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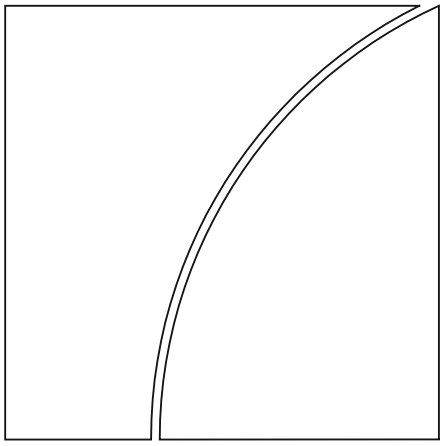

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Is monetary policy less effective when interest rates are persistently low?

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Keywords: monetary policy, low interest rates, balance-sheet recession, monetary transmission

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Is monetary policy less effective when interest rates are persistently low?

Claudio Borio and Boris Hofmann[1]

Abstract

Is monetary policy less effective in boosting aggregate demand and output during periods of persistently low interest rates? This paper reviews the reasons why this might be the case and the corresponding empirical evidence. Transmission could be weaker for two main reasons: (i) headwinds, which would typically arise in the wake of balance sheet recessions, when interest rates are low; and (ii) inherent non-linearities, which would kick in when interest rates are persistently low and would dampen their impact on spending. Our review of the evidence suggests that headwinds during the recovery from balance-sheet recessions tend to reduce monetary policy effectiveness. At the same time, there is also evidence of inherent non-linearities. That said, disentangling the two types of effect is very hard, not least given the limited extant work on this issue. In addition, there appears to be an independent role for nominal rates in the transmission process, regardless of the level of real (inflation-adjusted) rates.

JEL classification: E43, E52

Keywords: monetary policy, low interest rates, balance-sheet recession, monetary transmission

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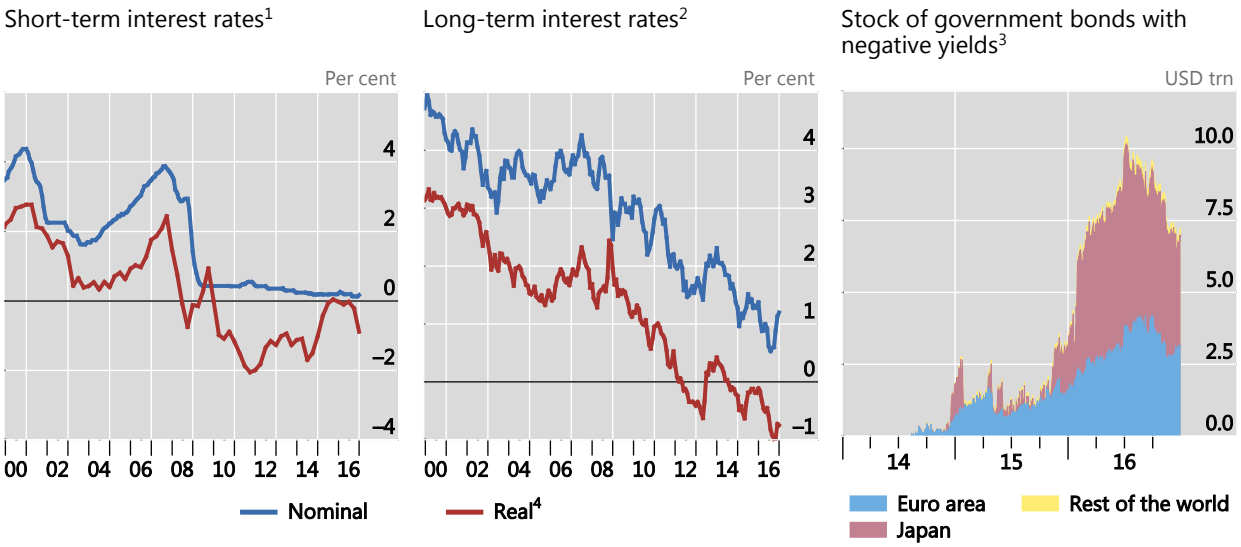
Introduction

Interest rates in the core advanced economies have been persistently low for about eight years now (Graph 1). Short-term nominal rates have on average remained near zero since early 2009 (left-hand panel) and have been even negative in the euro area and Japan, respectively, since 2014 and 2016. The drop in short-term nominal rates has gone along with a fall in real (inflation-adjusted) rates to persistently negative levels. Long-term rates have also trended down, albeit more gradually, over this period: in nominal terms, they fell from between 3–4% in 2009 to below 1% in 2016, on average (Graph 1, centre panel); in real terms, they have been mostly negative since 2012. Indeed, following the adoption of negative policy rates in the euro area, Japan and some smaller advanced economies, at the end of 2016 a significant stock of global government bonds (more than $7 trillion or 20% of the total outstanding)[2] was still trading at negative yields, after reaching a peak of over $10 trillion in mid-2016. For all its prominence, the post-US election backup in yields has so far not fundamentally changed this picture.

Low interest rates in core advanced economies Graph 1



[1] Simple average of Japan, euro area, the United Kingdom and the United States. [2] Simple average of France, the United States and the United Kingdom. [3] Based on the constituents of the Bank of America Merrill Lynch World Sovereign index. [4] Nominal policy rate minus CPI inflation (for the United States, PCE inflation); long-term index-linked bond yield.

Sources: Bank of America Merrill Lynch; Bloomberg; Datastream; BIS calculations; national data.

From a historical perspective, this persistently low level of short- and long-term *nominal* rates is unprecedented. Since 1870, nominal interest rates in the core advanced economies have never been so low for so long, not even in the wake of the Great Depression of the 1930s (Graph 2, top panels). Elsewhere, too, including in Australia, short- and long-term interest rates have fallen to new troughs, reflecting in part global interest rate spillovers especially at the long end (Obstfeld (2015), and Hofmann and Takáts (2015)).

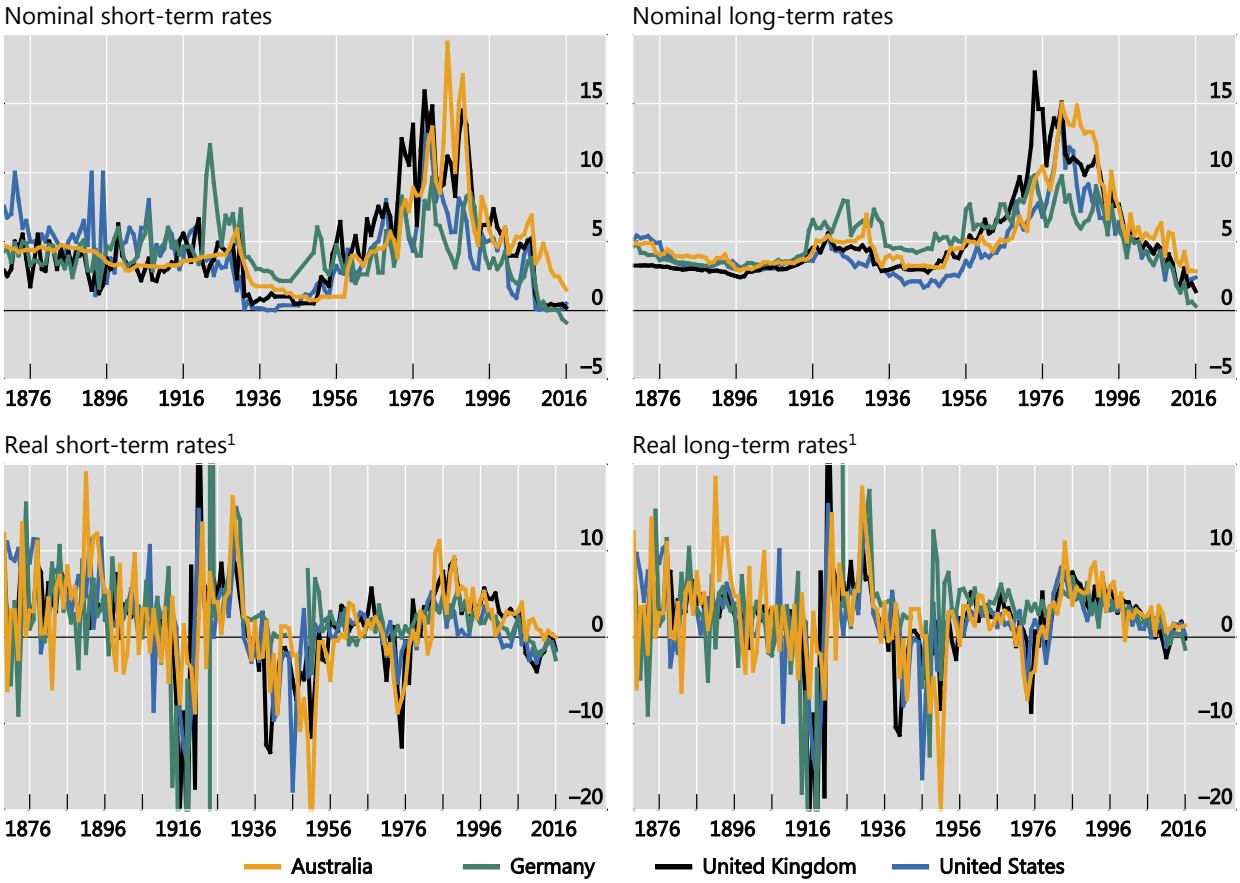
[2] The numbers refer to the sovereign bonds represented in the Merrill Lynch World Sovereign index.

The picture is not very different for interest rates measured in *real or inflation-adjusted* terms (Graph 2, bottom panels). To be sure, there have been periods during which, as a result of high inflation, real rates have been even lower, notably during the Great Inflation of the 1970s. But recently real rates have generally been negative for even longer than at that time.

Interest rates, 1870-2016

In per cent

Graph 2



[1] Nominal interest rate minus CPI inflation.

Sources: Jordà, Schularick and Taylor (2017); Global Financial Data; national data.

The persistently low rates of the recent past have reflected central banks' unprecedented monetary easing to cushion the fallout of the Great Financial Crisis (GFC), spur economic recovery and push inflation back up towards objectives. However, despite such efforts, the recovery has been lacklustre. In the core economies, for instance, output has not returned to its pre-recession path, evolving along a lower, if anything flatter, trajectory, as growth has disappointed (Graph 3). At the same time, in many countries inflation has remained persistently below target over the past three years or so (Graph 3).

Against this background, there have been questions about the effectiveness of monetary policy in boosting the economy in a low interest rate environment. This paper assesses this issue by taking stock of the existing literature. Specifically, the focus is on whether the positive effect of lower interest rates on aggregate demand diminishes when policy rates are in the proximity of what used to be called the zero

lower bound. Moreover, to keep the paper's scope manageable, we take as given the first link in the transmission mechanism: from the central bank's instruments, including the policy rate, to other rates. The extensive literature on this question has already been reviewed elsewhere (eg Borio and Zabai (2016)). And we focus exclusively on domestic transmission channels, thereby excluding the impact through the exchange rate.[3]

We review the conceptual arguments and empirical evidence. Conceptually, monetary policy transmission may be weaker when interest rates are low for at least two reasons. The first has to do with the economic context: macro-financial "headwinds" may blow more strongly when interest rates are low. Specifically, persistently low interest rates often prevail in the wake of balance-sheet recessions, such as in the aftermath of the GFC. These recessions feature impaired borrower and lender balance sheets, resource misallocations and heightened uncertainty, all factors that would tend to weaken the impact of monetary stimulus (Borio (2014a)). The second reason has to do with the possibility that, regardless of economic context, the impact of a change in interest rates on aggregate demand and output may be smaller at very low rates, ie that nonlinearities are present. Nonlinearities may reflect the effect of net interest margins and bank profitability on credit supply, changes in consumption and saving behaviour, resource misallocations and possibly the impact on confidence and expectations.

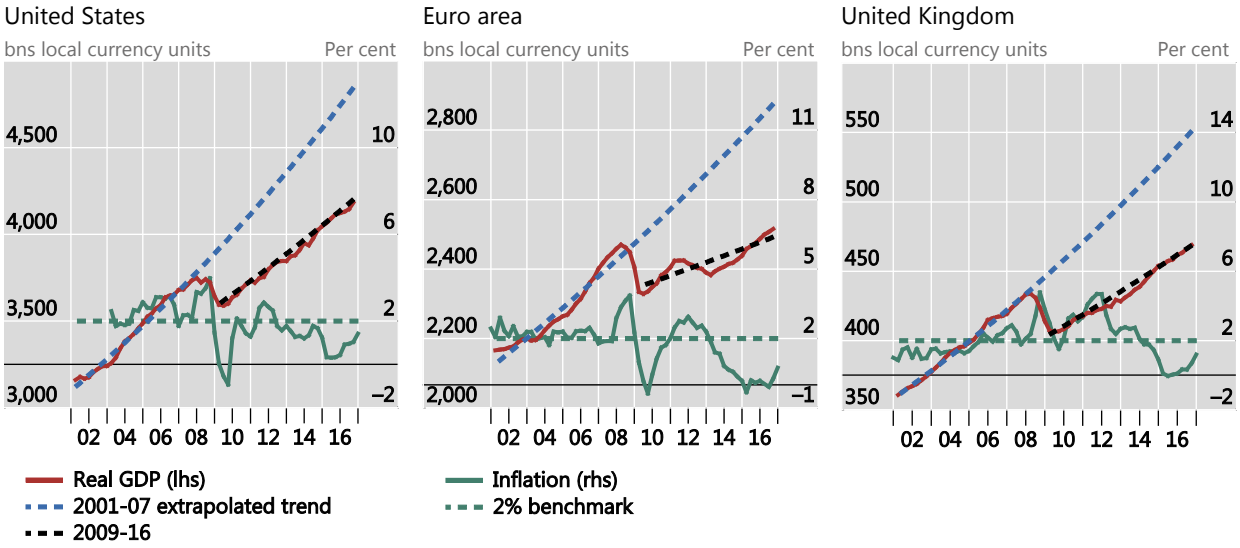
The empirical evidence relating to these questions is rather scant. That said, what is available suggests that monetary policy transmission is indeed weaker when interest rates are persistently low. The economic context appears to matter, making it more likely that policy may push on the proverbial string as headwinds blow. More general nonlinearities may also be present, at least in the case of bank profitability/credit supply as well as of consumption (ie a flattening of the IS curve). And there appears to be an independent role for nominal rates, regardless of the level of real (inflation-adjusted) rates.

At the same time, it is important to bear in mind the caveats in any such analysis. It is very difficult to distinguish empirically between the two possible reasons for weaker transmission. And it is also hard to ensure that the observed relationships are not "spurious", ie that the weaker link between interest rates and demand or output does not result from very weak economic conditions, thus masking the true relationship. To varying degrees, the empirical tests are designed to filter out this possibility but the techniques are inevitably imperfect. At a minimum, though, the analysis suggests that there is ample scope for further investigation of this neglected question.

The paper is organised as follows. Section 1 discusses how an environment of persistently low interest rates might affect the effectiveness of monetary transmission. Section 2 reviews the existing evidence, including recent work carried out at the BIS. In the conclusion, we highlight a number of takeaways and promising areas for further analysis.

[3] It is not obvious why the exchange rate channel should be weaker, unless the link between changes in interest rates and the exchange rate is itself weaker. This, of course, could be possible to the extent that at very low rates the scope for further reductions is more limited. However, the empirical evidence suggests that, if anything, the impact of monetary policy shocks on exchange rates has recently become stronger (Ferrari et al (2017)).

Output[1] and inflation[2] post-crisis Graph 3



[1] Seasonally adjusted, on a logarithmic scale. [2] PCE inflation for the United States.

Sources: Datastream; national data; BIS calculations.

1. Lower monetary policy effectiveness? Potential mechanisms

There are two possible reasons why monetary policy may be less effective at persistently low rates: (i) headwinds resulting from the economic context; (ii) inherent nonlinearities linked to the level of interest rates.

1.1 Headwinds

Persistently low interest rates tend to prevail in the wake of balance sheet recessions, ie recessions that occur when private debt is high and a full-blown financial crisis may erupt. This was the case, for instance, during the Great Depression of the 1930s, the Japanese financial bust of the 1990s and, more recently, the GFC and its aftermath.

The effectiveness of monetary policy may vary across the different phases of a balance sheet recession. In the initial phase, expansionary monetary policy can be highly effective in counteracting the uncertainty spikes and tail risks of a financial and economic meltdown, nipping in the bud adverse feedback loops (eg Mishkin (2009)). In the aftermath of the acute phase of the recession, persistent adverse demand and supply conditions may continue to weigh on the economy and may numb monetary stimulus (eg Borio (2014a,b)). These headwinds are to a large extent a legacy of the previous financial boom, typically characterised by unsustainable credit expansion, asset price increases and capital accumulation (at least in some sectors) as well as by aggressive risk-taking.

There are several reasons for such headwinds. First, debt overhangs may weaken demand. In particular, the drop in output and asset prices increases debt burdens

relative to income and reduces net worth. Borrowers, who may have previously overestimated their income prospects, are likely to respond by lowering expenditures in order to cut their debt burdens and restore their wealth through higher saving (Mian and Sufi (2015) and Drehmann and Juselius (2015)). Giving priority to balance sheet repair over intertemporal expenditure smoothing would tend to dampen the impact of lower rates (eg Koo (2009) and Di Maggio et al (2015)). [4]

Second, an impaired financial sector may curtail credit supply. Losses on loans and other assets weaken financial institutions' capitalisation and make it harder and more costly to raise capital, thereby sapping lending capacity (eg Holmstrom and Tirole (1997), and Diamond and Rajan (2011)). This would tend to reduce the pass-through of stimulus.[5] To be sure, the bank lending channel literature posits that monetary transmission is stronger when banks are weakly capitalised (eg Gambacorta and Mistrulli (2004) and Jimenez et al (2012)). But this relationship may be reversed in the wake of financial stress or deep recessions, when lenders are under pressure from markets or regulators to compensate the capital losses (Albertazzi et al (2016)).

Third, balance sheet recessions, especially if associated with full-blown crises, may tend to go hand-in-hand with low confidence and heightened uncertainty about economic prospects (Mian and Sufi (2015)). Moreover, the switch from aggressive risk-taking to pervasive risk aversion is likely to be especially marked. This uncertainty would tend to dampen expenditures and may make them less responsive to stimulus. It could boost precautionary saving (Skinner (1988), Deaton (1991) and Dynan (1993)) and raise hurdle rates for investment (eg Bernanke (1983), Dixit (1992), and Dixit and Pindyck (1994)).[6] In such a situation, firms may also prefer to take advantage of low interest rates to finance mergers and acquisitions and, even more safely, buy back shares or pay out higher dividends rather than embark on capital investment. Management incentives linked to the behaviour of share prices may strengthen this temptation. More generally, higher risk aversion may also dampen the impact of stimulus on asset prices and lending. [7]

Finally, the effectiveness of stimulus may be weakened by conditions on the supply side of the economy. Financial booms tend to go hand-in-hand with slower

[4] For example, in a stylised DSGE model, Alpanda and Zubairy (2016) show that in high debt regimes household borrowing responds in a more muted way to an increase in housing collateral values engineered by monetary easing. This is because households first use rising housing equity values to reduce leverage, by letting the debt-to-equity ratio fall, before they start borrowing again.

[5] The problem could be exacerbated if the sovereign's creditworthiness came under strain: historically, fiscal crises have often occurred on the heels of financial crises (eg Jordà et al (2016)). This is partly because financial booms tend to flatter the fiscal accounts and financial busts drive large holes in public finances, including because of the need to deal with banking sector distress (eg Reinhart and Rogoff (2009), and Borio et al (2016)).

[6] Bloom et al (2007) and Aastveit et al (2013) show theoretically that higher uncertainty not only reduces investment but also lowers the responsiveness of investment to demand shocks, specifically to monetary impulses.

[7] Adverse initial conditions – asset prices and debt that are too high, risk-taking that has been excessive – will arguably also tend to weaken the risk-taking channel of monetary policy, ie the impact on expenditures resulting from the effect of interest rates on risk perceptions and appetite (see Borio and Zhu (2012), and Adrian and Shin (2010) for a description of the channel and eg Buch et al (2014), Gambacorta (2009), Peersman and Wagner (2015) and Cecchetti et al (2017) for empirical evidence). Given these headwinds, it is possible that any higher risk-taking induced by unusually low interest rates may exert an impact on the financial system (financial risk-taking) but feed less into expenditures.

productivity growth, mainly as a result of a shift of resources into sectors such as construction (Borio et al (2015b)). The adverse implications for productivity growth become considerably larger if the bust ushers in a financial crisis. The mechanisms at work are poorly understood. But a possible explanation is that the boom results in the overexpansion of certain, especially interest rate sensitive, sectors, such as construction, which then need to shrink during the contraction. The reallocation of resources may, in turn, be hindered if the banking sector runs into trouble. All else equal, headwinds would blow most strongly precisely in interest rate-sensitive sectors, where excess capacity would be prevalent. In addition, ultralow interest rates could delay the welcome reallocation of resources to higher productivity sectors and firms. For instance, unless their balance sheets are quickly repaired, weakly capitalised, loss-averse banks would have an incentive to keep afloat weaker borrowers ("extend and pretend") and curtail or increase the cost of credit for healthier ones – the so-called zombie lending phenomenon (see below).[8]

The strength of some of the mechanisms outlined above will depend on country-specific characteristics. Of special relevance is the structure of debt contracts and their impact on deleveraging pressures. For instance, the higher the share of the debt stock that is at variable rates and that is more sensitive to the short-term rate, the bigger will be the impact on debt servicing costs and cash flows and, hence, on spending. Shorter maturities are also helpful here. The same is true of refinancing options, which allow borrowers to cut the net present value of their debt despite its fixed-rate long-maturity character.[9] Similarly, non-recourse loans allow over-indebted borrowers to reduce their debt burden, thereby obviating the need to cut spending. For these reasons, for instance, the US mortgage market may be more sensitive to monetary stimulus than some of its European counterparts.

1.2 Nonlinearities linked to the level of interest rates

There are a number of channels through which persistently low interest rates might themselves sap the effectiveness of monetary policy. These include their impact on: (i) bank profitability and hence credit supply; (ii) consumption and saving; (iii) uncertainty; and (iv) resource misallocation.

Net interest margins, bank profitability and bank lending

Low *nominal* interest rates can harm bank profitability. Under quite general conditions, low *short-term* interest rates sap net interest income through the "endowment effect". Retail bank deposits are typically priced as a markdown on market rates, generally reflecting some form of oligopolistic power and compensation for transaction services. As a result, as rates decline, the markdown narrows and the benefit from this relatively cheap funding source shrinks. This is because banks are reluctant to reduce deposit rates below zero, even when the policy rate crosses that

[8] For conceptual analyses of banks' decisions to charge-off loans, or to engage in zombie lending, see eg Lepetit et al (2011), and Bruche and Llobet (2014).

[9] However, lower collateral values post-crisis, possibly in combination with tighter lending standards, such as lower loan-to-value ratios, may limit the effectiveness of refinancing options.

barrier. The effect is nonlinear: it becomes stronger at very low rates.[10] Intuitively, as deposit rates hit zero, any further reduction in the short-term rate would affect returns on the asset side without any corresponding impact on the cost of retail deposits.[11] The impact of low short-term rates is compounded if policy also compresses long rates and hence the *slope of the yield curve*, eroding the returns from maturity transformation (borrowing short and lending long). A compression of the term premium is especially costly.[12]

The negative effects of low interest rates on net interest income are counterbalanced by positive effects on other components of profits. Lower interest rates reduce loan loss provisions, as they reduce borrowers' debt servicing costs and default probabilities. They also increase non-interest income by boosting securities' valuations. Thus, the overall effect of low rates on bank profitability is unclear *a priori*. However, the net effect of *persistently* low rates would likely be negative. This is because net interest income is usually the largest single component of bank profits and because the impact of lower rates on net interest income is long-lasting while that on the other components is only temporary,[13] or at least wanes over time. This helps to explain, for instance, the very negative response of bank stocks to markets' perceptions that interest rates would stay lower for longer in January 2017 (BIS (2017)).

A negative impact of low rates on bank profitability can reduce the effectiveness of monetary policy. It may inhibit loan supply, which depends positively on bank capitalisation and hence on profits – retained earnings being the main source of capital accumulation. For example, based on a stylised general equilibrium model, Brunnermeier and Koby (2016) show that the negative effect of lower rates on banks' net interest margins can give rise to a "reversal interest rate" – the level of the rate at which accommodative monetary policy becomes contractionary. In their model, this level could even be positive, depending on structural features of the economy and the financial system.

Consumption and saving

Conventional consumption theory suggests that low real interest rates depress saving and boost consumption through intertemporal substitution. When the real interest rate is low, the returns from postponing consumption to the future are also low. This means that current consumption should increase (substitution effect). This reasoning

[10] Borio et al (2015a) illustrate the nonlinearity based on a version of the Monti-Klein model (equation A12 in the paper's annex).

[11] The endowment effect was a big source of profits at high inflation rates and when competition within the banking sector, and between banks and non-banks, was very limited, as was the case in many countries in the late 1970s. It has again become quite prominent but operating in reverse post-crisis as interest rates have become extraordinarily low.

[12] While the impact on the risk-free curve is temporary, that which reflects a compression of the term premium is permanent. See eg Borio et al (2015a), and Dietrich and Wanzenried (2011).

[13] The capital gains on securities holdings would actually be reversed if the securities were held to maturity (and would not even show up in the income statement in that case). Moreover, the impact on loan loss provisions would be much longer lasting. At the same time, the low carrying costs of non-performing loans could delay balance sheet repair, weighing on profitability.

is the cornerstone of the standard Euler consumption equation – the consumption demand-block of modern DSGE models.[14]

In more general settings, interest rates may also affect consumption through income/cash flow and wealth effects. In particular, there is also a redistribution channel of monetary policy through its impact on incomes and/or cash flows (La Cava et al (2016)). Lower interest rates mean lower interest payments by borrowers to the extent that loans are at adjustable rates or can be refinanced. But they also mean lower interest receipts for lenders. While these channels are in essence redistributive, they can give rise to first-order effects in the aggregate whenever borrowers have higher marginal propensities to consume than lenders, as is typically assumed (Tobin (1982) and Auclert (2016)). Clearly, the strength of the redistribution channel will also depend on the structural features of credit markets. For instance, the redistribution to borrowers will be greater if debt contracts are at adjustable rates (Garriga et al (2016)).

If interest rates are persistently low, additional expected income effects may come into play. If agents become concerned that the low returns on savings will persist and render their envisaged lifetime savings insufficient to ensure an adequate standard of living after retirement, they may step up saving and reduce consumption to compensate for the shortfall (White (2012) and Hannoun (2015)). To be sure, in principle this effect should operate *regardless* of the level of interest rates. But it may become much more visible and prominent when interest rates are unusually and persistently low. For instance, concerns about the viability of pension funds or much less remunerative life insurance saving products can highlight the need for higher saving for retirement (see below). As a result, the effect of low rates on consumption may diminish and even reverse as rates drop to very low levels. That said, while this argument is often brought up in public debate, we are not aware of a formalisation of this point in a theoretical model of consumption and saving.

A possible countervailing force relates to wealth effects, linked to the boost that lower interest rates give to asset prices.[15] Standard asset pricing theory suggests that changes in real interest rates should actually have a *larger* impact on asset prices when real interest rates are low.[16] As a result, the corresponding wealth effects on consumption (and possibly investment) would be *stronger* in a low rate environment. Of course, such a countervailing force would tend to be weaker during recoveries from a balance sheet recession, given heightened risk aversion and initial overvaluation.[17]

Finally, just as in the case of bank lending, nominal interest rates may matter quite independently of real rates. In addition to cash flow effects, agents may exhibit "money illusion", so that their behaviour is influenced by nominal magnitudes

[14] See Woodford (2003), Chapter 4, for a discussion of how consumption depends on the expected future path of real interest rates in textbook New Keynesian models.

[15] Under "wealth effects" we also include the indirect effect of the relaxation of borrowing constraints through the use of assets as collateral.

[16] This follows from the standard dividend discount model.

[17] Of course, wealth effects will tend to benefit wealthier households disproportionately. This matters because such households may have a lower propensity to consume. See Domanski and Zabai (2016) for a review of the implications of wealth inequality for monetary policy in light of cross-country differences in the distribution and type of wealth.

regardless of changes in the price level. [18] In this case, the potential nonlinearities linked to the various effects on consumption would apply to nominal, rather than real, rates.

Uncertainty

While monetary expansions usually appear to attenuate uncertainty and risk perceptions (Bekaert et al (2013) and Hattori et al (2016)), persistently very low rates could have adverse effects on expectations and confidence. If central banks push rates to levels that are unusually low by historical standards, agents might interpret this as signalling dark economic prospects, potentially offsetting the usual stimulus.[19] The effect could also operate through pension funds and insurance companies: prominent public discussions about the risk of underfunding for defined-benefit pension schemes[20] and, possibly, about insurance companies' viability, could raise concerns about their ability to honour their previous commitments to ensure post-retirement consumption and the need to save more for old age.

Here, too, nominal interest rates may play a special role. Insurance companies' contracts, and their guaranteed returns, are typically set in nominal terms. The discounting method of pension fund liabilities varies across countries and institutions but stickiness in long-term assumptions about inflation and wage growth would generally tend to heighten the impact of changes in nominal rates. And here, in contrast to the impact on asset prices, the effect on the value of the *liabilities* would actually increase at lower rates. [21]

Resource misallocation

Persistently low interest rates may also create disincentives to address a debt overhang and resource misallocation, fostering what has been graphically called a "zombification" of the economy. The best known channel here works through the banking sector. Low rates reduce the perceived need for banks to clean up their balance sheets. They tend to encourage banks to roll over rather than charge-off non-

[18] If the agent prefers the outcome with a higher nominal income but the same real income, then he/she is said to suffer from "money illusion" (Fisher (1928)). For a discussion of the concept of money illusion and the related evidence, see Borio and Zabai (2016).

[19] The problem of such negative confidence effects counteracting the intended expansionary effects of low rates was discussed in the context of forward guidance. The economic news element of forward guidance was referred to as "Delphic" (the central bank acting as an oracle) and the policy accommodation element as "Odyssean" (the central bank providing information about the mast it ties itself to in order to withstand the call of the sirens). This taxonomy was originally proposed by Campbell et al (2012). Specifically, calendar-based forward guidance, where the guidance applies to a clearly specified time horizon, was seen as being potentially less effective due to an overly strong Delphic element.

[20] The underfunding of pension funds could also erode investment by reducing firms' profits and their cash flows. These effects would come into play only at very low rates and would exhibit nonlinearities.

[21] Theoretically, there may also be adverse effects on inflation expectations and ultimately on actual inflation, according to the so-called "Neo-Fisherian" perspective (Cochrane (2015) and Bullard (2015)) which emphasises the long-term relationship between nominal interest rates and inflation. If interest rates are too low compared with the prevailing rate of inflation, the long-run relationship would normally be restored by adjustments in the interest rate to counter rising inflationary pressures. However, if such inflationary pressures cannot build up, eg because of high central bank credibility, the adjustment could also be brought about by a drop in inflation expectations (and ultimately inflation itself).

performing loans in a number of ways. Lower rates increase the expected recovery from non-performing loans by reducing the discount factor.[22] And they reduce the opportunity cost of carrying non-performing loans on the balance sheet, as the returns from alternative investments, and the cost of funding the bad loans, are low. All this saps banks' intermediation capacity because rolled over bad loans crowd out new lending for more productive borrowers. In turn, this can complicate the prudential authorities' task of identifying and resolving weak institutions, in concert with other policymakers. [23]

Here, too, nominal rates may have a prominent role to play. This is because they influence banks' funding costs and are commonly used in the discounting of non-performing loan recovery values. It is also because some loan covenants become less effective when interest rates, and hence contractual repayments, are very low. In general, distinguishing viable from less viable business becomes harder.

2. The evidence

Testing the hypothesis of reduced monetary policy effectiveness at persistently low rates faces a number of challenges.

To start with, assessing the effectiveness of monetary policy requires disentangling its effects from those of other factors driving the macroeconomy. The coexistence of persistently low interest rates and economic weakness is in itself no proof of policy ineffectiveness. Monetary policy may be as effective as ever but its power may be masked by the depressed economic conditions. Put differently, the apparent reduced effectiveness may just be spurious if the countervailing forces are not controlled for. This, of course, is a familiar identification issue in econometrics. But it may be especially hard to resolve when economic conditions are particularly depressed or unusual, as during a balance sheet recession, and when the central bank resorts to multiple policy instruments in addition to the policy rate, such as large-scale asset purchases, which can confound the signal.

In a similar vein, and for similar reasons, even if policy is indeed less effective, it is difficult to disentangle the factors at work. In particular, is it because of headwinds that coincide with low rates or because of inherent nonlinearities linked to the level of rates? True, one might be able to shed further light on this issue by focusing on specific channels and using more granular data (eg the banks' profit-lending nexus or the impact on resource misallocation). Even so, this would still leave open the relevance of the detected effect at the aggregate level.

In what follows, we provide a selective review of the extant evidence. Two main strands of empirical literature can be distinguished: (i) studies that assess the role of

[22] Specifically, the decision to charge off or roll over will depend on how the expected repayment from a loan compares with its liquidation value, which is typically its collateral value. So, for given collateral values, higher discounted repayments can induce more banks to decide to roll over a larger part of their bad loans, in particular in crisis times when the market for collateral can be depressed and illiquid. See Lepetit et al (2011) for a formal analysis.

[23] Another potential channel is of a more political economy nature: persistently and unusually low rates can make it less pressing for policymakers to address the structural root causes of protracted weak economic performance. Structural reforms in the real economy or needed fiscal consolidation are possible examples.

headwinds in monetary transmission but which could also capture effects coming from inherent nonlinearities; and (ii) studies that focus on specific nonlinearities, such as the impact of low rates on bank profitability (and through this on credit supply), on consumption and on resource misallocation.

2.1 Headwinds

In the wake of the GFC, a growing literature has sought to assess whether financial crisis-related headwinds influence the effectiveness of monetary policy. Since periods of financial stress are usually also periods of low interest rates, this literature also speaks to the question of whether transmission is different when rates are low, albeit only indirectly.

As already mentioned, one has to differentiate between the different phases of a financial crisis and a balance sheet recession. Monetary policy is probably more effective than usual in the acute phase of a crisis but less effective in the recovery phase. This conjecture seems to be borne out by the empirical evidence, for both conventional policy (ie for the policy rate) and unconventional policy (ie measures working through instruments other than the policy rate, in particular, large-scale asset purchases).

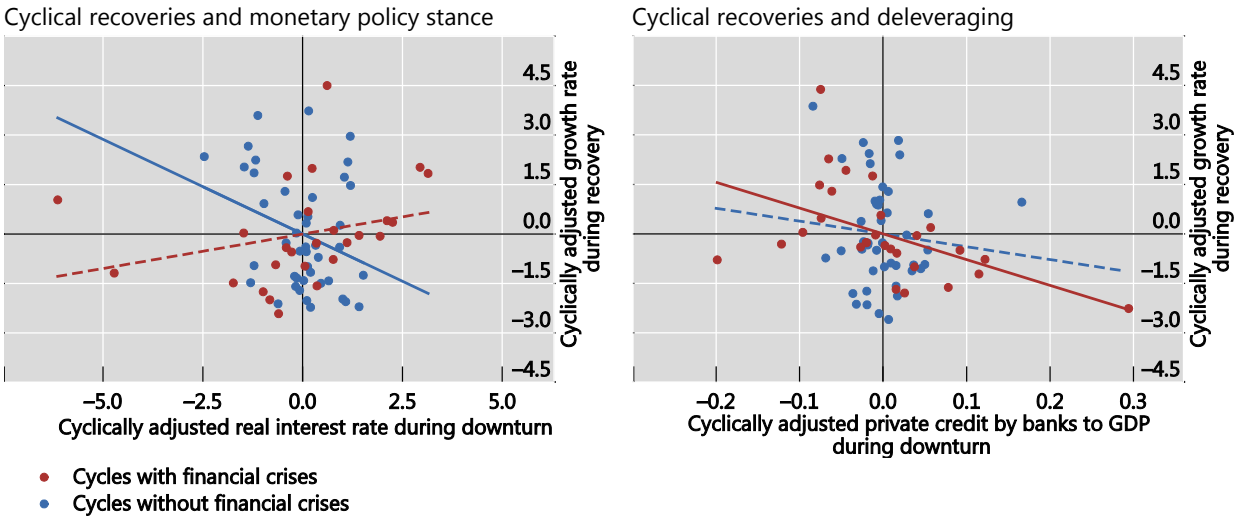
A number of recent studies have found that conventional monetary policy has stronger effects in periods of financial stress. Ciccarelli et al (2013) suggest that the estimated effects of a monetary policy shock in the euro area increase when the GFC period (2007–2011) is added to their sample. More generally, Dahlhaus (2016) finds that the effect of a monetary policy shock in the United States is larger in periods of financial stress than otherwise. This result is confirmed by Jannsen et al (2015) for a sample of 20 advanced economies based on panel VAR analysis. They find that the impact of monetary policy in the acute phases of a financial crisis is larger than in normal phases. These results are consistent with the notion that monetary policy might be more effective in the acute phase of a financial crisis by reducing uncertainty and tail risks. That said, the mechanisms through which higher policy effectiveness during crises work remain untested.

At the same time, there is evidence that monetary policy is less effective in the recovery from a balance-sheet recession, presumably reflecting the effects of persistent headwinds and possibly low rates themselves. Jannsen et al (2015) allow for three different phases in the analysis of monetary policy effectiveness: a normal phase, a crisis phase and a recovery phase. While, as noted, they find stronger transmission during crises than during normal phases, their analysis also suggests that monetary policy has essentially no macroeconomic effect during the recovery from a financial crisis. This finding is consistent with previous BIS research. Based on a sample of 24 economies, Bech et al (2014) find that across countries lower real interest rates during "normal" business cycle downturns are followed by stronger cyclical recoveries but that there is essentially no statistically significant link between real rates and recovery strength after downturns associated with financial crises (Graph 4, left-hand panel). Instead, deleveraging seems to be the key factor determining the speed of recovery (Graph 4, right-hand panel). Overall, these results support the relevance of balance-sheet related headwinds reducing monetary policy effectiveness once the acute crisis phase is over.

Monetary policy, deleveraging and economic recoveries[1]

In per cent

Graph 4



[1] The solid (dashed) regression lines indicate that the relationship is statistically significant (insignificant). For a sample of 24 economies since the mid-1960s. Downturns are defined as periods of declining real GDP and recoveries as periods ending when real GDP exceeds the previous peak. The data cover 65 cycles, including 28 cycles with a financial crisis just before the peak. Data points for cycles are adjusted for the depth of the preceding recession and the interest rate at the cyclical peak. See Bech et al (2014) for details.

Sources: M Bech, L Gambacorta and E Kharroubi, "Monetary policy in a downturn: are financial crises special?", International Finance, vol 17, Spring 2014, pp 99–119 (also available in BIS Working Papers, no 388, at www.bis.org/publ/work388.pdf); OECD; Datastream; national data; BIS calculations.

Other studies test directly for the impact of specific types of headwind, in particular debt overhang and heightened uncertainty.[24] Specifically, Alpanda and Zubairy (2016) find for the United States that monetary transmission is weaker in states where household debt is relatively high, reflecting in their view the attenuating effect of deleveraging motives. Bloom et al (2007) show for the United Kingdom that higher uncertainty, measured by stock market volatility (proxying financial headwinds more generally)[25] significantly reduces the responsiveness of investment to demand conditions, which in turn depend on the monetary policy stance. Similarly, Aastveit et al (2013) find that in the United States the monetary transmission to real output is weaker when uncertainty (also measured by stock market volatility) is high. They interpret this result as reflecting the impact of uncertainty on investment but acknowledge that other mechanisms might also be at work since the response of

[24] There is a somewhat related literature that considers asymmetries in monetary transmission according to the direction of monetary impulses. This literature tends to find larger effects of monetary contractions than expansions. Angrist et al (2013) find that US policy rate hikes have larger effects on the economy than rate cuts. Similarly, Barnichon and Matthes (2016), and Tenreyro and Thwaites (2016) suggest that monetary policy shocks have larger effects in expansions than recessions. All these studies interpret their findings as reflecting the well known string metaphor: that it is harder for monetary policy to push on a string than to pull it because of the headwinds prevailing in situations when monetary policy is loosened. And there is also a literature on the dependence of monetary transmission on the phase of the business cycle, which, however, has come up with conflicting findings. While some studies find stronger transmission in recessions (Peersman and Smets (2002) and Lo and Piger (2005)), the analysis of Tenreyro and Thwaites (2016) finds the opposite.

[25] See Forbes (2016) for a comparison of different measures of financial and economic uncertainty for the United Kingdom.

consumption drops significantly too. This suggests that the relationship between uncertainty and monetary transmission may itself be state-dependent: while uncertainty and tail-risk perceptions might be important transmitters of monetary accommodation in crisis phases, heightened uncertainty in general seems to sap monetary policy effectiveness.

The literature on the effectiveness of unconventional monetary policies implemented in the wake of the GFC should also give us some clues about monetary policy effectiveness in environments of persistent headwinds and low interest rates. Indeed, the lacklustre recovery from the GFC has raised doubts about the effectiveness of extraordinary measures, as discussed in BIS (2016). There is by now a large literature assessing the effectiveness of the measures on financial market prices and a somewhat smaller one investigating the ultimate impact on the macroeconomy (see Borio and Zabai (2016) for an overview). The overall picture is that the measures have been effective in easing monetary conditions by lowering interbank rates, bond yields and credit risk spreads, and, less conclusively, that these effects have also boosted the macroeconomy.

For our purposes, however, the extant studies are less informative than would be desirable. The reason is that they do not specifically test the hypothesis of reduced effectiveness at low rates. More generally, they tend to assume that previous relationships continue to hold – whether these concern the link between central bank balance sheets and activity (and hence indirectly interest rates) or that between interest rates and economic activity. One obvious reason is the limited sample size. Indeed, for the time series analysis of the extraordinary measures' impact on macroeconomic variables the sample period is typically rather short. That said, with now eight years of available data, it is becoming easier to assess whether the effects have changed over time, although the results should be taken with a pinch of salt.

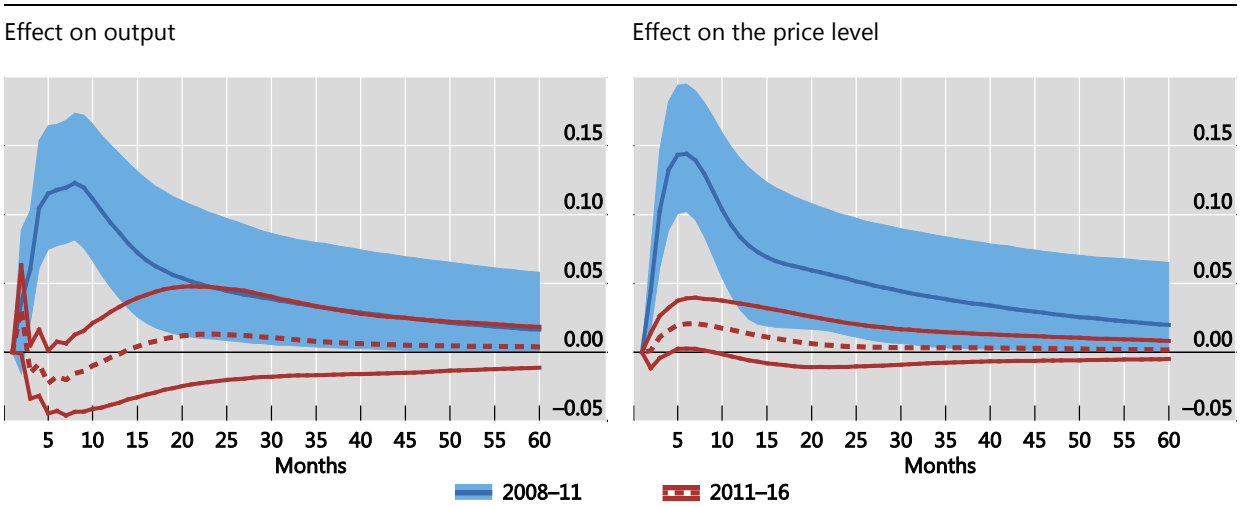
In this vein, a recent BIS study by Hesse et al (2017) suggests that, at least for the United States, there is some indication that the effectiveness of large-scale asset purchase programmes (LSAP) has fallen (Graph 5).[26] The authors find that while an unanticipated increase in LSAP1 and LSAP2 purchases had a significant positive impact on real GDP and the price level, the effects of the same sized shock were much smaller for the maturity extension programme (MEP) and LSAP3. Similar evidence is reported in Haldane et al (2016). They find that quantitative easing (QE) shocks have a significant effect when financial market stress is high but not when it is low, with the two regimes roughly coinciding with the sample split of Hofmann and Weber (2017). Panizza and Wyplosz (2016) explore the decreasing effectiveness hypothesis for the core advanced economies that implemented large-scale asset purchases (USA, euro area, Japan and UK), also based on subsample analysis, and come to inconclusive results. For some empirical exercises they find decreasing effectiveness, but not for others.

[26] Specifically, Hesse et al (2017) follow the approach by Weale and Wieladek (2016) and assess the macroeconomic effects of a QE shock in an otherwise standard Bayesian VAR with the QE policy instrument being the cumulated size of asset purchase announcements.

The macroeconomic impact of asset purchase shocks in the United States[1]

In per cent

Graph 5



[1] From Hesse, Hofmann and Weber (2017); impulse responses to the unexpected component of a $100 billion asset purchase announcement in a Bayesian VAR for the United States, consisting of log real GDP, log CPI, the size of the announced asset purchases, the 10-year Treasury yield and the log S&P 500 (the set up closely follows that of Weale and Wieladek (2016)). Median and the 68% probability range of the impulse responses. The two subsamples considered are January 2008 to June 2011 (covering two large-scale asset purchase programmes, LSAP1 and LSAP2) and July 2011 to June 2016 (covering the maturity extension programme (MEP) and LSAP3).

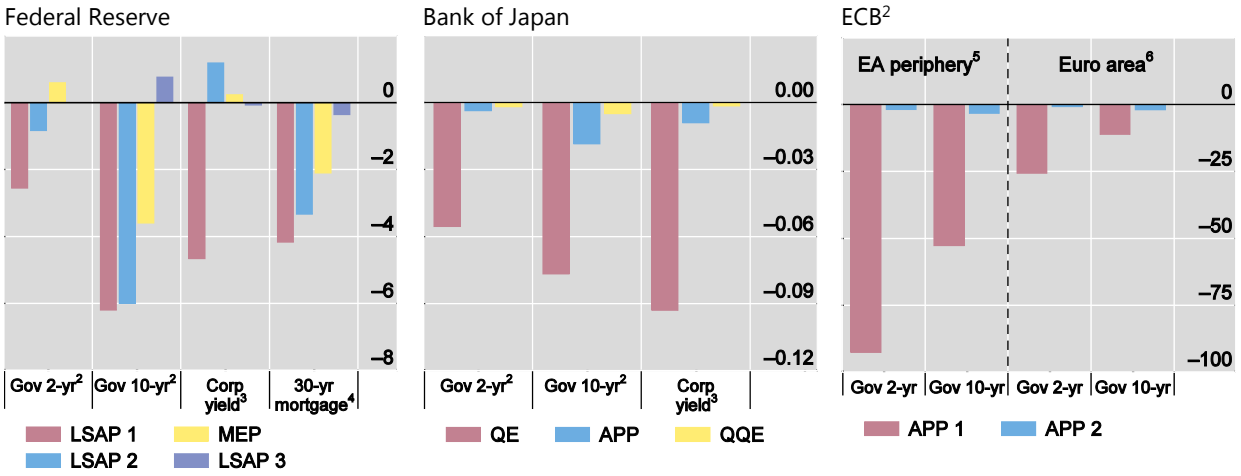
Sources: H Hesse, B Hofmann and J Weber, "The macroeconomic effects of asset purchases revisited", BIS, mimeo, 2017.

This evidence of potentially reduced effectiveness of unconventional monetary policy may reflect various factors. One possibility is headwinds or inherent nonlinearities at low rates. Another may relate to factors specific to large-scale asset purchases. For instance, such purchases may be most effective when financial markets are segmented and dislocated, so that the authorities' intervention can help alleviate the corresponding distortions. As the distortions vanish over time, the effectiveness of policy may diminish. Moreover, there are physiological limits to how far risk premia can be compressed, expectations guided and interest rates pushed into negative territory. Indeed, the consecutive programmes seem to have had a progressively smaller impact on financial market prices (Graph 6). The reduction in bond yields and loan rates per dollar spent in the programmes has consistently fallen over time in the G3 economies. To be sure, this might simply reflect the fact that the programmes were increasingly well anticipated by market participants. But the alternative possibility cannot be excluded either.

In sum, there is evidence that monetary transmission is weaker in recoveries from balance sheet recessions. The conditions identified with weaker transmission are also those that would be expected to be associated with lower interest rates. This is the case for high debt overhangs, the recovery phase after banking crises and, admittedly less specifically, high uncertainty. Thus, the detected asymmetries may at least in part also reflect reduced monetary policy effectiveness when rates are generally low.

Financial market impact of asset purchase announcements

Impact per 100 billion units of local currency[1] Graph 6



APP = asset purchase programme; LSAP = large-scale asset purchases; MEP = maturity extension programme; QE = quantitative easing; QQE = Quantitative and Qualitative Monetary Easing.

[1] For each programme, the cumulative two-day change in basis points around the announcement dates, divided by the total size of each programme in local currency. For open-ended programmes, divided by the estimated size of the programme assuming an unchanged pace of purchases until December 2017. For terminated programmes, the total amount of purchases at the time of termination. [2] Government bond yields; for the ECB, weighted averages based on rolling GDP and PPP exchange rates of the economies listed in footnotes 5 and 6. [3] Merrill Lynch corporate bond yields. [4] Thirty-year fixed mortgage rate. [5] Greece, Ireland, Italy, Portugal and Spain. [6] Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain.

Sources: Bank of America Merrill Lynch; Bloomberg; national data; BIS calculations.

2.2 Nonlinearities linked to the level of interest rates

There is very limited analysis of nonlinearities in monetary transmission linked to the level of interest rates. The empirical literature is scant for both nonlinearities in aggregate relationships and in specific channels.

Net interest margins, bank profitability and bank lending

The positive link between interest rates and bank profitability has been long established in the academic literature (Samuelson (1945), Flannery (1981) and Hancock (1985)). English (2002) studies the link between interest rate risk and bank interest rate margins in 10 industrialised countries. He finds that, as the average yield on bank assets is more closely related to long-term rates than the average yield on liabilities, a steep yield curve raises interest margins. More recently, Alessandri and Nelson (2015) establish a positive long-run link between the level and slope of the yield curve and bank profitability in the United Kingdom. Genay and Podjasek (2014) also find that persistently low interest rates depress US banks' net interest margins. They also note, however, that the direct effects of low rates are small relative to the economic benefits, including through better support for asset quality. For Germany, Busch and Memmel (2015) argue that in normal interest rate environments the long-run effect of a 100 basis points change in the interest rate on net interest margins is very small, close to seven basis points. In the recent, low-interest rate environment, by contrast, they find that interest margins for retail deposits, especially for term

deposits, have declined by up to 97 basis points. The Bundesbank's Financial Stability Review of September 2015, analysing 1,500 banks, also finds that persistently low interest rates are one of the main risk factors weighting on German banks' profitability.[27]

Borio et al (2015a) revisit the link between bank profitability and interest rates for a sample of 108 internationally active banks. In contrast to previous studies, they allow for nonlinearities in the relationship, as theory would suggest. They find evidence that, controlling for aggregate demand, a reduction in both short-term interest rates and yield curve slope depresses the return on assets, and that the effect increases at the margin (Graph 7). The estimated impact is significantly larger than in studies that do not allow for nonlinearities.[28] Taken at face value, the results indicate that, in the sample of banks covered, the combined impact was, on balance, positive in the first two years post-GFC (2009–2010), by an estimated cumulative 0.3 percentage points, but turned negative in the following four years (2011–2014), by 0.6 percentage points, equivalent to one year of profits for the average bank in the sample.

In another recent paper, Claessens et al (2016) confirm the findings of Borio et al (2015a) based on a sample of 3,418 banks from 47 countries for the period 2005–2013. They classify countries for each year as being in a low- or high-rate environment based on whether the three-month Treasury bill rate was below or above 1.25 percent (other cut-offs were also tested and yielded similar results). After documenting that both net interest margins and returns on assets are on average higher in high-rate environments, they find that the negative impact of a decrease in the short-term interest rate is statistically larger in low-rate regimes.

These findings suggest that, over time, bank capital is negatively affected by lower interest rates and that the impact is larger when rates are low. This could then also inhibit credit expansion if the supply of credit is capital-constrained, especially given that banks are generally reluctant to raise capital externally. The results reported in Gambacorta and Shin (2016) suggest that higher bank capital is indeed associated with stronger lending, and that the mechanism involved in this channel is the lower funding costs enjoyed by better capitalised banks.[29]

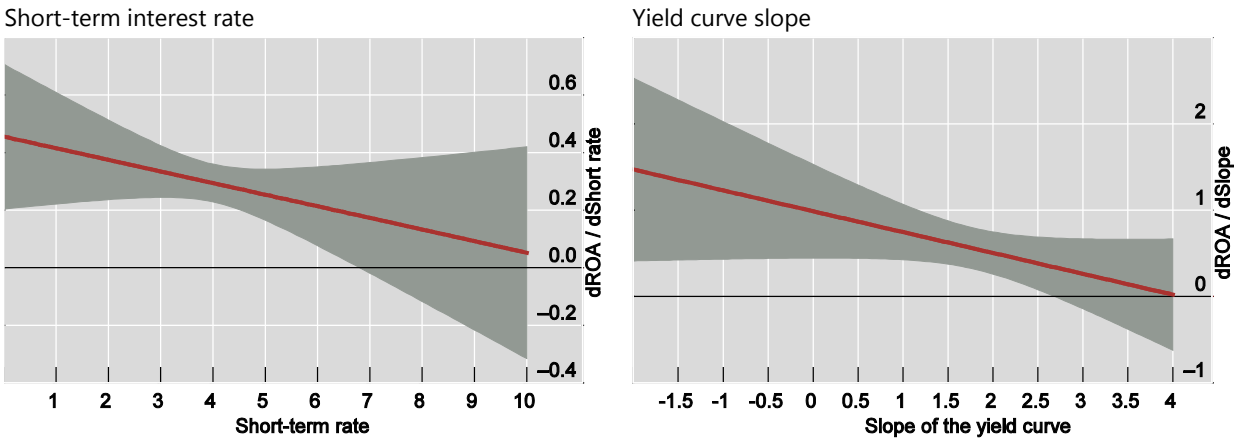
[27] Using capital market prices, rather than financial statements, English et al (2012) also find a negative effect of low interest rates on bank profitability. In their analysis, they find that while the stock prices of US banks fall following unanticipated increases in interest rates or a steepening of the yield curve, a large maturity gap weakens this effect. Thus, because of their maturity transformation function, banks gain from a higher interest rate or a steeper yield curve.

[28] Specifically, an increase in the short-term rate from 0% to 1% raises the return on assets (ROA) by 0.4 percentage points over one year but by only 0.15 percentage points if the rate increases from 6% to 7% (Graph 7, left-hand panel). By contrast, Alessandri and Nelson (2015) find that the (linear) impact is around 0.2 percentage points and Genay and Podjasek (2014) find that it is 0.1 percentage points. Of course, other aspects of the studies could account for the results. Similar differences apply to the impact of changes in the slope (eg a 1.2 decline in ROA for increases in the slope from -2 to -1 percentages points compared with 0.1–0.7 percentage points in linear specifications). Here, however, comparisons are even harder given the different slope measures used in the literature.

[29] A positive association between bank capitalisation and credit supply had already been found in previous studies, eg by Albertazzi and Marchetti (2010), who show that credit contraction in Italy in the wake of the GFC was driven by weak bank capitalisation. Michelangeli and Sette (2016) use a novel dataset constructed from randomised applications to online mortgage brokers to show that better capitalised banks lend more. Also the results reported in EBA (2015) suggest that more strongly capitalised banks are in a better position to expand lending.

Effect of the short-term interest rate and the slope of the yield curve on bank profitability

Graph 7



Note: The horizontal axis shows respectively possible values for the level of the short-term interest rate (three month interbank rate) and the slope of the yield curve (the difference between the 10-year government bond and the three-month interbank rate, in percentage points). The vertical axis shows the derivative of bank profitability (return on assets) respectively with respect to the short-term rate and the slope. The shaded area indicates 95% confidence bands.

Source: Authors' calculations.

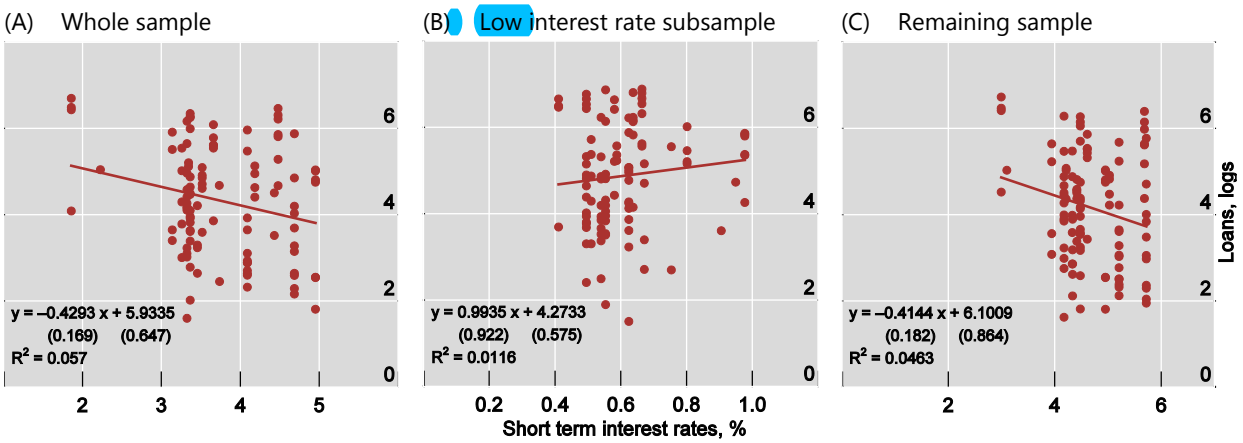
Borio and Gambacorta (2017) directly address the question of the impact of low interest rates on bank lending. They find evidence that lending becomes less responsive to reductions in short-term interest rates when interest rates are already low. Graph 8 conveys this point in a simple way based on raw data. The chart plots the average log level of lending to the non-financial sector of the 108 internationally active banks against the average short-term interest rate that each bank has faced in the jurisdiction in which it operates. The usual negative link between lower rates and bank loans (left-hand and right-hand panels) is not apparent at very low rates (middle panel) – in fact, the relationship switches sign. Borio and Gambacorta (2017) find that the pattern suggested by Graph 8 also holds after controlling for business and financial cycle conditions, and different bank-specific characteristics, such as liquidity, capitalisation, funding costs, risk and income diversification. Importantly, it also holds when financial crises are controlled for. And it operates through the impact of lower rates on net interest margin. A simple back-of-the-envelope calculation suggests that the reduction of net interest income caused by the low interest rate environment could explain one third of lending dynamics in the period 2010–2014.[30] To be sure, any such result should not be taken at face value. And fully controlling for the various influences, including weakness in loan demand, is not straightforward. But the results do suggest that the effect could be material and worthy of further exploration.

Overall, therefore, there is evidence that persistent low interest rates compress net interest margins and bank profitability, and that such a negative effect on bank

[30] Borio and Gambacorta (2017) suggest that the result may reflect the impact of lower rates on the profitability of the lending business. If capital is perceived to be scarce, banks would have an incentive to allocate it towards activities that are more profitable at the margin. And lower interest rates could have a larger effect on the profitability of such activities relative to, say, mergers and acquisitions or trading. Any such impact would be even larger at the margin if the banks operated under some minimum profit constraint (eg so as to remain attractive to investors while seeking to maximise some managerial objective).

profitability may in turn inhibit lending. How relevant this effect is for aggregate macroeconomic outcomes remains an open question.

Semi-elasticity of bank lending to the short-term interest rate[1] Graph 8



[1] Scatter plots of the average level of lending (in logs) against the level of the short-term interest rate for a group of 108 international banks; the interest rate is the average for the currencies in which each bank obtains funding. The dots thus refer to semi-elasticities. The left-hand panel covers the whole sample (1995–2014); the centre panel only periods in which the average interest was very low (last quartile of the distribution, below 1.25 percentage points); and the right-hand panel the rest of the sample. Standard errors are shown in brackets.

Sources: BankScope; authors' calculations.

Consumption and saving

A screening of the literature reveals that work on the possible nonlinear effects of low interest rates on consumption and saving is very limited.

Recently, ING (2016) reported the results from an IPSOS survey that sought to shed some light on this question. The survey asked 13,000 consumers from Europe, the United States and Australia how their saving behaviour had changed in response to low interest rates and, going forward, how they would react to negative interest rates (see also Cliffe (2016) for a summary). According to this survey, 31% of respondents had changed their behaviour, albeit possibly only their portfolio decisions. Of those that did, some 38% said that they had saved less. However, as much as 17% said that they had in fact saved *more*. The rest answered that they had mainly changed their asset allocation. This indicates the possibility of adverse effects from very low rates. But the study is silent about how behaviour would have changed at higher rates.

Recent BIS research explores further the possible nonlinearities in the consumption-interest rate nexus through formal panel-econometric analysis. Specifically, Hofmann and Kohlscheen (2017) estimate reduced-form regressions linking real consumption growth to the level of the interest rate.[31] The analysis is

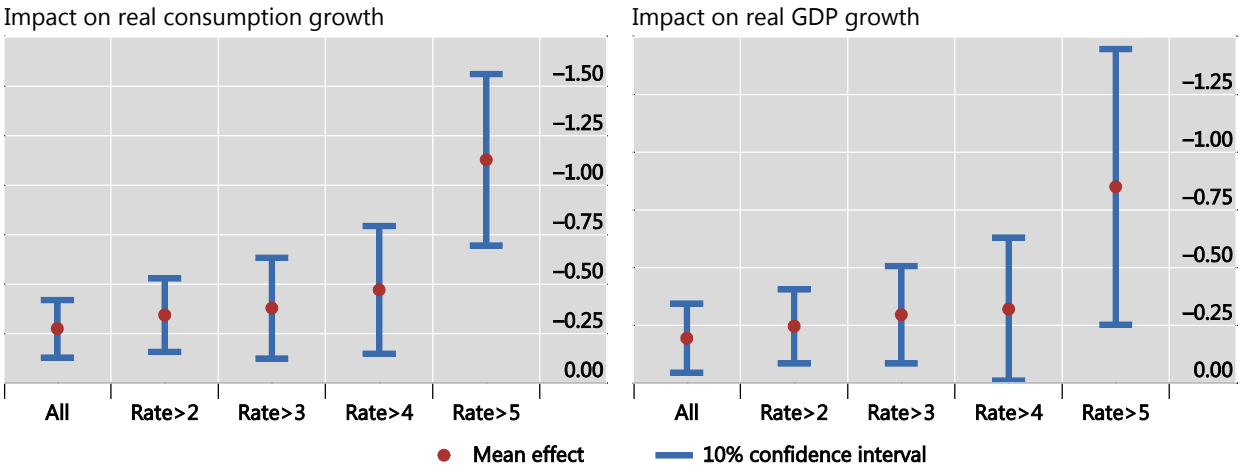
[31] There is a voluminous empirical literature on the baseline Euler equation for consumption, which tests the intertemporal elasticity of substitution in consumption. Establishing a link between consumption and real interest rates has turned out to be difficult and has required modifications to the baseline model of intertemporal consumption optimisation, such as allowing for consumption habits, hand-to-mouth consumers and wealth effects. See Ascari et al (2016) for a review and an empirical assessment of the various extensions of the baseline equation for the United States.

based on annual data for a panel of 31 countries over the period 1995–2015. Nonlinearities are modelled using piece-wise regressions, allowing the interest rate semi-elasticity to vary across different interest rate level thresholds.[32]

The results yield two main insights. First, real consumption growth seems to be linked to the level of *nominal* rates rather than *real* rates, pointing to the empirical relevance of money illusion or specific transmission channels working through or proxied by the nominal interest rate.[33] Second, there is evidence that the interest rate elasticity of consumption growth increases with the level of the interest rate (Graph 9, left-hand panel). The elasticity rises from -0.3 for the full set of observations to above -1.2 when only observations with a nominal rate of above 5% are included. The nonlinearity also carries over to aggregate output growth, albeit in this case it is weaker and is not statistically significant owing to large confidence bands, suggesting that the nonlinearity works mainly through consumption (Graph 9, right-hand panel).

Interest rate semi-elasticity of consumption and GDP growth[1]

In percentage points — Graph 9



[1] Estimated semi-interest rate elasticities from reduced-form empirical Euler equations linking real consumption and real GDP growth to the level of the nominal short-term interest rate. The analysis is based on annual data for a panel of 31 countries over the period 1995–2015. Nonlinearities are modelled by means of piece-wise regressions, allowing the interest rate semi-elasticity to vary across different interest rate thresholds.

Source: Hofmann and Kohlscheen (2017), mimeo, Bank for International Settlements.

These findings could be interpreted as indicating a flattening of the IS curve at low rates. However, the nonlinearities detected at such an aggregate level cannot shed light on the underlying mechanisms. They might reflect specific nonlinear effects of low interest rates on consumption (arising from the channels discussed before).

[32] The controls included in the regressions comprise country and time fixed effects; real GDP growth; real house and stock prices increases; the level of per capita income; the credit-to-GDP ratio; and the dependency ratio.

[33] One important transmission channel of the nominal rate is the debt service ratio, defined as the ratio of interest obligations to income, which is directly influenced by the nominal interest rate. Recent studies have found a significant negative link between the debt-service ratio and consumption growth (Kharroubi and Kohlscheen (2017)), which would also be picked up by the nominal interest rate elasticity of consumption growth. Another reason could be that the short-term nominal rate proxies for the ex-ante long-term real interest rate, as suggested by Fuhrer and Moore (1995).

Yet, just as the studies testing for the role of headwinds may pick up effects originating from low rates, the detected lower interest rate elasticity at low interest rates may likewise partly reflect the effects of headwinds, as the two mechanisms cannot be clearly disentangled in an empirical analysis of aggregate relationships.

Resource misallocation

The empirical literature on the existence of possible resource misallocation at very low interest rates typically finds evidence of such a mechanism at work. Caballero et al (2008) find that after the asset price crash of the late 1980s/early 1990s, Japanese banks kept credit flowing to "zombie" firms (defined as firms receiving subsidised credit) – a form of forbearance. The market congestion created by the zombies reduced the profits of healthy firms, depressing investment, employment growth and productivity. A recent study by the OECD suggests that such zombification is a more general phenomenon since the mid-2000s. Specifically, Adalet McGowan et al (2017) show that zombie firms, defined as old firms that have persistent problems meeting their interest payments, are stifling labour productivity performance because they are themselves less productive and because they constrain the growth of more productive firms. This paper suggests that the rise of the zombies has probably been a key factor behind weak investment and low productivity growth in the OECD countries over this period, and that forbearance lending has probably been a channel through which zombie firms contribute to the productivity slowdown.

There is, however, only scant *specific* econometric evidence on the role that very low interest rates play in this context. The bank-level regressions reported by Lepetit et al (2011) indicate that banks' loan charge-offs significantly increase with the level of short-term interest rates, consistent with the prediction of their theoretical analysis. Similarly, Borio et al (2015a) find that the interest rate sensitivity of loan loss provisions increases at low rates, which could reflect evergreening. But in both cases the link between interest rates and loan charge-offs could also reflect other mechanisms, notably the impact of monetary conditions on default probabilities through aggregate demand.

Closely related evidence on possible misallocations comes from a recent paper by Acharya et al (2016), who study the effects of the ECB's Outright Monetary Transactions (OMT) announcement. The paper finds that banks that benefited from the announcement (through the revaluation of their sovereign bond holdings) increased their overall loan supply but that this supply was mostly targeted towards low-quality firms that enjoyed pre-existing lending relationships. There was, however, no positive impact on real economic activity, such as on employment or investment, as these firms mainly used the newly acquired funds to build up cash reserves. The paper further documents that creditworthy businesses in industries with a prevalence of zombie firms suffered significantly from the misallocation of credit and that this slowed down the economic recovery.

Conclusion

This review suggests that both conceptually and empirically there is support for the notion that monetary transmission is less effective when interest rates are persistently low. Reduced effectiveness can arise for two main reasons: (i) headwinds that typically blow in the wake of balance sheet recessions, when interest rates are low (eg debt overhang, an impaired banking system, high uncertainty, resource misallocation); and (ii) inherent nonlinearities linked to the level of interest rates (eg impact of low rates on banks' profits and credit supply, on consumption and saving behaviour – including through possible adverse confidence effects – and on resource misallocation). Our review of the existing empirical literature suggests that the headwinds experienced during the recovery from balance-sheet recessions can significantly reduce monetary policy effectiveness. There is also evidence that lower rates have a diminishing impact on consumption and the supply of credit. Importantly, these results point to an independent role for *nominal* rates, regardless of the level of real (inflation-adjusted) rates.

Our review reveals that the relevant theoretical and empirical literature is much scanter than one would have hoped for, in particular given that periods of persistently low interest rates have become more frequent and longer-lasting. While there are appealing conceptual arguments suggesting that monetary transmission may be impaired when rates are low, many of these have not been formalised by means of rigorous theoretical modelling. And the extant empirical work is limited, both geographically and in scope. For instance, most studies assessing changes in monetary transmission in low rate environments focus on the United States. Similarly, there is hardly any work assessing specific mechanisms. The field is wide open and deserves further exploration, not least given the first-order policy implications.[34]

[34] This paper did not explore the policy implications of the analysis. But a possible one is that policymakers should pay closer attention than hitherto to the financial cycle, ie boom-bust cycles in credit and asset markets that then usher in balance sheet recessions and persistently low interest rates. See Borio (2014a,b) for a more detailed exposition of this view.

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