar (2017), "The Formation of Expectations, Inflation and the Phillips Curve", *Journal of Economic Literature*, forthcoming.

Constancio, V. (2015), "Understanding inflation dynamics and monetary policy", speech at the Jackson Hole Economic Policy Symposium, 29 August.

Cœuré, B. (2017a). "Scars or Scratches? Hysteresis in the euro area", Speech at the International Center for Monetary and Banking Studies, Geneva, 19 May.

Cœuré, B. (2017b), "The transmission of the ECB's monetary policy in standard and non-standard times", speech at the "Monetary Policy in Non-standard Times" workshop, ECB, Frankfurt am Main, 11 September.

DeLong, B. and L. Summers (2012), "Fiscal Policy in a Depressed Economy", *Brookings Papers on Economic Activity* 43(1), pp. 233-297

Del Negro, M., M. Giannoni, and F. Schorfheide (2015), "Inflation in the Great Recession and New Keynesian Models", *American Economic Journal: Macroeconomics* 7(1), pp. 168-196 .

Draghi, M. (2017), "The interaction between monetary policy and financial stability in the euro area", speech at the First Conference on Financial Stability, Banco de España and Centro de Estudios Monetarios y Financieros, Madrid, 24 May.

Dupraz, S. (2016), "A Kinked-Demand Theory of Price Rigidity", mimeo, Columbia University.

Eichengreen, B. and K. O'Rourke (2010), "A tale of two depressions: What do the new data tell us?", VoxEU.org, 8 March (available at http://voxeu.org/article/tale-two-depressions-what-do-new-data-tell-us-february-2010-update).

Fallick, B., M. Lettau and W. Wascher (2016), "Downward Nominal Wage Rigidity in the US During and After the Great Recession", Finance and Economics Discussion Series No. 2016-001, Board of Governors of the Federal Reserve System, Washington, DC.

Fatás, A. and L. Summers (2016), "The Permanent Effects of Fiscal Consolidations", Working Paper No. 22374, National Bureau of Economic Research, Cambridge, MA.

Federal Open Market Committee (FOMC) (2016), "Statement of Longer Run Goals and Monetary Policy Strategy", Washington, DC.

Federal Reserve Banks (2017), *2016 Small Business Credit Survey: Report on Employer Firms*, New York: Federal Reserve Bank of New York.

Fender, I. and U. Lewrick (2016), "Adding it all up: the macroeconomic impact of Basel II and outstanding reform issues", Working Paper No. 591, Bank for International Settlements, Basel.

Firestone, S., A. Lorenc and B. Ranish (2017), "An Empirical Economic Assessment of the Costs and Benefits of Bank Capital in the US", Finance and Economics Discussion Series No. 2017-034, Board of Governors of the Federal Reserve.

Fisher, I. (1933), "The Debt-Deflation Theory of Great Depressions", *Econometrica* 1(4), pp. 337-357.

Fischer, S. (2017), "An Assessment of Financial Stability in the US", remarks at the IMF Workshop on "Financial Surveillance and Communication: Best Practices from Latina America, the Caribbean and Advanced Economies", Washington, DC, 27 June.

Friedman, M. (1968), "The Role of Monetary Policy", *The American Economic Review* 58(1), pp. 1-17.

Friedman, M. (1977), "Inflation and Unemployment", *Journal of Political Economy* 85(3), pp. 451-472.

Friedrich, C. (2016), "Global inflation dynamics in the post-crisis period: What explains the puzzles?", *Economics Letters* 142(C), pp. 31-34.

Fuhrer, J. (2017), "Expectations as a source of macroeconomic persistence: Evidence from survey expectations in a dynamic macro model", *Journal of Monetary Economics* 86, pp. 22-35

Furman, J. (2016), "The new view of fiscal policy and its applications", VoxEU.org, 2 November (available at http://voxeu.org/article/new-view-fiscal-policy-and-its-application).

Gambacorta, L. and H. Shin (2016), "Why bank capital matters for monetary policy", Working Paper No. 558, Bank for International Settlements, Basel.

Gilchrist, S., R. Schoenle, J. Sim and E. Zakrajsek (2017), "Inflation Dynamics During the Financial Crisis", *American Economic Review*, Forthcoming.

Hall, R.E. (2011), "The long slump", *American Economic Review* 101(2), pp. 431-69.

Hasenzagl T., F. Pellegrino, L. Reichlin and G. Ricco (2017), "A Model of the Fed's View on Inflation", presentation at the EEA-ESEM Annual Meetings, Lisbon, 21-15 August.

Holston, K., T. Laubach and J. Williams (2016), "Measuring the natural rate of interest: International trends and determinants", Working Paper Series No. 2016-11, Federal Reserve Bank of San Francisco.

International Monetary Fund (2013), "Unconventional Monetary Policies - Recent experiences and prospects", *World Economic Outlook*, Washington, DC.

International Monetary Fund (2016), "Global Disinflation in an Era of Constrained Monetary Policy", *World Economic Outlook*, Washington, DC.

Izquierdo, M, J. Jimeno, T. Kosma, A. Lamo, S. Millard, T. Room and E. Viviano (2017), "Labour market adjustment in Europe during the crisis: microeconomic evidence from the Wage Dynamics Network survey", Occasional Paper No. 192, European Central Bank, Frankfurt am Main.

Juselius, M., C. Borio, P. Disyatat and M. Drehmann (2016), "Monetary policy, the financial cycle and ultra-low interest rates", Working Paper No. 569, Bank for International Settlements, Basel.

Kiley, M. and J. Roberts (2017), "Monetary policy in a low interest rate world", *Brookings Papers on Economic Activity*, Spring.

Kitsul, Y. and J. Wright (2013), "The economics of options-implied inflation probability density functions", *Journal of Financial Economics* 110(3), pp. 696-711.

Mankiw, N.G. and R. Reis (2002), "Sticky Information Versus Sticky Prices: A Proposal To Replace The New Keynesian Phillips Curve", *Quarterly Journal of Economics* 117, pp. 1295-1328.

Mankiw N.G., R. Reis and J. Wolfers (2004), "Disagreement about Inflation Expectations", in *NBER Macroeconomics Annual* 18, pp. 209-270

Miles, D. (2015), "What Can Monetary Policy Do?", public lecture at Edinburgh University (available at http://www.bankofengland.co.uk/publications/Pages/speeches/2015/791.aspx).

Nakamura, E., J. Steinsson, P. Sun and D. Villar (2016), "The Elusive Costs of Inflation: Price Dispersion during the U.S. Great Inflation", Working Paper No. 22505, National Bureau of Economic Research, Cambridge, MA.

Nalewaik, J. (2016), "Inflation Expectations and the Stabilization of Inflation: Alternative Hypotheses", Finance and Economics Discussion Series No. 2016-035, Board of Governors of the Federal Reserve System, Washington, DC.

Nickell, S. and G. Quintini (2003), "Nominal Wage Rigidity and the Rate of Inflation", *The Economic Journal* 113, pp. 762-781.

Orlik, A. and L. Veldkamp (2014), "Understanding Uncertainty Shocks and the Role of Black Swans", NBER Working Paper No. 20445, National Bureau of Economic Research, Cambridge, MA.

Pivetta, F. and R. Reis (2007), "The persistence of inflation in the US*", Journal of Economic Dynamics and Control* 31(4), pp. 1326-1358.

Reis, R. (2016), "Funding Quantitative Easing to Target Inflation", paper presented at the Jackson Hole Economic Policy Symposium, 25-27 August.

Reis. R. (2017), "Can the Central Bank Alleviate Fiscal Burdens?", forthcoming in D. Mayes, P. Siklos and J.-E. Strum (eds), *The Economics of Central Banking*, Oxford: Oxford University Press.

Reis, R. and M. Watson (2010), "Relative Goods' Prices, Pure Inflation, and the Phillips Correlation", *American Economic Journal: Macroeconomics* 2(3), pp. 128-157.

Samuelson, P. and R. Solow (1960), "Analytical Aspects of Anti-Inflation Policy", *American Economic Review Papers and Proceedings* 50(2), pp. 177-194.

Sargent, T. (1982), "The Ends of Four Big Inflations", in *Inflation: Causes and Effects*, Cambridge, MA: National Bureau of Economic Research, pp. 41-98.

Sargent, T. and N. Wallace (1975), "'Rational' Expectations, the Optimal Monetary Instrument, and the Optimal Money Supply Rule", *Journal of Political Economy* 83(2), pp. 241-254.

Sims, C. (2016), "Fiscal policy, monetary policy, and central bank independence", paper presented at the Jackson Hole Economic Policy Symposium, 25-27 August.

Stock, J. and M. Watson (2007), "Why Has U.S. Inflation Become Harder to Forecast?", *Journal of Money, Credit and Banking* 39(s1), pp. 3-33, 02.

Stock, J., and M. Watson (2010), "Modeling inflation after the crisis", *Proceedings of the Jackson Hole Economic Policy Symposium*, Jackson Hole, MO: Federal Reserve Bank of Kansas City, pp. 173-220.

Sundaresan, S. (2017) "Rare events and the persistence of uncertainty", working paper, Imperial College London.

Svensson, L. (2017), "Cost-Benefit Analysis of Leaning Against the Wind", *Journal of Monetary Economics* 90, pp. 193-213

Swanson, E. (2017), "Measuring the Effects of Federal Reserve Forward Guidance and Asset Purchases on Financial Markets", Working Paper No. 23311, National Bureau of Economic Research, Cambridge, MA.

Taylor, J. (2016), "Unconventional Monetary Policy, Normalization, and Reform", testimony before the Subcommittee on Monetary Policy and Trade Committee on Financial Services, U.S. House of Representatives, 7 December 7.

Tobin, J. (1972), "Inflation and Unemployment", *American Economic Review* 62 (1), pp. 1-18.

Trehan, B. (2010), "Survey Measures of Expected Inflation and the Inflation process", Working Paper No. 2009-10, Federal Reserve Bank of San Francisco.

Tucker, P. (2016) "The political Economy of central bank balance sheet management", mimeo (available at https://www.newyorkfed.org/medialibrary/media/newsevents/events/markets/2016/frbny-columbiasipa-paultucker-paper.pdf).

Ubide, A. (2016), "The case for an active fiscal policy", VoxEU.org, 11 October (available at http://voxeu.org/article/case-active-fiscal-policy).

Ubide, A. (2017), *The Paradox of Risk. Leaving the Monetary Policy Comfort Zone*, Washington, DC: Peterson Institute for International Economics.

Verdugo, G. (2016), "Real wage cyclicality in the Eurozone before and during the Great Recession: Evidence from micro data", *European Economic Review* 82(C), pp. 46-69.

Warsh, K. (2016), "Wrap up panel", in J. Caruana and K. Warsh (eds), *Long Term Issues for Central Banks*, BIS Paper No 92, Bank for International Settlements, Basel.

Yellen, J. (2012), "Perspectives on Monetary Policy", speech at the Boston Economic Club Dinner, 6 June.

Yellen, J. (2016), "Macroeconomic Research After the Crisis", speech at "The Elusive 'Great' Recovery: Causes and Implications for Future Business Cycle Dynamics", 60th Annual Economic Conference, Federal Reserve Bank of Boston, 14-15 October.

Yellen, J. (2017), "Financial Stability a Decade after the Onset of the Crisis", speech at "Fostering a Dynamic Global Recovery", a symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, WY, 25 August.

Over the last decade, the developed world has been hit by the deepest recession since the Great Depression and a rollercoaster in commodity prices. And yet, core inflation has been both low and fairly stable. A rule of thumb that inflation is always near 2%, though more often than not just a bit below, has been quite reliable. The young, or those with short memories, could be forgiven for looking condescendingly at their older friends who speak of inflation as a major economic problem. But, like Galileo Galilei told his contemporaries who thought the Earth was immovable, "*Eppur si muove*" ("and yet it moves"). Since most societies regard stable inflation as a goal, it is tempting to describe this solid anchoring of inflation as a great achievement of monetary policy. But what if it was just luck? Will the great anchoring soon lead a great bout of inflation, just as the Great Moderation was followed by the Great Recession? Do we need to change the way in which policy is set to better handle changed circumstances since the financial crash?

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A description of what policies were adopted and how they interacted with economic shocks informs the conclusions on appropriate policies – both monetary and fiscal – for the future. The report pays particular attention to the role of central banks and the extent of their activities.

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