Monetary policy in the grip of a pincer movement*

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Abstract

Monetary policy has been in the grip of a pincer movement, caught between growing financial cycles, on the one hand, and an inflation process that has become quite insensitive to domestic slack, on the other. This two-pronged attack has laid bare certain limitations of prevailing monetary policy frameworks, particularly in the analytical notions that have guided much of its practice. We argue that the natural rate of interest may not be a useful guidepost for monetary policy in two respects: the concept, as traditionally conceived, neglects the state of the financial cycle in the definition of equilibrium and it underestimates the role that monetary policy regimes may play in persistent real interest rate movements. These limitations may blind-side monetary policy to the collateral damage that comes from an unhinged financial cycle. We propose a more balanced approach that recognises the difficulties monetary policy has in fine-tuning inflation and responds more systematically to the financial cycle.

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Introduction

Monetary policy has come under huge strain since the Great Financial Crisis (GFC). Once the crisis broke out, central banks' swift and determined response was essential to stabilise markets and to avoid a self-reinforcing downward spiral between the financial system and the real economy. But putting the economy back onto a robust, balanced and sustainable path has proved much harder than expected. This has been so despite the adoption of extraordinary measures, which would have been simply unthinkable just a few years back.

The GFC has raised some tough questions about monetary policy. The pre-crisis experience has shown that, in contrast to common belief, disruptive financial imbalances could build-up even alongside low and stable, or even falling, inflation. Granted, anyone who had looked at the historical record would not have been surprised; just think of the banking crises in Japan, the Asian economies and, going further back in time, the US experience in the run-up of the Great Depression. But somehow the lessons had got lost in translation during the inebriating enthusiasm of the Great Moderation. And post-crisis the performance of inflation has repeatedly surprised. Inflation was higher than expected during the Great Recession, given the depth of the slump, and lower than expected during the recovery. And it has been puzzlingly low especially more recently, as a number of economies have been reaching or even exceeding previous estimates of full employment. Again, this is not entirely new: even well before the GFC central banks had been raising questions about the sensitivity of inflation to domestic slack. But the recent experience has hammered home the point, raising nagging doubts about a key pillar of monetary policymaking.

This essay explores the implications for monetary policy of the conjunction of these two developments – the emergence of disruptive financial cycles and the limited sensitivity of inflation to domestic economic slack. It is as if monetary policy was in the grip of a pincer movement that threatened to upend the current regime, just as many of its predecessors have been in the past. We largely draw on our previous work, although we also provide a preview of some research under way.

Our conclusion is that adjustments to current monetary policy frameworks may indeed be desirable particularly in the analytical underpinnings that guide their implementation. We argue that the natural rate of interest, as traditionally conceived, is not a particularly useful guidepost: in fact, rather than being part of the solution, it may be part of the problem. And we suggest that responding systematically to the financial cycle need not imply abandoning price stability-oriented frameworks but simply their more flexible interpretation and application. While amending monetary policy mandates to explicitly include financial stability concerns may be appropriate in some circumstances, mainly for institutional considerations, this should be done with great caution.

The paper is organised as follows. The first section briefly describes the nature of the challenge – the pincer movement, its causes and consequences. The second draws implications for the natural rate of interest as guidepost for policy. It explains why the pincer movement means that monetary policy may have a longer-lasting impact on real rates than commonly assumed, why it may not be helpful to think of market rates as tracking natural rates that are independent of monetary policy, and why, *if the concept is used at all*, a natural or equilibrium

interest rate should also include a reference to financial equilibrium. The third section discusses possible adjustments to policy frameworks. Drawing on the previous analysis, and based on a simple counterfactual exercise, it illustrates how policy might respond to the financial cycle and, in the process, improve macroeconomic outcomes. It then considers practical adjustments to monetary policy frameworks to allow for the necessary room for policy manoeuvre to respond to the financial cycle.

1. The pincer movement: the financial cycle and inflation

The emergence of disruptive financial cycles and the limited sensitivity of inflation to domestic slack may at first sight seem to be unrelated. In fact, however, there is a common thread: the behaviour of monetary policy. Consider each in turn.

1.1 The financial cycle

The first major development is that, since around the early 1980s, financial cycles appear to have grown in amplitude and length (eg Borio and Lowe (2002), Drehmann et al (2012), Claessens et al (2011), Borio (2014a)). There is no unique definition of the financial cycle. A useful one refers to the self-reinforcing processes between funding conditions, asset prices and risk-taking that generate expansions followed by contractions. These processes operate at different frequencies. But if one is especially interested in those that cause major macroeconomic costs and banking crises, probably the most parsimonious description is in terms of credit and property prices. Graph 1 illustrates the phenomenon for the United States using some simple statistical filters, although the picture would not be that different for many other countries or using other types of technique (eg, peak-trough analysis). The graph shows that the amplitude and length of the fluctuations has been increasing, that the length of the financial cycle is considerably longer than that of the traditional business cycle (blue versus red line) and that banking crises, or serious banking strains, tend to occur close to the peak of financial cycle.

Another key feature of financial cycles is that the bust phase tends to generate deeper recessions. Indeed, if the bust coincides with a banking crisis, it causes *very long-lasting* damage to the economy.[1] There is evidence of permanent output losses, so that output may regain its pre-crisis long-term growth trend but evolves along a lower path. There is also evidence that recoveries are slower and more protracted. And in some cases, growth itself may also be seriously damaged for a long time.

Some recent work with colleagues sheds further light on some of the mechanisms at work (Borio et al (2016)). Drawing on a sample of over 40 countries and over 40 years, we find that credit booms misallocate resources towards lower-productivity growth sectors, notably construction, and that the impact of the misallocations that occur *during the boom* is twice as large in the wake of a subsequent banking crisis (Graph 2). The reasons are unclear, but may

[1] See the BCBS (2010) survey and, in particular, Cerra and Saxena (2008) and, more recently, Ball (2014). Blanchard et al (2015) find that other recessions too may have permanent effects.

reflect, at least in part, the fact that over-indebtedness and a broken banking system make it harder to reallocate resources away from bloated sectors during the bust. This amounts to a form of supply-side, rather than purely demand-side, hysteresis. The impact can be sizeable, amounting cumulatively to several percentage points of GDP over a number of years.[2]

Why should financial cycles have grown in intensity and disruptiveness? Part of the answer lies in changes in financial and monetary regimes. On the one hand, financial liberalisation back in the 1980s weakened financing constraints and made funding easier and cheaper to obtain. Meanwhile, prudential safeguards lagged behind. On the other hand, the emergence of monetary policy regimes focused on near-term inflation control meant that policy would be tightened during financial booms only if inflation increased but would then be loosened aggressively and persistently during busts. Downplaying the role of monetary and credit aggregates also worked in the same direction.

1.2 Inflation

The second major development is that inflation has generally been quiescent, at times surprisingly so. Indeed, from a longer-term perspective, the response of both price and wage inflation to domestic measures of slack has been quite muted and appears to have declined over time (Graph 3).[3] Why?

One possible explanation is that central banks have been extraordinarily successful in bringing inflation down and keeping it there. Heightened anti-inflation credibility could also help explain why inflation has proved rather insensitive to domestic slack: that credibility means wages and prices are less likely to respond to tight conditions, as economic agents anticipate the central bank's response. Indeed, proxies of inflation expectations have tended to be generally well anchored around inflation objectives. This general narrative is the most popular, especially within the central banking community. No doubt, it is part of the answer. To that extent, it may also mean that central banks have been partly the victim of their own success: their heightened credibility, by keeping inflation low and avoiding the need to tighten, has added fuel to the financial cycle – the "paradox of credibility" (Borio and Lowe (2002)).

But this explanation is probably incomplete. After all, post-GFC central banks have toiled to push inflation back to target, with disappointing results overall; and the Bank of Japan has had huge difficulties for almost two decades. If credibility was the only factor, and if inflation expectations exerted such a powerful sway over inflation, surely the mechanisms should have worked symmetrically.

Another possible explanation is that some deeper forces have been at work, acting as tailwinds pre-crisis and turning into headwinds post-crisis. A likely candidate is globalisation, particularly the entry into the trading system of former communist countries and many

[2] If taken at face value, the results suggest that over the period 2008-13, the effect shaved off some 0.5 percentage points per year productivity growth for those countries that saw a financial boom-bust cycle. This is roughly equal to their actual productivity growth during the same period. The findings could help explain the faster pace in the long-term decline in productivity growth seen in recent years.

[3] See, among others, Stock and Watson (2007), Ball and Mazumder (2011), IMF (2013), Faust and Wright (2013), Faust and Leeper (2015), Kiley (2015) and Blanchard (2017). For a different view, see Gordon (2013) and Coibion and Gorodnichenko (2015).

emerging economies that liberalised their markets – countries that, in addition, tended to resist exchange rate appreciation.[4] As argued and documented in more detail elsewhere (Borio (2017a)),[5] the entry and greater prominence of such producers have likely weakened the pricing power of firms and, above all, of labour, as markets have become more contestable. During the cost-convergence process, this would result in persistent disinflationary winds, especially in advanced economies, where wages are higher.[6] If so, on balance, developments in the real economy may have exerted powerful and persistent downward pressure on inflation, arguably outweighing the influence of aggregate demand.

1.3 Monetary policy challenges

The emergence of larger and more virulent financial cycles and a subdued and less responsive inflation process interact in important ways, giving rise to the pincer movement.

In particular, globalisation amounts to a string of positive supply-side "shocks" that may well have added fuel to financial cycles. Not only has it put persistent downward pressure on inflation; it has also generated expectations of stronger growth and thus provided fertile ground for asset price booms.

Supply-side-driven disinflation can also help explain another development that has been quite prominent since the 1990s: disinflations, and at times outright deflations, have often coincided with par or strong growth, rapid credit expansion and asset price increases. Just looking at the more recent period, countries such as China, Nordic economies, or Switzerland, to name a few, have been experiencing such a combination.

Nor is this combination so exceptional: historical experience tends to indicate that it may be more the rule than the exception. In recent work with colleagues we examined deflations using a newly constructed data set that spans more than 140 years (1870–2013), and covers up to 38 economies and includes equity and house prices as well as debt (Borio et al (2015)). We come up with three finding. First, before controlling for the behaviour of asset prices, we find only a weak association between deflation and growth; the Great Depression is the main exception. Second, we find a stronger link with asset price declines, and controlling for them further weakens the link between deflations and growth. In fact, the link disappears even in the Great Depression (Graph 4). Finally, we find no evidence of a damaging interplay between deflation and debt (Fisher's "debt deflation"; Fisher (1932)). By contrast, we do find evidence of a damaging interplay between private sector debt and property (house) prices, especially in the postwar period. These results are consistent with the prevalence of supply-induced deflations.

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[4] This phenomenon has been greatly boosted by technology, which has allowed the relocation of production to lower-cost countries; see Baldwin (2016).

[5] That paper contains numerous reference to the literature on the impact of globalisation on inflation.

[6] Technological change, quite apart from strengthening globalisation, may have similar effects to it on inflation (Borio (2017a)). Technological change can undermine labour's pricing power – through, for example, the rise of "robotisation" – as well as reduce incumbent firms' pricing power – through cheaper products, through newer products that make older ones obsolete, and through more transparent prices that make shopping around easier. Going forward, technological advance may become more important than globalisation in influencing price dynamics.

The conjunction of financial cycles and benign disinflationary pressures generates fundamental dilemmas for monetary policy. On the one hand, benign disinflations below targets or outright deflations put central banks under huge pressure to ease policy. On the other hand, such a response may add fuel to the build-up of financial imbalances. The risk is that a benign or good deflation may turn into a bad deflation, reflecting serious demand weakness, if the boom turns to bust further down the road.

All this, in turn, raises tough questions about the analytical framework that underlies policy. We next turn more specifically to the implications for a popular policy guidepost: the natural interest rate.

2. Implications for monetary policy: the natural interest rate

In recent years, with the advent of DSGE models in the New Keynesian tradition (Woodford (2003)), economists and policymakers has rediscovered the concept of the natural interest rate, initially developed in the late 19th century by Wicksell (1898). The pincer movement from the financial cycle and inflation has significant implications for the usefulness of the concept. We next consider, sequentially, the implications for the concept's analytics and some new empirical evidence. In Annex 1 we also sketch an alternative model that might provide the basis for a different interpretation that incorporates some elements of the interaction of financial factors and prices that are relatively unresponsive to economic slack.

2.1 The natural rate of interest: analytical and empirical limitations[7]

The natural interest rate is defined as the *real* (inflation-adjusted) rate that prevails when the economy is at full employment (output at potential). In a closed economy, this amounts to equilibrating desired saving and investment at that point.

The natural rate is generally assumed to depend only on real factors. This perspective takes root in the notion that money (monetary policy) is neutral in the long run, ie that it can only have a transitory impact on real variables. The notion of the "long run" is purely an *analytical* concept, the result of a thought experiment: what would occur once all the variables in the system, including prices, were allowed to adjust in the absence of shocks? In practice, when translated into *calendar time* – the only one relevant for policy – this is taken to mean something like a decade, if not considerably less.[8] Put differently, the idea is that, over time, market rates will tend to gravitate towards the natural rate.

This gravitational pull is important and non-trivial. For we all know that *market* rates are not determined by anonymous forces. Rather, they are determined by a combination of central banks' and market participants' actions. Central banks set the nominal short-term rate and they influence the nominal long-term rate through their signals of future policy rates and their asset purchases. Market participants, in turn, adjust their portfolios based on their expectations

[7] See Borio et al (2017a) for a more detailed discussion of the issues and evidence presented in this section.

[8] In fact, in his famous presidential address, Friedman (1968) notes that the effect could take some *two decades* to play itself out, underlying the difficulties in mapping analytical statements about neutrality into calendar time.

of central bank policy, their views about the other factors driving long-term rates, their attitude towards risk and various balance sheet constraints. Given nominal interest rates, actual inflation – which is given in the short run – determines ex post real rates and expected inflation determines ex ante real rates.

How, then, can we tell whether market rates are indeed close to the natural rate – an inherently unobservable, model-dependent concept? And what forces guide central banks and market participants to get them there?

The answer to the first question is, at best, "with great difficulty". The two main approaches used to provide evidence for the claim that the two interest rates are, on average, close to each other over long horizons rely heavily on *maintained* hypotheses. They allow the data to speak, but only within quite tight constraints.

The first approach simply *assumes* that, over the relevant sample, the market rate tracks the natural rate.[9] In the process, it abstracts entirely from the behaviour of inflation. It then proceeds to do a couple of things. The less formal variant is to tell plausible stories based on visual inspection of graphs; the more formal one is to use more articulated models and calibrate parameters to see whether they can produce results roughly consistent with the data.[10]

The second approach seeks to filter out the unobservable natural rates from market rates. Since the natural rate is defined as the real interest rate that prevails at full employment, or when output equals potential output, the behaviour of inflation provides a key signal. After all, the Phillips curve tells us that when output is above potential (the output gap is positive), inflation rises; when it is below, inflation falls. So, one infers that whenever inflation rises, the market rate is below the natural rate, and vice versa when inflation falls. This is because the real interest rate is assumed to be the key variable influencing aggregate demand, via the IS-curve.

The drawbacks of the first approach are apparent. Neither of its two variants provides *independent* evidence that the market rate has actually tracked the natural rate. Moreover, upon closer reflection, neither really *tests* the underlying saving-investment framework of interest rate determination. The approach's less formal variant takes it as the starting point to see whether some factors might provide reasonable explanations. Its more formal variant at best tells us whether the stylised model can in principle describe some features of the data, but not whether the model is true or not: the behaviour of the interest rate is not actually used to test it – the bar would be too low. Moreover, the numerous degrees of freedom mean that it may typically be not that hard to reproduce the qualitative behaviour of the interest rate.[11]

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[9] Admittedly, the studies focus mainly on medium-term fluctuations, where, assuming that the framework is correct, it might be more reasonable to expect the rates to be close to each other, as long as on average output is at potential. Even then, though, the variant is also used to explain post-crisis developments, for which the assumption is less compelling.

[10] Examples of the narrative approach include IMF (2014), CEA (2015), Bean et al (2015) and Eichengreen (2015); examples of calibration include Rachel and Smith (2017), Gagnon et al (2016), Carvalho et al (2016), Thwaites (2015) and Marx et al (2017).

[11] In calibration, the researcher choses values for both the structural parameters and unobserved shock processes to mimic some key features of the data. These commonly include steady-state ratios between variables, second moments of selected variables and so on. Yet, the key features typically only constitute a small subset of the

The drawbacks of the second approach concern, in particular, the role of inflation and the Phillips curve. If one takes the model as true, it becomes almost a tautology to say that, since inflation is not rising and economies are close to estimates of full employment, the natural rate *must* have fallen.[12] And yet, as discussed above, the Phillips curve is precisely the relationship that has proved so elusive. Recall, for instance, how inflation has remained remarkably subdued recently even though economies seem to be close to full employment or beyond it using benchmarks *other than inflation itself*; or how inflation remained quiescent during the run-up to the crisis. Indeed, recent research has found that information about the state of the financial cycle, excluded from the standard procedure, does better in a horse race with inflation in identifying potential output and output gaps in real time, ie as events unfold. Specifically, with colleagues we have found that while traditional approaches indicate that pre-crisis output was above potential only with the benefit of hindsight, using financial cycle proxies this would have been apparent in real time (Borio et al (2014, 2017b and Graph 5)).[13]

All this has significant implications for how to think of natural or equilibrium interest rates and for the persistence of the monetary policy impact on real interest rates.

For one, defining an equilibrium or natural interest purely in terms of inflation is arguably too restrictive. Inflation need not be the only signal of disequilibrium; financial imbalances can also be. If low interest rates can contribute to financial instability by encouraging booms and busts and if financial instability has long-lasting, if not permanent, effects on output and employment, then it is hard to regard a given interest rate as an equilibrium or natural rate if it generates financial instability, even if inflation is low and stable. The notion needs to be broadened to encompass some form of financial equilibrium (see below).

Broadening the notion of equilibrium would avoid an apparent paradox. It is not uncommon to hear supporters of the "saving glut" and "secular stagnation" hypotheses say that the equilibrium or natural rate is very low, even negative, and that this very rate generates financial instability. Seen from this angle, such a statement is somewhat misleading. It is more a reflection of the incompleteness of the analytical frameworks used to define and measure the natural rate concept – frameworks that rule out financial instability – than a reflection of an inherent tension between natural rates and financial stability.

More generally, if inflation is not as responsive to economic slack as once thought, the impact of changes in nominal (policy) rates on the real rate may be correspondingly larger and longer-lasting. To fix ideas, in the limit, if inflation was *entirely* exogenous and trendless, the trend in the real interest rate would simply depend on whether inflation was below or above target. For instance, the real rate would tend to fall continuously if inflation started below target, as the central bank cut nominal interest rates repeatedly in the vain attempt to boost

model's full implications for the data and there is less discipline in the remaining directions. This gives the investigator considerable degrees of freedom when fitting the features of interest at the expense of general model fit. Equally problematic is the high reliance on persistent shock processes or unobserved stochastic trends. With sufficiently many such processes, the model can generates a perfect fit without an increase in predictive power – a case of "overfitting".

[12] Indeed, it is not uncommon for policymakers to revise their estimates of potential output or the NAIRU – two other unobservable variables – assuming that the Phillips curve relationship holds, ie if inflation fails to rise, potential output is revised upwards and the NAIRU downwards.

[13] These findings have been confirmed by subsequent research, eg Arseneau and Kiley (2014), Blagrave et al (2015) and Melolinna and Tóth (2016).

inflation towards target. More realistically, imagine that inflation is below target and that headwinds make it hard to generate the second-round effects whereby wages chase prices. Then, easing policy would have a permanent impact on the price *level*, say through a currency depreciation, but only a temporary one on *inflation*. If the central bank continued to try to push inflation up, nominal and hence real interest rates would trend downwards.

The general point is that what happens to the real interest rate depends on the reaction function of the central bank (ie the monetary regime in place) and the behaviour of inflation. One can get persistent effects when inflation is unresponsive and the central bank seeks to influence it. This is the unfamiliar case, not discussed much in the literature. But one can equally get persistent effects if inflation takes off and the central bank does not respond. This is a more familiar case, and often aptly used to describe the experience of the Great Inflation in the 1970s.

The two cases, however, differ substantially in terms of the role of the natural rate. In the standard framework, changes in real rates that reflect a persistent rise in inflation coupled with a passive monetary policy would be interpreted as a persistent deviation of market rates from the (Wicksellian) natural rate.[14] By contrast, changes in real rates that reflect a limited influence of monetary policy on inflation would cast doubt on the usefulness of the very concept of a natural rate. This is because they would undermine the presumption that real interest rates have a tendency to revert to a given equilibrium level and that the resulting gap between actual rates and this equilibrium level drives inflation.

2.3 The natural rate of interest: new empirical evidence and interpretation

The previous analysis suggests that the impact of purely real factors on real interest rates may be overestimated and that of monetary factors correspondingly underestimated. How can one try to break out of the grip of maintained hypotheses in current tests in order to explore this possibility further?

One option is to let the data speak a bit more. Crucially, this also requires going beyond the traditional period used to discuss the decline in real interest rates – from the early 1990s or, in some cases, early 1980s. During that period, one can indeed observe some similarity in the trends between real interest rates and the saving-investment factors emphasised by, say, the popular "saving glut" (Bernanke (2005, 2015)) and secular stagnation (Summers (2014)) hypotheses. But these trends may simply be coincidental.

This is what we have done in some work under way, not yet out as a BIS Working Paper (Borio et al (2017b)).[15] We go back to the 1870s for 19 countries, and we examine the relationship between real interest rates and the "usual suspects": growth, productivity, demographics, income distribution, the relative price of capital and the marginal product of

[14] Lubik and Matthes (2016), for example, estimated a model of learning and argued that misperceptions about the state of the economy on the part of the Federal Reserve led to sustained deviations from equilibrium real rates during the Great Inflation of the 1970s.

[15] For studies following a similar approach, but testing a fewer set of variables and largely on US data, see Hamilton et al (2015) and Lunsford and West (2017). In line with the results reviewed below, they do not find any systematic relationship between real interest rate and variables such as GDP and productivity growth, which theory takes for granted as the determinants of the natural interest rate.

capital. We do this for both real long-term interest rates and the most popular filtered estimate of the short-term natural rate, based on the behaviour of inflation. We then compare the role of these factors with that of monetary policy. The advantage of going that far back is that we cover different monetary policy regimes.

We come up with two key findings. First, while the usual suspects appear to work reasonably well over the often-cited, more recent sample, the relationships break down when going back in history: no consistent pattern emerges – a sign that the relationships may be spurious. Even a simple visual inspection of the data suggests that this is likely to be the case (Graph 6). The finding is confirmed in more formal testing, when one allows the various real-sector determinants to interact (see Table 1 where significant correctly signed coefficients are in green and significantly wrong signed ones are in red). And it appears robust to the use of different interest rates – long and short; market or traditional estimates of natural rates – and measures of inflation expectations.[16] Second, there are generally economically and statistically significant differences in the level of interest rates across monetary policy regimes; moreover, their trends also differ. This is so even when one controls for the usual suspects (see Graph 7, left-hand panel for an illustration).

It is then possible to provide an interpretation of the historical evolution of real interest rates in which monetary policy regimes figure more prominently than in the prevailing narrative. Consider, in particular, two periods: the experience over the sample since the 1980s-1990s, and that during the classical gold standard.

The decline in real rates over the recent standard sample could be attributed to the combination of three factors. The first factor is the gradual normalisation of interest rates after the Volcker shock that ended the Great Inflation (Graph 6), which saw interest rates rising from peace-time troughs. This suggests that the starting point is rather unrepresentative and already embeds a key monetary policy imprint.

The second factor is an asymmetrical policy response to successive financial and business cycles in a context of prevailing disinflationary tailwinds linked to globalisation (eg Borio (2014a,b and 2017b)). In particular, asymmetrical responses were in evidence around the financial boom and bust of the 1980s–1990s and the one that surrounded the GFC.[17] As long as inflation remained low and stable, there was no incentive for central banks to tighten policy during the financial booms that preceded financial strains in both cases. But there was a strong incentive to respond aggressively and persistently to fight the bust and stave off any deflation threat.

The third factor, especially post-GFC, is strenuous central bank efforts to push a stubbornly low inflation rate towards target, as the disinflationary tailwinds before the crisis turned into unwelcome headwinds after it. Difficulties in generating second-round effects, with

[16] Measuring expectations is notoriously hard for long-term rates. On this issue and a review of much of the evidence, including under the gold standard, see Friedman and Schwartz (1982). See also the discussion in eg Borio and Filardo (2004).

[17] Drehmann et al (2012) document how the asymmetrical response to equity prices in the late 1980s and early 2000s added to the downward trend in interest rates. Equity prices co-move more closely with the business than with the longer financial cycle, better captured by the joint behaviour of credit and property prices. In both cases, lowering interest rates further boosted the credit and property price boom.

wages chasing prices, would imply that reductions in interest rates have a largely temporary effect on inflation. Thus, repeated cuts would end up reducing real interest rates further and further even as inflation remained persistently below target.

The classical gold standard is also quite revealing. During this regime, central banks did not respond systematically with changes in interest rates to output and inflation as they do now. They simply tended to keep nominal interest rates constant unless the (internal or external) convertibility-into-gold constraint came under threat (eg Flandreau (2008)).[18] Gold acted as a monetary anchor, but only over very long horizons.[19] Still, inflation remained very much range-bound, with the price level gradually falling or rising over long periods.[20] As a result, nominal and real interest rates were remarkably stable and did not deviate much from each other (Graph 7, middle and right-hand panels). Given the behaviour of inflation, the standard approach would infer that the market rate tracked the natural rate quite closely. And yet the usual suspects tended to vary just as much as they have in the recent sample (Graph 6). Another possible interpretation is that monetary policy had a persistent impact on the real interest rate without exerting a strong influence on inflation. Indeed, the classical gold standard era coincided with a major globalisation wave, saw rapid technological change and featured a labour force with limited pricing power. The resemblance with the experience since the 1980s-90s is striking (eg Obstfeld and Taylor (2003), BIS (2017)).

3. Implications for monetary policy: adjusting frameworks

The previous analysis suggests that there is a prima facie case for monetary policy to play closer attention to the financial cycle than in the past. We may have been underestimating the influence of benign disinflationary forces and overestimating the ability of monetary policy to fine-tune inflation, especially to push it up towards targets in the face of powerful headwinds. If so, we may also have been underestimating the collateral damage that such strategies may generate in terms of financial and macroeconomic stability over longer horizons, especially by amplifying the financial cycle.

This combination of factors could even give rise to a debt trap (Borio and Disyatat (2014), Borio (2017b)). Such a trap could result from asymmetric policies over successive business and financial cycles, failing to tighten during expansions but easing aggressively and, above all,

[18] For illuminating discussions on the gold standard, and the rules of the game as applied in practice, see Bloomfield (1959) and De Cecco (1974).

[19] In his political economy lectures, Wicksell (1906) recognises this and discusses the related issues in some detail. He notes, for instance, that the direct impact of increased gold supplies may be relatively small compared with the indirect influence operating through interest rates and the convertibility constraint. He then postulates an unobservable and time-varying natural rate to explain periods in which price declines coincide with falling interest rates and contractions in gold production. This contrasts with economists more firmly rooted in the monetarist tradition, who ascribe a bigger role to exogenous increases in gold in circulation in influencing the price level by boosting expenditures (eg Fisher (1911) and, more recently, Bordo (1999)). For a discussion of these issues, and of Wicksell's shifting views, see Laidler (1991).

[20] Inflation was actually quite volatile in the short run, given the composition of the price index, in which commodities and food had a much larger weight than today. The stability mentioned in the text abstracts from this volatility, which is not relevant for our analysis.

persistently during contractions. Over time, policy could run out of ammunition, and it could become harder to raise interest rates without causing economic damage, owing to the large debts and distortions in the real economy that the financial cycle creates. Such a risk can be amplified by the transmission of monetary policy across countries, to the extent that the very low rates in the economies that issue international currencies tend to support the build-up of financial imbalances in economies elsewhere.[21] And, as discussed further below, it is also amplified by the evidence indicating that debt service burdens have a substantial impact on aggregate expenditures: if debt-to-GDP ratios continue to rise along this path, the level of interest rates an economy is able to withstand would decline. From this perspective, the continued increase in indebtedness alongside the shrinking room for manoeuvre does not bode well (Graph 8).

Note also the twist that such a scenario implies for the interpretation of any natural or equilibrium interest rate. Seen through the lens of the standard approach, the contraction in aggregate demand in a debt trap would be interpreted as a sign that the natural rate has fallen, driven exclusively by some deep underlying factors. Seen through the lens of an approach that attaches importance to the financial cycle and growing indebtedness, it would be seen as a sign that the economy has been following a disequilibrium path. And what policymakers would take as given (exogenous) at that point would be, at least in part, the result of a sequence of past policy decisions. This indicates a new form of time inconsistency, which is arguably more insidious than the familiar one in the context of inflation (Borio (2014a)). Policies that are too timid in leaning against financial booms but that are then too aggressive and persistent in leaning against financial busts may end up leaving the authorities with no further ammunition over successive financial and business cycles.

3.1 Why respond to the financial cycle?

One possible objection to this analysis is that, rather than adjusting monetary policy frameworks, it would be better simply to enlist another instrument to target the financial cycle – prudential, and more specifically macroprudential frameworks, based on solid microprudential foundations. If successful, such an approach would have additional benefits. It would allow monetary policy to continue to focus exclusively on price stability and short-term output stabilisation, reducing the risk of overburdening it. It would make it easier to ensure accountability wherever the objective is set in terms of an inflation target. And it would prevent monetary policy from actually damaging the economy. This is generally the conclusion reached by those who argue that "leaning" against financial imbalances is harmful (eg Svensson (2014), (2017)).

These objections clearly have force. But, in our view, are not compelling enough to rule out adjustments to the frameworks.

First, it is debatable whether prudential measures alone can be sufficient to prevent the build-up of financial imbalances (Borio (2014d)). Indeed, even in countries that have used macroprudential tools aggressively there have been signs of the emergence of such imbalances. These are captured by standard indicators like increases in the private credit-to-

[21] For an in-depth discussion, see Borio and Disyatat (2011), Borio (2014c), Shin (2012), Bruno and Shin (2015), Rey (2013), Rajan (2014) and Taylor (2015).

GDP ratio and property prices in excess of critical thresholds (BIS (2017)). Of course, there is little doubt that prudential measures have strengthened the resilience of the financial system. Even so, only once the expansions turn into contractions will one find out by how much. Moreover, even if the financial system is able to withstand the shock, the macroeconomic implications could be severe. For instance, the turn of the recent financial cycle in Brazil coincided with one of the deepest recessions on record, although the country has avoided a full-blown crisis.[22]

Second, it is not clear how macroprudential measures can address the risk of a debt trap following a financial bust. The measures are designed to address signs of exuberance in credit and asset markets, but that is not quite what a debt trap is about. To be sure, asset prices may appear high measured on their own terms (eg, historical price-to-rent ratios), but valuations may not be unusual compared to bond yields. Similarly, private credit may be expanding, but its pace need not look alarming, especially given the post-bust adjustment. And public sector debt is also an integral part of the picture. The debt trap is not a financial imbalance in the usual sense of the term: it is the result of a cumulative and gradual process over successive business and financial cycles. It is not synonymous with hot credit and asset markets; it is more like a cold "cul de sac". As a result, the literature that defines the response to the financial cycle exclusively as "leaning-against-the-wind" of financial excesses does not do justice to the full nature of the problem – and this quite apart from calibration questions (Annex 2).

Third, at issue is not so much a change in monetary policy objectives, but in the time frame over which to pursue traditional objectives and in the underlying analytical framework. This is a framework in which financial factors have a first-order and long-lasting impact on the economy, in which monetary policy has a substantial impact on those factors, and in which inflation may be less responsive to monetary easing than traditionally assumed. Under those conditions, over horizons that go *beyond* the traditional business cycle, monetary and financial stability, broadly defined, are mutually supportive; short-run trade-offs tend to vanish.

3.2 How to respond to the financial cycle? An illustration

One can illustrate these points with the results of a recent empirical study (Juselius et al (2017)).[23] The analysis uses the United States as an example. It proceeds in three steps.

The first step is to decompose the financial cycle into two sets of variables that in the data are found to have very stable long-run relationships (Juselius and Drehmann (2015)). One is a proxy for the private sector (households and firms) debt service burden, ie the ratio of the sum of interest payments and amortisation to income (or GDP); the other is a proxy for "leverage", linking the debt-to-income ratio to property and equity prices. Deviations of these variables from their long-run (co-integrating) relationships ("gaps") interact and, when embedded in a richer econometric system, are found to have a sizeable impact on private sector expenditure

[22] This is not to say that the turn was the cause of the recession, although it clearly amplified it. The fact that the banking system is largely public-sector owned has also helped cushion the blow, as has the extensive use of foreign exchange reserves to insulate the corporate sector from exchange rate risk.

[23] The numerical results here refer to the more elaborate, working paper version of the published paper. Those in the published version are very similar.

and output fluctuations.[24] This is intuitive. Heavier debt service burdens depress spending, not least as they squeeze cash flows. And higher asset prices in relation to credit can boost both spending and credit growth. There are many stories and simple models that capture these mechanisms, although none that as yet fully captures their interaction.[25]

The system has a couple of interesting properties, which set it apart from the previous studies. For one, it can result in financial busts with permanent output losses. In fact, the interaction between the two financial gaps can help trace the Great Recession quite well out of sample, though not quite its depth – the financial crisis still appears to have an additional effect (Juselius and Drehmann (2015)). The possibility of permanent losses does not depend on the GFC: it is a more general property.[26] In addition, it does not rely on a separate crisis module (Annex 2): the financial cycle is fully integrated in the dynamics of the economy. The system gives rise to "endogenous" fluctuations in which the financial and real sectors interact, but not to crises as such.

The second step is to use the two financial gaps to derive estimates of the typical unobservable variables in any policy rule. These are economic slack (or the output gap) and the natural rate of interest. Estimates of the output gap and natural interest rate are derived by adding the two financial gaps to a very standard macroeconomic setup.[27] Thus, the natural rate now requires not just output at potential and inflation on target, but also closing the financial gaps – the concrete definition of "financial equilibrium" in this approach.

Note that the financial gaps are *allowed* to have an impact on the output gap and the natural rate, but it is the *data that decide*. This richer system nests the standard model (Laubach and Williams (2003)), and the data are allowed to tell us which one is a better characterisation of the economy's evolution.

The third step is to carry out a counterfactual experiment. This is done by adding the financial gaps[28] to a traditional Taylor rule, in which the interest rate is adjusted in response to the output gap and the deviation of inflation from target (Taylor (1993)), and then seeing how the economy would evolve under this different rule. Thus, the aim is *not* to respond only once the signs of an impending crisis emerge, which would be too late, but *to steer the economy throughout the financial cycle*. The financial gaps simply complement the variables traditionally included in the policy rules, which retain their role.

A number of findings emerge. First, responding systematically to the financial cycle proxies in addition to output and inflation can result in significant output gains (Graph 9).

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[24] The co-integrating relationships can be closely approximated by actual financial data, namely the actual debt-service ratio itself and the ratio of debt to real and financial wealth, which are approximately stationary.

[25] See Juselius and Drehmann (2015) for references to this work. In more recent work, Drehmann et al (2017) also find that the debt service ratio explains the delayed negative impact of credit expansion on GDP found by Mian et al (2013) and (2017). Om the relationship between credit booms and recessions, see also Jordá et al (2013).

[26] That said, Drehmann and Juselius (2013) also find that, over horizons of around one year, the debt service ratio outperforms also the credit gap as a leading indicator of banking crises; the credit gap performs better over longer horizons.

[27] The standard model follows Laubach and Williams (2003, 2015).

[28] The specific rule in the study includes explicitly only the debt service gap, but the leverage gap conveys crucial information about the output gap and, as noted, is in turn closely influenced by the debt service gap.

Second, there need not be much cost in terms of inflation. In fact, on average, inflation is effectively unchanged: it is a bit lower pre-crisis, reflecting the tightening phase, and higher post-crisis, as economic slack is smaller then. Third, leaning early is key, and this can gain considerable room for manoeuvre in the bust (Graph 10). In the counterfactual, the policy rate is some 1 percentage point higher until mid-2005; it can then afford to decline earlier, starting roughly when asset prices peak (not shown) and is normalised more quickly after the recession, as output recovers faster. Finally, the source of the gains is that the policy helps to smooth out the financial cycle (Graph 11): the amplitude in the cycle in asset prices, real credit and the credit-to-GDP ratio is clearly smaller in the counterfactual.[29]

The results also shed light on the notion and usefulness of the natural rate of interest (Graph 12). Even with these minimal changes in its definition, the decline in the financial-adjusted natural rate (red line), which includes information about the financial cycle, is smaller than the standard estimate (blue line) and it is even smaller in the counterfactual (dashed purple). The smaller decline emerges even if the procedure *by construction* severely constrains the evolution of the natural rate to follow output growth which, as we saw in the previous discussion, does not seem to have much explanatory power historically. In fact, once financial factors are allowed to play a big role, stabilising the economy sometimes requires sizeable deviations of the policy rate from the natural rate in response to the financial gaps. This is necessary so as to keep the economy close to financial equilibrium. The deviations tend to be larger than those in a standard Taylor rule. And they raise questions about the usefulness of the very concept of a natural rate for policy.[30]

There are, of course, obvious limitations in this type of analysis. It is always hazardous to do counterfactual evaluations based on historical correlations. The exercise is quite stylised, and does not address explicitly the complications that arise in small open economies, notably the exchange rate and capital flows. Moreover, it does not fully characterise the uncertainty that plagues policymaking.

Even so, we would argue that the limitations are not show-stoppers. The "Lucas critique" can be overdone.[31] Indeed, the public becoming aware of the central bank's reaction function could even enhance the policy's effectiveness, just as anti-inflation credibility reduces the likelihood of second-round effects in wages and prices. Including explicitly the impact of the policy on the exchange rate is bound to change the balance of the policy mix in favour of macroprudential measures. In the limit, for instance, if the exchange rate was pegged, these would be the only measures de facto available. And a richer characterisation of the uncertainty

[29] Naturally, the performance of the economy improves further if the counterfactual experiment begins earlier (not shown). The reason is that the policy has more time to work and hence gets more traction.

[30] As is well known, the concept itself has come under attack in the past. For instance, Keynes (1936) rejected the notion, after having embraced it in his Treatise. For an in-depth discussion, see Leijonhufvud (1981) and for a more recent sceptical view of the natural rate, see Laidler (2011) and his review.

[31] Studies have found that the Lucas critique may be of limited relevance in practice. For instance, a common finding is that the parameters of empirical VARs are remarkably stable despite changes in estimated policy equations in the sample (eg Favero and Hendry (1992), Leeper and Zha (2003), Rudebusch (2005)). In the present context, the main parameters of the VAR model are stable over both pre- and post-crisis samples. This suggests, for instance, that the adoption of unconventional monetary policy tools post-crisis has not generated sizeable changes to the system's dynamics. To the extent that the adoption of these tools constitutes shifts in the monetary policy function, this provides indirect evidence against a strong Lucas critique effect in our sample.

need not overturn the conclusion. The costs of a debt trap would be very large and current frameworks exclude this possibility altogether.

3.3 How to adjust current frameworks? Practical considerations

If this analysis is accepted, how could one adjust monetary policy frameworks? How can central banks gain the necessary room for manoeuvre to respond more systematically to the financial cycle?

The first point to note is that there is no one-size-fits all. The analysis does not claim universality: some countries around the world are still struggling with the age-old problem of ensuring that inflation is brought down or does not get out of control. And initial conditions matter: the inherited regime constrains and helps shape the desirable and feasible adjustments. Even so, some general considerations are possible.

The smallest adjustment is to lengthen the horizon over which to achieve a given inflation objective. An obvious advantage of this approach is that a specific number, or narrow band, could help anchor expectations by acting as a focal point. In fact, to varying degrees, this is already how flexible inflation targeting is implemented. It has been widely recognised that the optimum horizon over which to guide inflation back to target depends on the nature of the "shocks". In principle, one could apply the same logic to the financial cycle.[32] Indeed, some central banks that take into account financial stability/financial cycle considerations have done precisely this (eg the Norges Bank or the Reserve Bank of Australia, to mention two).

The problem with this approach is that the tolerance for inflation deviations from target may have to be quite high. How persistent and large can the deviations be before central bank credibility comes into question? This is likely to be country-specific and depend on history and institutional arrangements. For instance, in a country like Switzerland, persistent deviations in the form of actually falling prices have been tolerated quite easily: the central bank has progressively de-emphasised the target while never officially renouncing it. Similarly, in Thailand, where financial stability considerations have played an important role in the decision to leave policy unchanged despite over 2 years of undershooting the inflation target band, the central bank's credibility does not appear to have been affected significantly.

A second option is to move from a point target to a band or to widen a target band. In practice, there may not be that much difference between the two approaches. And the room for manoeuvre would be greater if one treated the edges of the band as soft, rather than hard, bounds. The disadvantage of this option is that it would weaken the target's anchoring role. How serious a problem this could be would depend on one's views about the strength of the target's gravitational pull on expectations and about their influence on wage and pricing decisions. The advantage would be to dispel the notion that monetary policy can fine-tune inflation. For instance, the Riksbank has decided to re-introduce a (softer) target band for precisely these reasons.

A third option would be to reduce the point target or shift the band downwards in order to take into account the longer-term headwinds that may be reducing inflation. This option is

[32] That said, it is debatable whether the shock-propagation terminology is well suited to capture the underlying process.

trickier, since it may jeopardise more directly the central bank's credibility. And it raises tougher communication issues. But it is viable in countries that have seen persistent shortfalls in inflation alongside obvious signs of the build-up of financial imbalances and good growth. The central bank of Korea, for instance, has decided to reduce its point target from 3% to 2% based on such considerations. No doubt, of course, reducing the target to a standard figure internationally has facilitated the move.

A fourth option is to go one step further and change the mandate to, say, include financial stability as a separate consideration. The advantage of this approach is that it would definitely give the central bank ample room for manoeuvre. The disadvantage is that it explicitly introduces the notion of a trade-off that need not be there over a sufficiently long horizon. Moreover, the political process of changing a mandate is unpredictable. While helpful under the right circumstances, the step may not be necessary. In fact, the mandates enshrined in the central bank law are typically written in very general terms and provide plenty of room for interpretation.[33] They tend to be the product of the time when they were written. For example, the Reserve Bank of Australia's actually refers also to the "economic prosperity and welfare of the people of Australia", and is clearly less constraining that the agreement the central bank has reached with the government concerning its objectives. In order to give a higher weight to financial stability considerations, the central bank has modified that agreement and used the mandate in its communication to avoid further easing in a context of very high and rising household debt and rich property prices.[34] By contrast, the recent independent commission in Norway has recommended adding explicitly financial stability to the mandate as well as setting up a joint policy committee for monetary and macroprudential policies. The objective is to strengthen the foundation for policies that the Norges Bank has already been following since 2012.

The key point is that, at the end of the day, mandates matter less than the analytical framework used to implement them. Many of the current arrangements already provide significant room for manoeuvre, as evidenced by the varying degree to which inflation-targeting central banks take financial stability concerns into account. And one could imagine circumstances in which changes in the mandate, if interpreted the wrong way, could actually be harmful. For instance, that would be the case if a financial stability objective was interpreted as keeping interest rates low because the banking system was weak even as inflation was threatening to increase out of control. Under those circumstances, the right policy would be to tackle the banking problems head-on with other instruments. Admittedly, including financial stability in central banks' mandates could help the institution resist political pressure when taking decisions that put long-term gains above short-term ones. That said, the

[33] For instance, Section 2a of the Federal Reserve Act sates that "The Board of Governors of the Federal Reserve System and the Federal Open Market Committee shall maintain long run growth of the monetary and credit aggregates commensurate with the economy's long run potential to increase production, so as to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates." Given the reference to monetary and credit aggregates as well as moderate interest rates, this leaves considerable room for interpretation.

[34] The agreement signed in September 2016 modifies the previous one from October 2013. It clarifies that the medium-term 2-3% inflation objective, on average, is to be pursued "over time", rather than more precisely "over the cycle", and it now states explicitly that "the medium-term focus provides the flexibility for the Reserve Bank to set its policy so as best to achieve its broad objectives, *including financial stability* (emphasis added).

unpredictability of the political process means that changes in mandates should be treated with great caution.

Conclusion

Paradigms die hard. This is fully understandable. The hurdle *should* be set high. New evidence cannot be interpreted in isolation. It must be evaluated against the backdrop of the body that precedes it. What is true for intellectual disciplines is equally, if not more, true for policymaking. Innovation is risky, for those who carry it out and for society. The danger in all this, however, is that change may come too late, only when damaging events make it unavoidable. And then the pendulum may swing too far.

This was clearly the case pre-crisis. The experience showed once more how some of the most serious risks do not arise from the mechanical repetition of errors in identical circumstances, but from the interaction between policy and changes in the economic environment. And they arguably reflect overconfidence in our ability to understand the economy, a sense that policy is finally on the right track. The belief in the Great Moderation in the run-up to the GFC was simply retracing an all too familiar historical pattern. In the 1960s, having "digested" the lessons of the Great Depression, policymakers thought they had discovered the secret of how to achieve full employment at the cost of moderate inflation. In the lead-up to the Asian crisis, fiscal probity and low inflation were seen as guaranteeing the sustainability of the Asian boom. Further back in history, in the lead-up to the Great Depression, the roaring twenties had held out the promise of permanent prosperity.

Post-crisis, policymakers have made huge efforts to shore up the financial sector and strengthen financial regulation and supervision. As part of that, they have been implementing wholly new macroprudential frameworks, crystallising a concept that had been put forward a decade before and had remained largely ignored until the crisis (Crockett (2000), Borio (2003), Borio and Drehmann (2011)).[35] These efforts are necessary and welcome. But they have also nurtured the expectation that they are sufficient to avoid financial instability, broadly defined, and its serious macroeconomic costs – that they can, on their own, avoid the disruptive financial booms and busts of the past (Borio (2014c)). As a result, monetary policy – and fiscal policy, for that matter – have by and large continued to operate as it if it was business as usual.

This may be the right answer. But in this paper we have argued that it is, at least, an imprudent one. Monetary policy has been in the grip of a pincer movement, caught between growing financial cycles, on the one hand, and an inflation process that has become quite insensitive to domestic slack, on the other. With inflation stubbornly unresponsive to attempts to push it back towards target, it may be imprudent to downplay or even ignore the collateral damage of extraordinarily and persistently accommodative monetary policy for the financial side of the economy.

If so, a more balanced approach may be preferable. The approach would recognise the difficulties monetary policy has in fine-tuning inflation when the rate is already low, possibly owing to supportive real factors such as globalisation and technology. It would take into

[35] See Clement (2010) for a history of the term.

account the risks of conducting policy based on unobservables that do not consider its impact on the financial side of the economy, such as the Wicksellian or New Keynesian natural interest rate. And it would provide sufficient room for maneouvre to respond more systematically to the financial cycle. This, too, may not be the full answer. But it may take us closer to it.

Annex 1: A model with non-neutral monetary policy[36]

In this Annex we outline a modelling framework in which monetary policy influences real outcomes persistently and the concept of the natural interest rate is ill-defined. Our focus is on the "policy relevant horizon" over which monetary policy has real effects on the economy. While we do not take a specific stance on how long such a horizon may be, our setup accommodates effects that can be very persistent, through monetary policy's impact on the state of the financial sector and the supply side of the economy. Moreover, in our model many equilibrium configurations are possible and sustainable.

We depart from the standard framework in three important respects. First, we emphasise the centrality of *financing* in underpinning economic activity. Firms and households must acquire financing *before* production and expenditures can take place. This highlights the importance of *cash flows* in addition to flows of goods. Banks generate the required volume of financing, through loan creation and the corresponding creation of deposits, *independently of any saving or endowments* (see also Borio and Disyatat (2015)). Since monetary policy closely influences financing conditions, it can act as an anchor or forcing variable in the system. Second, and since financing is necessary for production, the supply side of the economy is endogenous to financial conditions, and hence to monetary policy.[37] This implies that the economy need not settle down at a unique point; rather, there is a range of endogenously-determined possibilities. Third, economic outcomes are path-dependent. In our specific example, this results from the evolution of bank capital — a stock variable that links the constraints prevailing at any point in time to past decisions.

As in any model where monetary policy has real effects, some form of price stickiness is necessary. We simply assume goods prices are fixed, and let the goods market clear through endogenous supply and inventory adjustments. Our focus is on the policy trade-off between current economic activity and the longer-term effects on the financial sector's proclivity to incur risks. In other words, in the optimal monetary policy problem we replace the Phillips curve with a financial stability condition.

The model

The economy consists of many 2-period-lived households, firms, and bank managers.[38] Households provide labour when they are young in exchange for deposits, which they may

[36] This annex is based on Rungcharoenkitkul et al (2017).

[37] This echoes a strand of the literature that highlights the potential for developments on the demand side to affect the supply side and hence medium-term economic trajectories (eg. Reifschneider et al (2015) and Comin and Gertler (2006)).

[38] The overlapping-generation structure allows the equilibrium interest rate not to be pinned down by the rate of time preference (as the Euler equation would do in the representative agent context).

save or withdraw for immediate consumption. Firms require bank loans to pay for wages upfront, as production takes one period to complete. A firm may either deploy a safe technology with a guaranteed payoff, or a potentially more productive but risky one. The risky project is subject to aggregate uncertainty and may fail. With limited liability, firms maximise the upside returns and pass any losses to banks. Banks underwrite new loans which they use to create risk-free deposits every period. Firms use these deposits to pay wages and settle loans. Banks, as infinitely-lived institutions, retain any profits and losses on their books. Bank managers focus on short-term profits and ignore the risk of depleting capital in the future should a string of bad luck materialise. When equity reaches a critically low level, the financial system enters a crisis period, during which banks take minimal risks. The crisis phase lasts until bank capital recovers sufficiently.

The central bank chooses a policy rate R_t^d at the beginning of each period, thus setting the tone for the rest of the economy. Taking R_t^d as given, agents begin a fresh round of activity, including issuing new loans/deposits, new hiring of young households, and a new production round by young firms. The real wage W_t and the bank lending rate R_t adjust to equilibrate the labour and credit markets. Once this round is completed, the goods market opens. Old firms sell goods to households in return for deposits used to settle their loans. When the risky production succeeds, all existing loans and deposits settle exactly and both banks and firms make positive profits. Firms consume profits immediately, while banks retain their earnings as stored goods. When the risky production fails, firms default on their loans, and households withdraw deposits from banks against their inventory of goods. Banks mark down their assets and equity accordingly. In this way, banks absorb any shortage or surplus of goods, and the goods market clears through banks' inventory adjustments.

Five equations capture the essence of the model:

$$
\begin{aligned}
&L_t = L^s(W_t, R_t^d) \\
&L_t = L_{F,t}(R_t W_t) + L_{G,t}(R_t W_t) \\
&R_t = \begin{cases} \varphi_1\left(R_t^d, L_t, L_{G,t}\right) & \text{if} \quad s_t = 1 \\ \varphi_2\left(R_t^d, L_t, L_{G,t}\right) & \text{if} \quad s_t = 2 \end{cases} \\
&s_t = T(s_{t-1}, R_t^d, K_t) \\
&K_t = K_{t-1} + \Pi_t^B
\end{aligned}
$$

The first condition, derived from households' optimisation, states that the labour supply increases with real wage W_t and the risk-free deposit rate R_t^d (income effect). The labour demand, the second condition, is derived from firms' profit maximisation and comes from safe-technology-adopting firms ($L_{F,t}$) and risky-technology firms ($L_{G,t}$). In both cases it declines with total production costs, $R_t W_t$. At the same time, a lower $R_t W_t$ enhances the profits' upside, making the risky option more appealing. In aggregate, a lower $R_t W_t$ increases the proportion of risky-technology firms – a risk-shifting effect. A monetary policy easing, to the extent it lowers R_t, boosts the demand for labour and expected output, but also raises financial fragility by increasing the amount of loans at risk of default.

The last three conditions describe the banking sector. In the normal regime $s_t = 1$, banks have adequate equity and compete normally (eg Bertrand competition implies zero expected profit). When capital falls below a critical level, the economy enters a crisis phase $s_t = 2$, and bank managers switch to a conservative lending stance to rebuild capital, limiting risk-taking and curtailing lending. The fourth condition describes the stochastic transition between the

two regimes, which depends on monetary policy via its effect on risk-taking. Finally, bank capital K_t reflects retained earnings and losses, with banks' per-period profit given by Π_t^B.

Policy implications

Three key implications emerge.

First, there is no equilibrium rate of interest in the conventional sense. In fact, the central bank can maintain the risk-free rate R_t^d at any level indefinitely. Each level of interest rate corresponds to different levels of employment, expected output, the bank lending spread, and so on. There exists a welfare-maximising rate of interest, but it is not the only sustainable one. Should the central bank set its policy persistently in a way that does not maximise welfare, the symptom would only show up slowly in the cumulative effect on bank capital. In standard models, by contrast, a persistent deviation from the natural rate would lead to rising or falling inflation, a clear sign for the central bank to take a corrective action.

Second, a policy rule that puts a premium on short-run output can lead to a bias towards lower interest rates. In the first instance, a lower rate is required to boost output. But there is also an endogenous effect. Because the rule does not internalise the policy's effect on risk-shifting, it leads to more frequent crises. In a crisis, the financial headwinds call for an even lower rate to sustain output and counter higher spreads. In this model, secular trends in interest rate simply reflect different policies rather than exogenous forces.

Finally, in normative terms, the optimal monetary policy entails a 'leaning against the wind' feature, in order to internalise the negative effect of a crisis on the broader economy. In this simple model, the feature means that optimal policy must strike a balance between short-term output maximisation and keeping the banks healthy enough to continue financing future activity. Doing the latter requires a higher interest rate to address the risk-shifting problem.

In this specific model, a crisis emanates solely from the banking sector, with bank equity the relevant stock variable. In general, a similar mechanism could operate through non-financial corporations' balance sheets. Suppose it is firms rather than banks that are infinitely-lived, and that their borrowing capacity is a function of their net worth, eg via a collateral channel. In this case a crisis occurs when firms' net worth falls below a critical level, leading to a tighter credit constraint and lower production. A protracted period of 'debt overhang' and low activity could then provide a similar rationale for the central bank to pre-empt too much firm risk-taking before a crisis materialises.

Annex 2: Recent approaches to evaluating leaning strategies

This Annex reviews recent approaches to evaluate the desirability of "leaning against the wind" (LAW) of the financial cycle (a "stability-oriented monetary policy"). It examines key assumptions underlying these approaches and highlights features that deserve greater prominence in future research to fully capture potential gains from such a strategy.

What is the standard way of evaluating empirically the costs and benefits of a financial stability-oriented monetary policy?[39] The basic idea is to trade off the output costs of leaning today with the possible output benefits that would arise tomorrow if leaning helps reduce the likelihood and/or the costs of future banking crises.

Implementing this thought experiment involves a number of steps. First, one takes a traditional model embedding relationships between the policy rate, output and inflation. Then one augments it with a "crisis module". The module describes the relationship between a financial variable and banking crises, links this variable to the policy rate and assumes something about the costs of banking crises. The variable most commonly used is the growth rate of (private sector) credit, which some work has found to be a reliable leading indicator of banking crises. Finally, one estimates the resulting net benefits in terms of output and (possibly) inflation by adjusting policy, either as a one-off deviation from traditional policy rules or as the optimal response given the model.

Analysis of this type tends to find that, for typical parameter values, a LAW strategy does not generate significant net benefits and may be counterproductive.[40] Extending this basic analysis in certain directions can strengthen the case for leaning[41], but the typical conclusion drawn from it has been that the first-order benefits are, at best, small.

This type of analysis follows a clear logic, but there are a number of reasons why it may underestimate the potential net benefits of leaning. These have to do with the assumptions and with the calibration (Table A.1).

In most studies, the crises do not result in permanent output losses, so that eventually output returns to its pre-crisis trend. But empirical evidence suggests that this is typically not the case.[42] Output may indeed regain its previous long-term growth rate, but it typically ends up following a parallel and lower path. Thus, if one postulates, plausibly, that actual and potential output eventually converge, this means that potential output is also permanently lower.

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[39] The focus here is on the empirical work, as opposed to the theoretical studies that typically find that there may be a role for monetary policy; for two examples among many, see Woodford (2012) and Gambacorta and Signoretti (2014). See also Smets (2013), Borio (2014b) or IMF (2015) for references.

[40] See, in particular, Svensson (2014, 2017) and IMF (2015).

[41] For example, uncertainty about the crisis' probability and severity could justify leaning as a robust-control strategy (Ajello et al (2015)).

[42] See the BCBS (2010) survey and, in particular, Cerra and Saxena (2008) and, more recently, Ball (2014). Blanchard et al (2015) find that other recessions, too, may have a similar effect.

Costs and benefits of LAW: assumptions Table A.1

	Permanent output losses	Cleaning is not feasible	LAW reduces crisis severity	Benefits beyond crisis prevention	Risks build up	Monetary policy experiment
Svensson (2017)	NO	NO	NO	NO	NO	Deviation from Taylor rule
IMF (2015)	NO	YES	NO	NO	NO	Deviation from Taylor rule
Ajello et al (2015)	NO	YES	NO	NO	NO	Optimal rule
Gourio et al (2017)	YES	YES	NO	NO	NO	Optimal linear rule
Gerdrup et al (2017)	NO	NO	YES	NO	NO	Optimal rule
Adrian and Liang (2016)	NO	YES	YES	NO	NO	Deviation from Taylor rule
Juselius et al (2017)	YES	YES	YES	YES	YES	Linear rules
Filardo and Rungcharoenkitkul (2016)	NO	YES	YES	YES	YES	Optimal rule

LAW = leaning against the wind.

In some cases, monetary policy can even "clean up" after a crisis hits, in the sense that the central bank can cut rates and make up for any demand shortfall as it would with any other normal recession. But the GFC experience clearly suggests otherwise: monetary policy has a harder time dealing with balance sheet recessions, as agents are over-indebted and balance sheets impaired (eg Borio (2014a)). There is indeed a consensus that this is a lesson to be drawn from the crisis.

Leaning is often assumed to affect the probability of a crisis but not its severity once it occurs. But one might expect that the bigger the initial imbalance, the larger the costs will be. Indeed, the severity of a balance sheet recession depends on the extent of bad debt previously accumulated. If policy can help restrain the build-up, it would also limit the damage of any subsequent strains. Some studies have incorporated this endogenous crisis cost and found support for leaning (eg Adrian and Liang (2016) and Gerdrup et al (2017)).

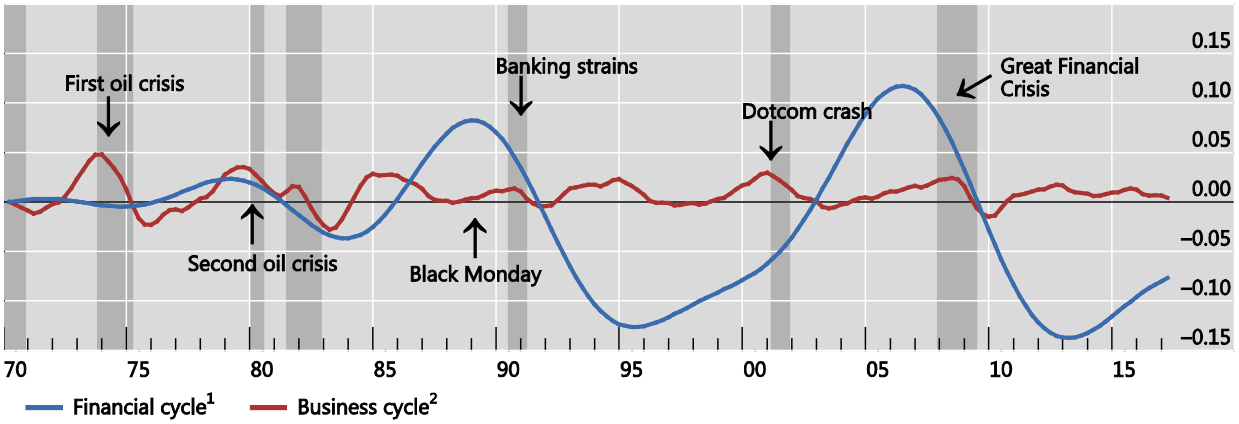
In most exercises, financial variables have no or limited impact on output other than through crises. And even if they do, this is not considered part of the analysis. But this means that benefits can only arise if crises occur, which is very restrictive. It couches the problem exclusively in terms of rare events rather than of the potential for financial fluctuations to damage the economy more generally.

Finally, another underappreciated key assumption concerns the evolution of financial risks. In prevailing approaches, risks do not grow over time. By that we mean that if no action is taken, then any "shocks" that may occur in normal times will die away. This implies that there is little or no cost to waiting. Importantly, this encourages the view that a financial stability-oriented monetary policy is one that follows a traditional policy most of the time and then deviates from it only once the signs of financial imbalances become evident. But the risk of this strategy is obvious: it could end up doing too little too late or, worse, it could be seen as precipitating the very crisis it intends to prevent.

Some work at the BIS has relaxed most of these restrictive assumptions of the standard approach. As a result, it has found higher potential benefits from leaning (eg Juselius et al (2017), Filardo and Rungcharoenkitkul (2016)). While the specifics differ, this research strand shares two elements: it allows risks to build up over time as the economy evolves – and here the notion of the financial cycle is key – and it allows monetary policy to play a bigger role in influencing both the probability and costs of financial busts, *even without crises*. In other words, there is path dependence, so that once financial imbalances are allowed to build up, some losses down the road are inevitable. The benefits from leaning stem not only from averting full-blown crises, but also from tempering the financial cycle and its associated cost.

Financial and business cycles in the United States

Graph 1

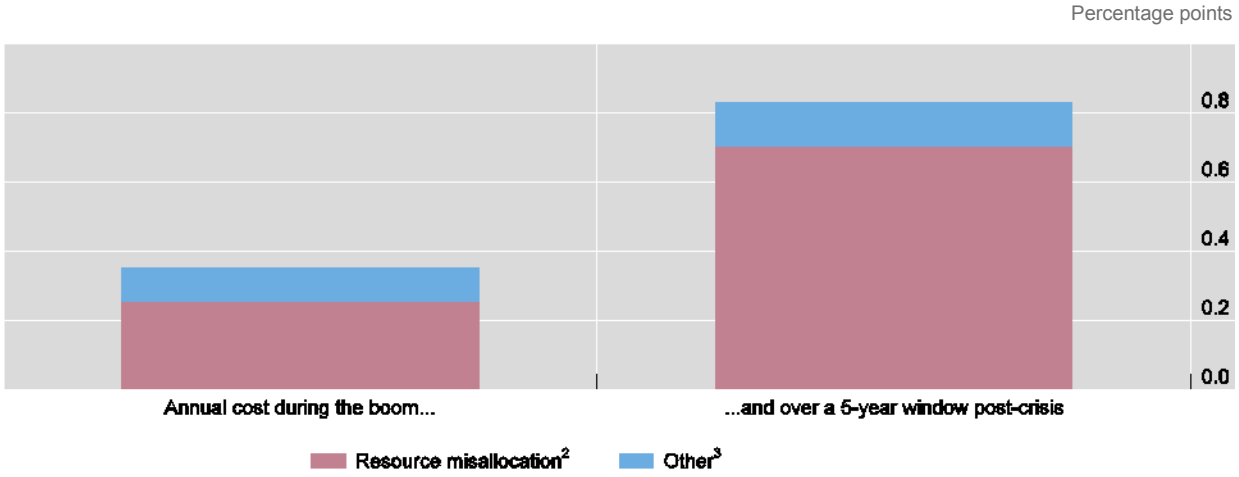


[1] The financial cycle as measured by frequency-based (bandpass) filters capturing medium-term cycles in real credit, the credit-to-GDP ratio and real house prices. [2] The business cycle as measured by a frequency-based (bandpass) filter capturing fluctuations in real GDP over a period from one to eight years.

Sources: Drehmann et al (2012), updated.

Financial booms sap productivity by misallocating resources[1]

Graph 2



[1] Estimates calculated over the period 1980–2010 for 22 advanced economies. [2] Annual impact on productivity growth of labour shifts into less productive sectors during the credit boom, as measured over the period shown. [3] Annual impact in the absence of reallocations during the boom.

Source: Based on Borio et al (2016).

A flatter Phillips curve for prices and (less so) wages[1]

Graph 3

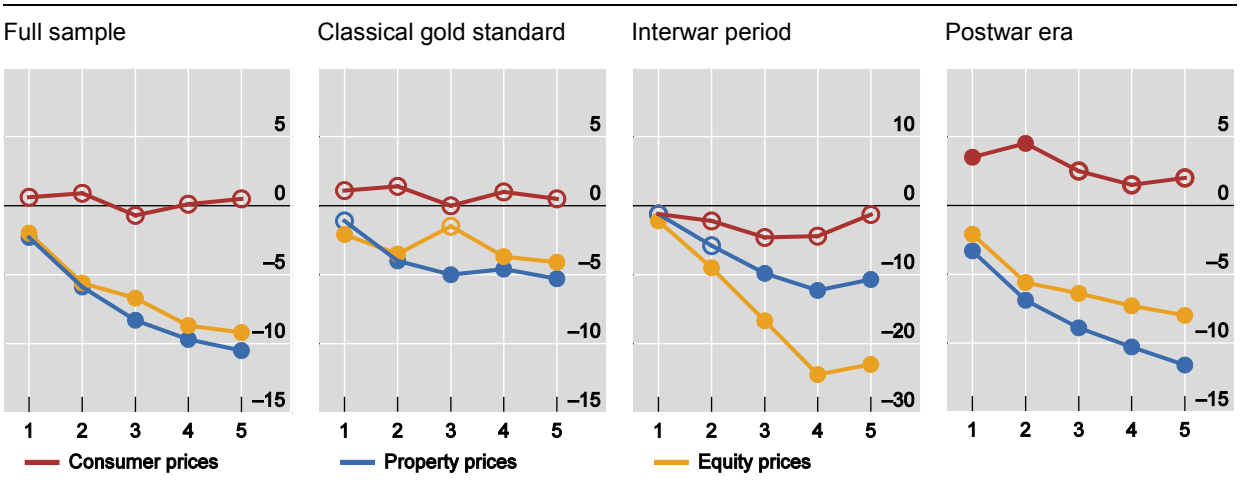
[1] Rolling 15-year window estimates from panel of G7 economies. See source for details.

Source: BIS (2017).

Change in per capita output growth after price peaks[1]

Graph 4

In percentage points[2]



The approach underlying the estimated effects shown in the graph is described in the main text of the paper; a circle indicates an insignificant coefficient, and a filled circle indicates that a coefficient is significant at least at the 10% level. Estimated effects are conditional on sample means (country fixed effects) and on the effects of the respective other price peaks (eg the estimated change in h-period growth after CPI peaks is conditional on the estimated change after property and equity price peaks) For the respective country samples, see the paper.

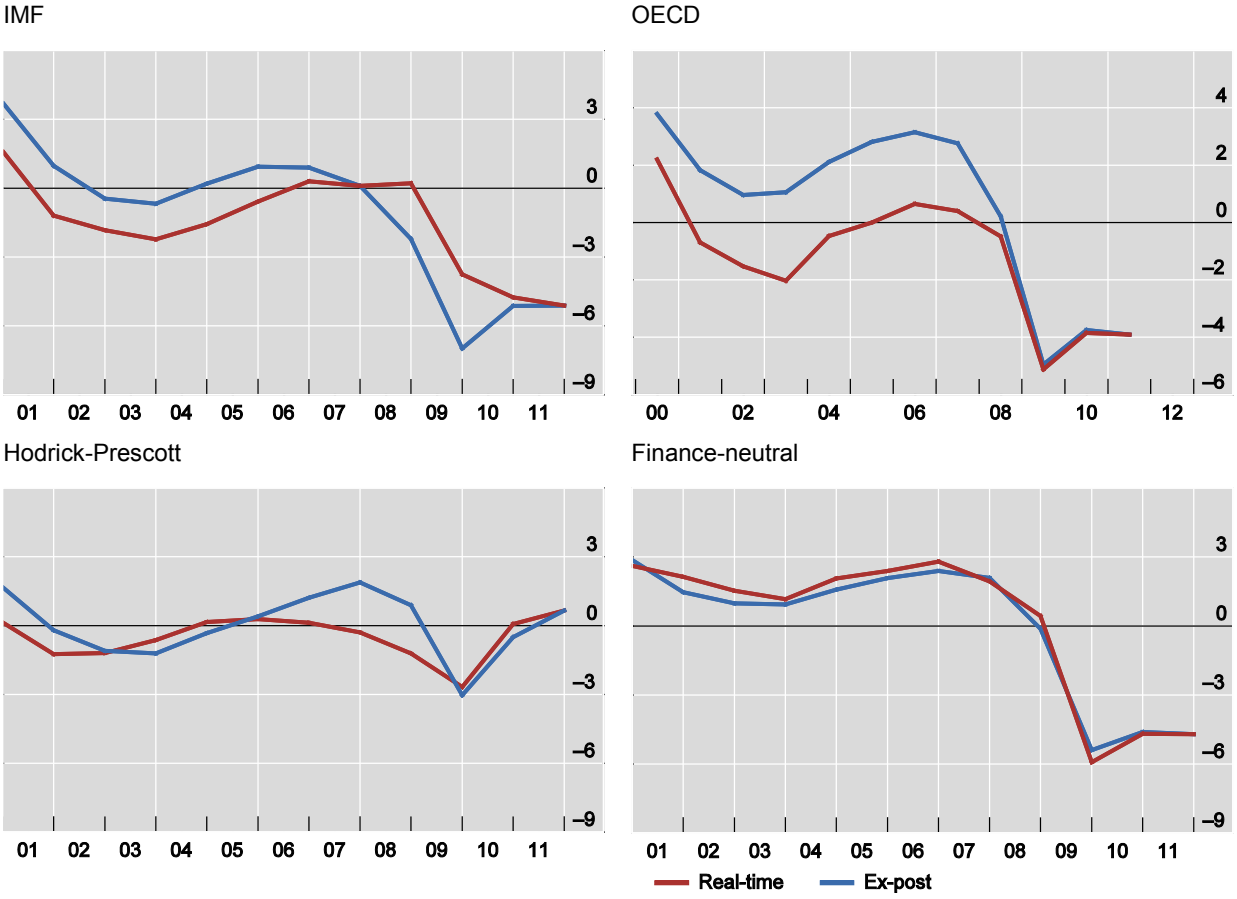
[1] The graph shows the estimated difference between h-period per capita output growth after and before price peak. [2] The estimated regression coefficients are multiplied by 100 in order to obtain the effect in percentage points.

Source: Borio et al (2015).

US output gaps: ex post and real-time estimates

In per cent

Graph 5

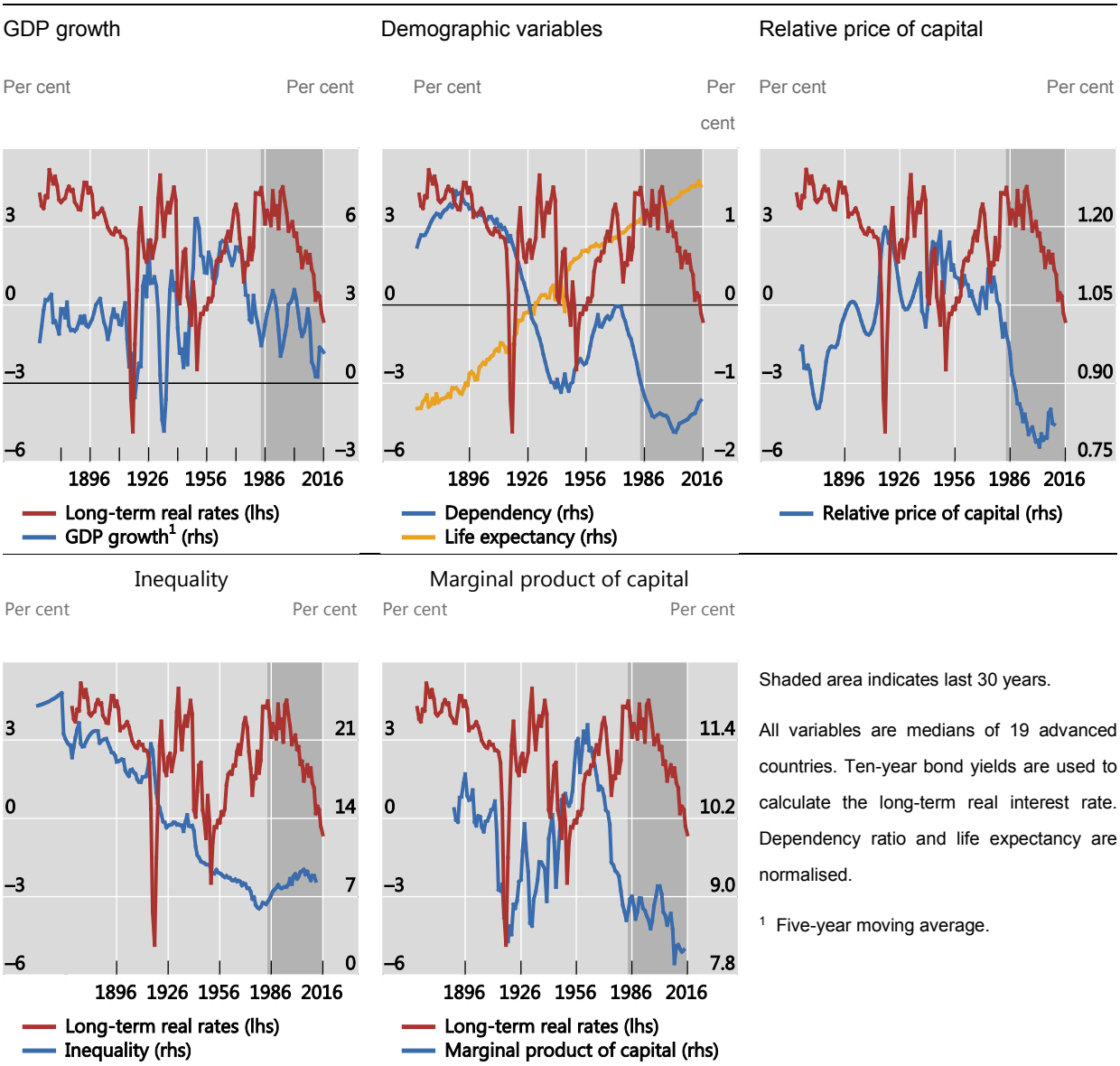


For each time *t*, the "real-time" estimates are based only on the sample up to that point in time. The "ex post" estimates are based on the full sample.

Source: Borio et al (2017a).

Real interest rate and saving/investment drivers: spot the correlation

Graph 6



Shaded area indicates last 30 years.

All variables are medians of 19 advanced countries. Ten-year bond yields are used to calculate the long-term real interest rate. Dependency ratio and life expectancy are normalised.

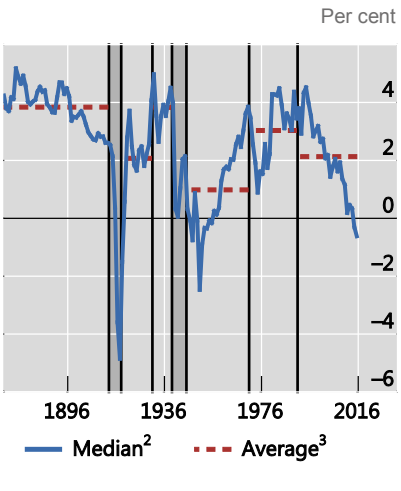
[1] Five-year moving average.

Sources: Borio et al (2017b).

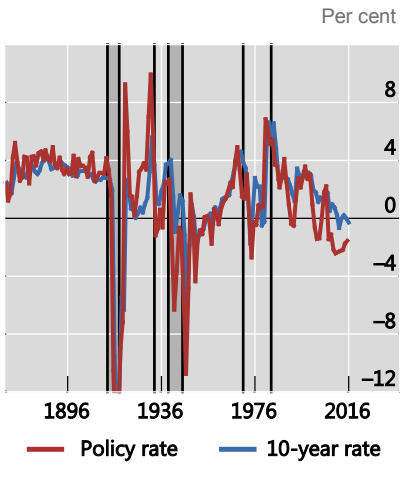
The influence of monetary regimes on real interest rates[1]

Graph 7

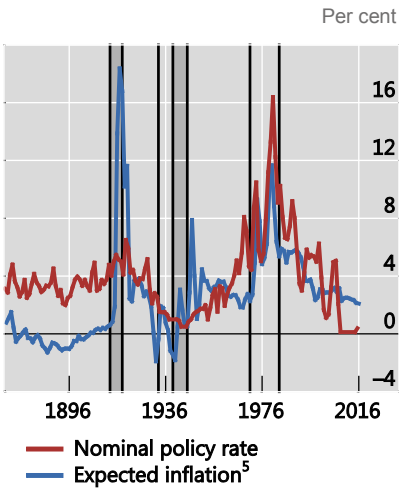
Median long-term rate across countries



Interest rates for the monetary anchor countries[4]



Nominal policy rate[4] and expected inflation[4]

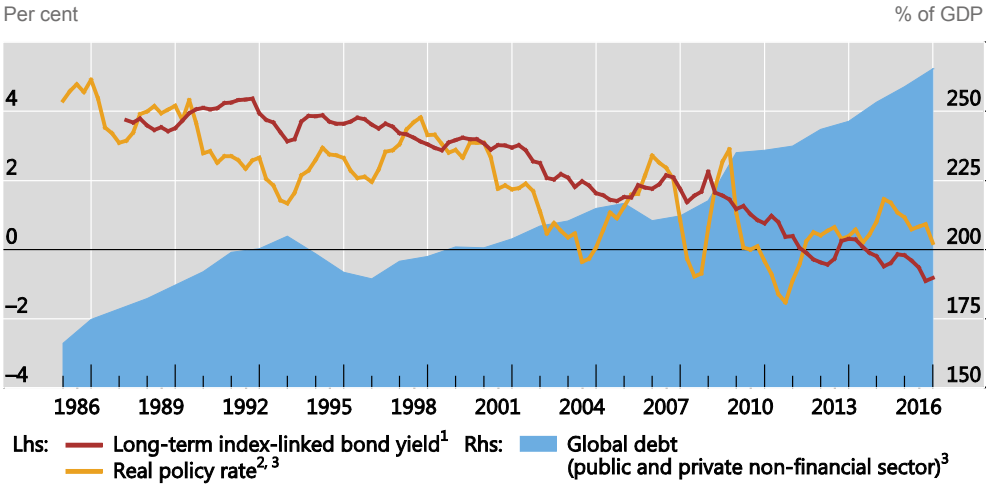


[1] Monetary policy regimes, in order: (mainly) classical gold standard; post-WWI gold standard; other interwar years; Bretton Woods; post-Bretton Woods, pre-Volcker; post-Bretton Woods, post-Volcker tightening. Shaded areas indicate WWI and WWII (excluded from the empirical analysis). [2] Median interest rate for 19 countries. [3] Average of median interest rate over the periods corresponding to regimes. [4] Data for the United Kingdom up to WWI, and for the United States thereafter. [5] One-year-ahead expected inflation (year-on-year headline CPI).

Source: Borio et al (2017b).

Interest rates sink as debt soars: a debt trap?

Graph 8

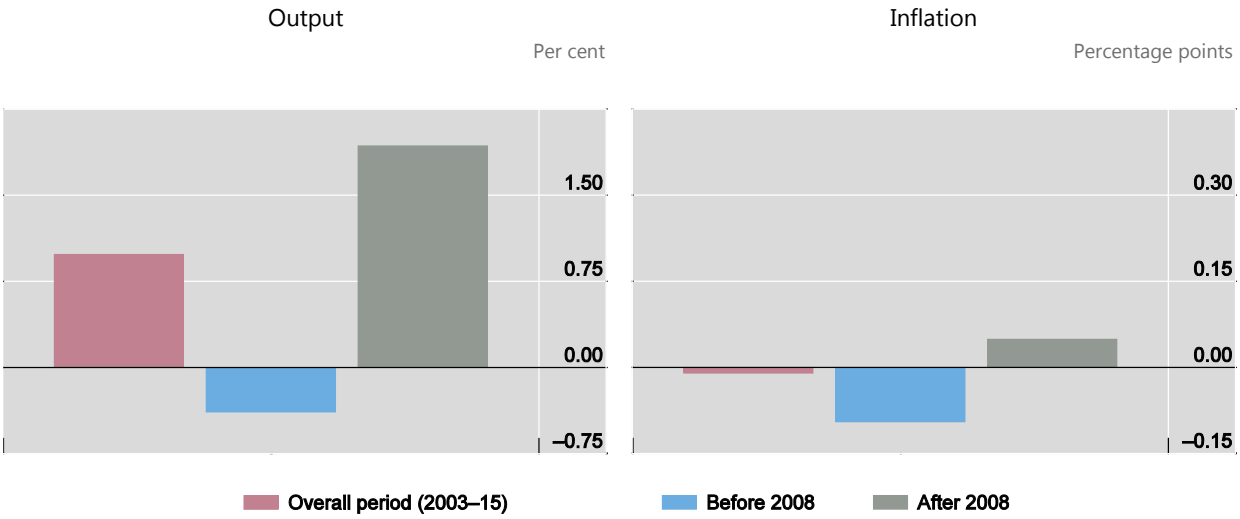


[1] From 1998, simple average of France, the United Kingdom and the United States; otherwise only the United Kingdom. [2] Nominal policy rate less consumer price inflation. [3] Aggregate based on weighted averages for G7 economies plus China based on rolling GDP and PPP exchange rates.

Sources: Borio and Disyatat (2014), updated..

An illustrative experiment: higher output and similar inflation

Graph 9

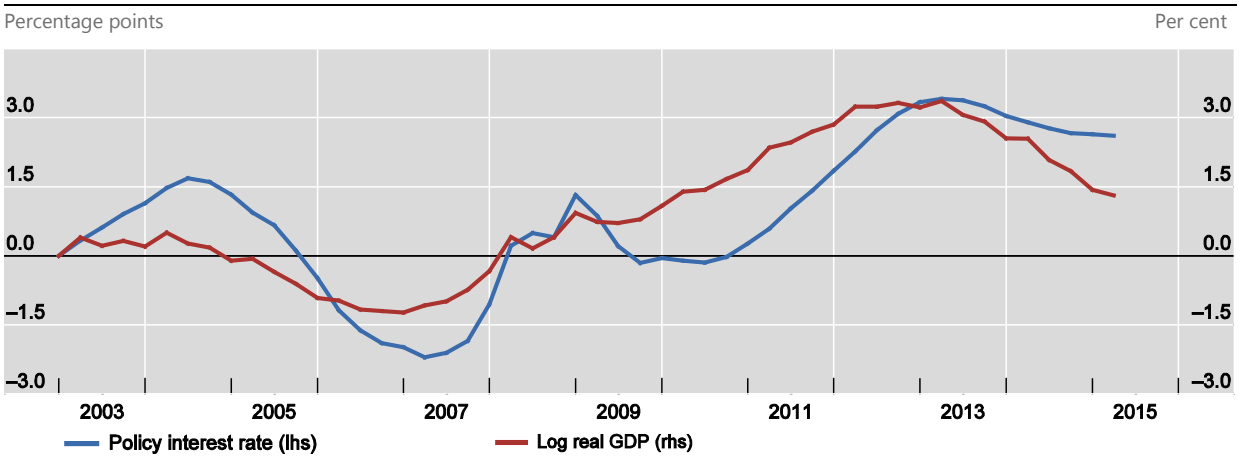


Source: Juselius et al (2017); based on US data.

An illustrative experiment: output and interest rate paths

Difference between counterfactual and actual outcomes

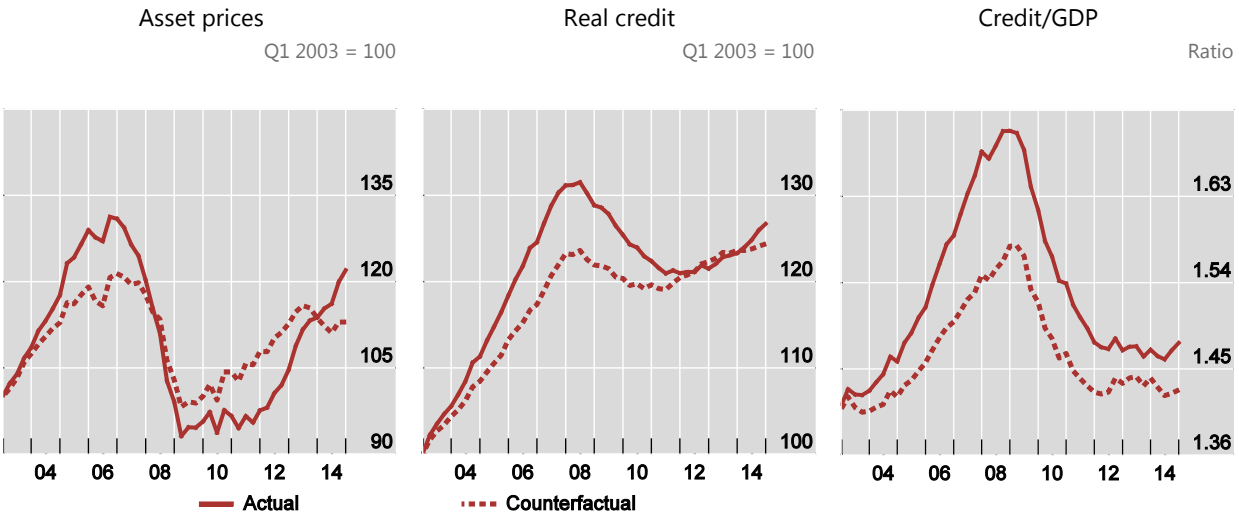
Graph 10



Sources: Juselius et al (2017); based on US data.

An illustrative experiment: smoothing the financial cycle

Graph 11

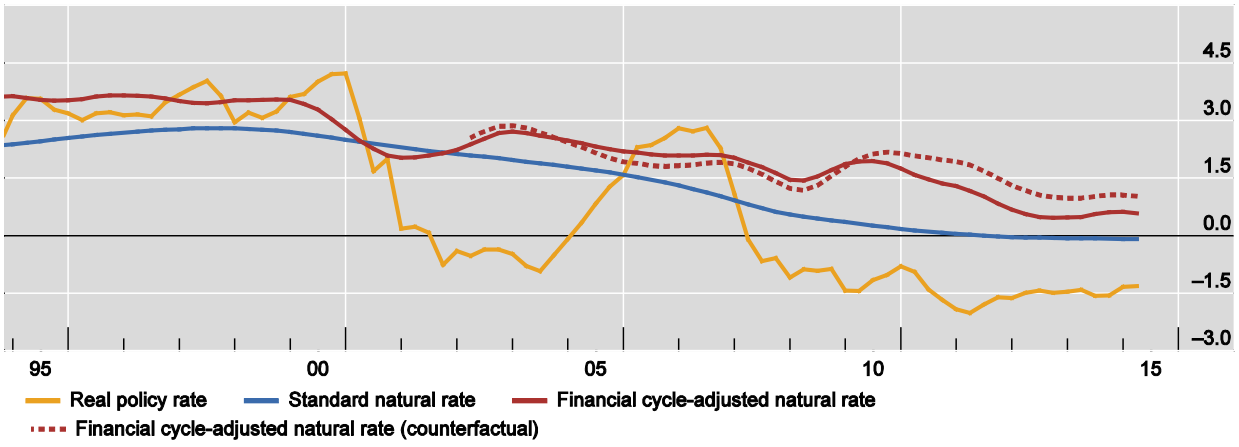


Sources: Juselius et al (2017); based on US data.

Comparing interest rates: standard and financial cycle-adjusted

In per cent

Graph 12



Sources: Juselius et al (2017); based on US data.

Real interest rates and the 'usual suspects'

Table 1

	(1) Full sample	(2) Gold standard	(3) Interwar	(4) Postwar	(5) Pre–Volcker	(6) Post–Volcker
GDP growth (+)	–0.09**	–0.00	–0.07	0.08	0.07	0.03
	(0.04)	(0.02)	(0.05)	(0.07)	(0.07)	(0.05)
Population growth (+/-)	–0.83*	–0.50	0.25	–0.77**	–0.00	–0.68
	(0.39)	(0.50)	(0.36)	(0.28)	(0.28)	(0.71)
Dependency ratio (+)	0.02	–0.03	–0.04	0.03	0.14***	–0.03
	(0.02)	(0.02)	(0.09)	(0.02)	(0.02)	(0.07)
Life expectancy (-)	0.04	–0.20***	0.41	0.23**	0.47***	–0.32***
	(0.03)	(0.05)	(0.24)	(0.09)	(0.13)	(0.09)
Relative price of capital (+)	0.01	0.11**	–0.06	–0.00	–0.06*	0.01
	(0.02)	(0.03)	(0.05)	(0.01)	(0.03)	(0.03)
Income inequality (-)	0.10*	–0.01	0.00	–0.26***	–0.10	–0.10
	(0.05)	(0.05)	(0.30)	(0.05)	(0.21)	(0.15)
Constant	–1.97	15.33***	–17.90	–14.27*	–42.48***	31.18***
	(2.97)	(2.61)	(21.61)	(7.79)	(11.80)	(7.95)
Adj. R–sq	0.07	0.51	0.22	0.21	0.34	0.26
N	1102	202	205	643	303	340
Country fixed effects	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses based on country clusters; ***/**/* denotes results significant at the 1/5/10% level.

Full sample, 1870-2016; Gold standard, 1870-1913; Interwar, 1920-1938; Postwar, 1950-2016; Pre-Volcker, 1950-1979; Post-Volcker, 1980-2016.

Source: Borio et al (2017b).

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