

Is Monetary Policy Less Effective When Interest Rates Are Persistently Low?

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1. Introduction

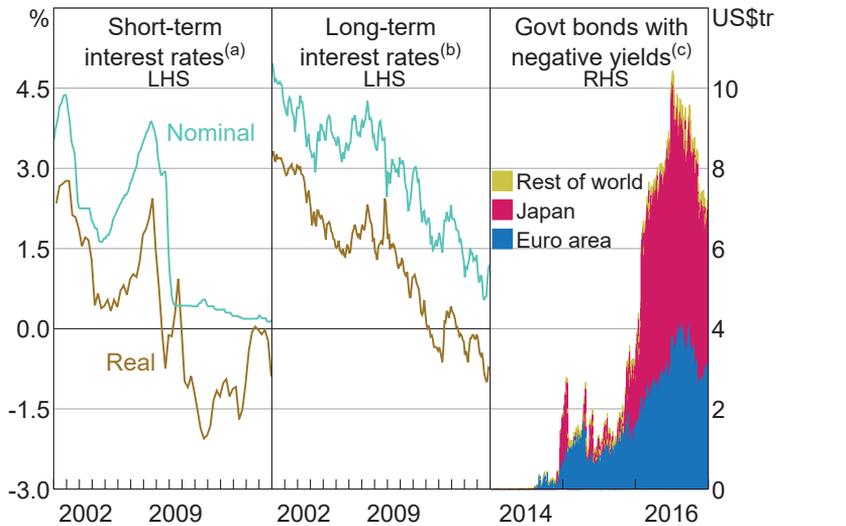
Interest rates in the core advanced economies have been persistently low for about eight years now (Figure 1). Short-term nominal rates have, on average, remained near zero since early 2009 and have even been negative in the euro area and Japan, since 2014 and 2016 respectively. The drop in short-term 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 and 4 per cent in 2009 to below 1 per cent in 2016, on average (Figure 1); in real terms, they have been mostly negative since 2012. Indeed, at the end of 2016 a significant stock of global government bonds (more than \$7 trillion or 20 per cent of the total outstanding¹) was still trading at negative nominal yields, after reaching a peak of over \$10 trillion in mid 2016. For all its prominence, the post-US election increase in yields has so far not fundamentally changed this picture.

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 (Figure 2). Elsewhere, too, including in Australia, short- and long-term interest rates have fallen to new lows, reflecting, in part, global interest rate spillovers, especially at the long end (Hofmann and Takáts 2015; Obstfeld 2015).

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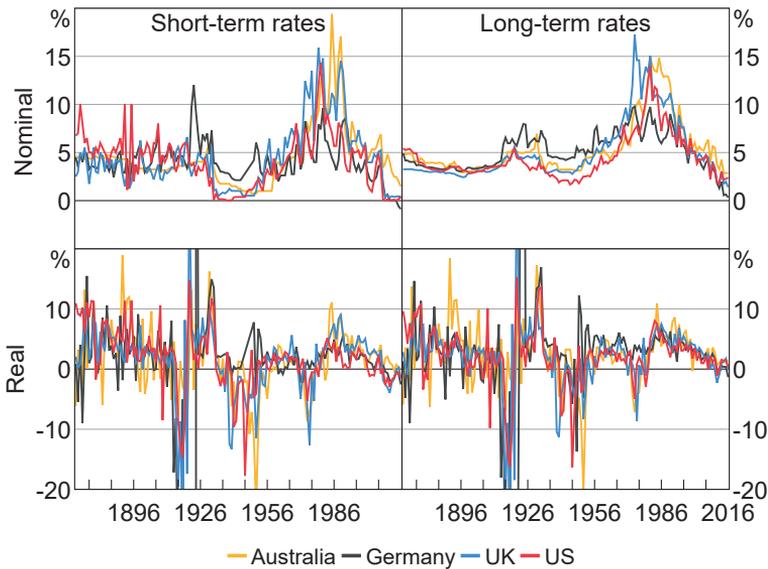
1 The numbers refer to the sovereign bonds represented in the Merrill Lynch World Sovereign index.

Figure 1: Low Interest Rates in Core Advanced Economies



Notes: (a) Simple average of the euro area, Japan, the United Kingdom and the United States; real interest rates are the nominal policy rate minus CPI inflation (PCE inflation for the United States)
 (b) Simple average of France, the United Kingdom and the United States; real interest rates are the long-term index-linked bond yield
 (c) Stock of government bonds, based on the constituents of the Bank of America Merrill Lynch World Sovereign index
 Sources: Bank of America Merrill Lynch; BIS; Bloomberg; National data sources; Thomson Reuters

Figure 2: Interest Rates

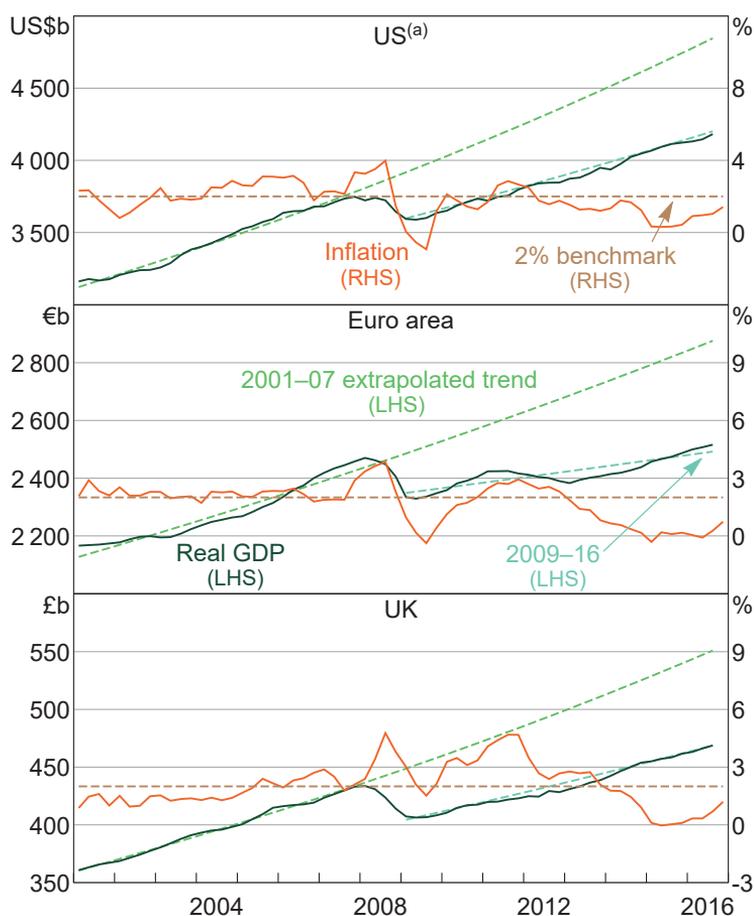


Sources: Global Financial Data; Jordà, Schularick and Taylor (2017); National data sources

The picture is not very different for interest rates measured in *real or inflation-adjusted* terms (Figure 2). 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.

The persistently low rates of the recent past have reflected central banks' unprecedented monetary easing to cushion the fallout of the global financial crisis (GFC), spur economic recovery and push inflation back up towards their 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 (Figure 3). At the same time, in many countries, inflation has remained persistently below target over the past three years or so.

Figure 3: Output and Inflation Post-crisis



Notes: Output is seasonally adjusted
 (a) PCE inflation
 Sources: BIS; National data sources; Thomson Reuters

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 (e.g. Borio and Zabai 2016). Also we focus exclusively on domestic transmission channels, thereby excluding the effect through the exchange rate.²

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: macrofinancial '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 effect of monetary stimulus (Borio 2014a). The second reason has to do with the possibility that, regardless of economic context, the effect of a change in interest rates on aggregate demand and output may be smaller at very low rates. That is, 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 effect 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 and credit supply, as well as of consumption behaviour (i.e. 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'. That is, that the weaker link between interest rates and demand or output does not simply reflect the 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.

2 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, Kearns and Schrimpf 2017).

The paper is organised as follows. Section 2 discusses how an environment of persistently low interest rates might affect the effectiveness of monetary transmission. Section 3 reviews the existing evidence, including recent work carried out at the BIS. In the conclusion, we highlight a number of findings and promising areas for further analysis.

2. 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; and (ii) inherent nonlinearities linked to the level of interest rates.

2.1 Headwinds

Persistently low interest rates tend to prevail in the wake of balance sheet recessions, that is, recessions that occur when private debt is high and which are associated with a period of balance sheet repair. 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 adverse feedback loops in the bud (e.g. 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 numb monetary stimulus (e.g. Borio 2014a, 2014b). 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 (Juselius and Drehmann 2015; Mian and Sufi 2015). Giving priority to balance sheet repair over intertemporal expenditure smoothing would tend to dampen the effect of lower rates (e.g. Koo 2009; Di Maggio, Kermani and Ramcharan 2015).³

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 (e.g. Holmstrom and Tirole 1997; Diamond

³ For example, in a stylised dynamic stochastic general equilibrium (DSGE) model, Alpanda and Zubairy (2017) 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.

and Rajan 2011). This would tend to reduce the pass-through of stimulus.⁴ While the bank lending channel literature posits that monetary transmission is stronger when banks are weakly capitalised (e.g. Gambacorta and Mistrulli 2004; Jiménez *et al* 2012), 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 for the capital losses (Albertazzi, Nobili and Signoretti 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 agents less responsive to stimulus. It could boost precautionary saving (Skinner 1988; Deaton 1991; Dynan 1993) and raise hurdle rates for investment (e.g. Bernanke 1983; Dixit 1992; Dixit and Pindyck 1994).⁵ 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 effect of stimulus on asset prices and lending.⁶

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 productivity growth, mainly as a result of a shift of resources into sectors such as construction (Borio *et al* 2015). 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 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 being equal, these headwinds would blow most strongly precisely in interest rate-sensitive sectors, where excess capacity would be prevalent. In addition, ultra-low 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 (i.e. 'extend and pretend') and curtail the quantity, or increase the cost, of credit for healthier ones – the so-called zombie lending phenomenon (see below).⁷

4 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 (e.g. Jordà, Schularick and Taylor 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 (e.g. Reinhart and Rogoff 2009; Borio, Lombardi and Zampolli 2016).

5 Bloom, Bond and Van Reenen (2007) and Aastveit, Natvik and Sola (2013) show theoretically that higher uncertainty not only reduces investment but also lowers the responsiveness of investment to demand shocks, specifically to monetary impulses.

6 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 (see Adrian and Shin (2010) and Borio and Zhu (2012) for a description of the channel and, for example, Gambacorta (2009), Buch, Eickmeier and Prieto (2014), Peersman and Wagner (2015) and Cecchetti, Mancini-Griffoli and Narita (2017) for empirical evidence). Given these headwinds, it is possible that any higher risk-taking induced by unusually low interest rates may have an effect on the financial system (financial risk-taking) but feed less into expenditures.

7 For conceptual analyses of banks' decisions to charge-off loans, or to engage in zombie lending, see, for example, Lepetit, Strobel and Dickinson (2011) and Bruche and Llobet (2014).

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 effect 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 effect 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.⁸ 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.

2.2 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 effect on: (i) bank profitability and hence credit supply; (ii) consumption and saving; (iii) expectations and confidence; and (iv) resource allocation.

2.2.1 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 barrier. The effect is nonlinear: it becomes stronger at very low rates.⁹ Intuitively, as deposit rates hit zero, any further reduction in the short-term rate would affect returns on the asset side without any corresponding effect on the cost of retail deposits.¹⁰ The effect 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 (i.e. borrowing short and lending long). A compression of the term premium is especially costly.¹¹

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

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

9 Borio, Gambacorta and Hofmann (2017) illustrate the nonlinearity based on a version of the Monti-Klein model (Equation A12 in the paper’s annex).

10 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.

11 While the impact on the risk-free curve is temporary, that which reflects a compression of the term premium is permanent. See, for example, Dietrich and Wanzenried (2011) and Borio *et al* (2017).

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 effect of lower rates on net interest income is long-lasting while that on the other components is only temporary,¹² or at least wanes over time. This helps to explain, for instance, the very negative response of bank stocks in January 2017 to markets' perceptions that interest rates would stay lower for longer (BIS 2017).

A negative effect 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 policy 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.

2.2.2 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 are also low. This means that current consumption should increase (substitution effect). This reasoning is the cornerstone of the standard Euler consumption equation – the consumption demand-block of modern DSGE models.¹³

In more general settings, interest rates may also affect consumption by influencing income or cash flows and through wealth effects. In particular, there is a redistribution channel of monetary policy that works by redistributing incomes and/or cash flows between agents (La Cava, Hughson and Kaplan 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 and depositors. 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 and depositors, as is typically assumed (Tobin 1982; 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, Kydland and Šustek 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; Hannoun 2015). To be sure, in principle this effect should operate *regardless of*

12 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). 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.

13 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.

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.¹⁴ Standard asset pricing theory suggests that changes in real interest rates should actually have a *larger* effect on asset prices when real interest rates are low.¹⁵ 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.¹⁶

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 regardless of changes in the price level.¹⁷ In this case, the potential nonlinearities linked to the various effects on consumption would apply to nominal, rather than real, rates.

2.2.3 Uncertainty

While monetary expansions usually appear to attenuate uncertainty and risk perceptions (Bekaert, Hoerova and Lo Duca 2013; Hattori, Schrimpf and Sushko 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.¹⁸ The effect could also operate through pension funds and insurance companies: prominent public discussions about the risk of underfunding for defined benefit pension schemes¹⁹ and, possibly, about insurance companies’ viability, could raise concerns about their ability to

14 Under ‘wealth effects’ we also include the indirect effect of the relaxation of borrowing constraints through the use of assets as collateral.

15 This follows from the standard dividend discount model.

16 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, Scatigna 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.

17 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).

18 The problem of such negative confidence effects counteracting the intended expansionary effects of low rates was discussed in policy and academic circles 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.

19 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.

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 effect of changes in nominal rates. And here, in contrast to the effect on asset prices, the effect on the value of the *liabilities* would actually increase at lower rates.²⁰

2.2.4 Resource allocation

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-performing loans in a number of ways. Lower rates increase the expected recovery from non-performing loans by reducing the discount factor.²¹ They also 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.²²

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 businesses becomes harder.

20 Theoretically, there may also be adverse effects on inflation expectations and ultimately on actual inflation, according to the so-called 'neo-Fisherian' perspective (Bullard 2015; Cochrane 2016) 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 nominal interest rate to counter rising inflationary pressures. However, if nominal rates are not increased, the adjustment could also be brought about by a drop in inflation expectations (and ultimately inflation itself).

21 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, particularly in crisis times when the market for collateral can be depressed and illiquid. See Lepetit *et al* (2011) for a formal analysis.

22 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.

3. 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 they are 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 (e.g. the banks' profit-lending nexus or the effect on resource misallocation). Even so, this would still leave open the question of 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 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 effect of low rates on bank profitability (and through this on credit supply), on consumption and on resource misallocation.

3.1 Headwinds

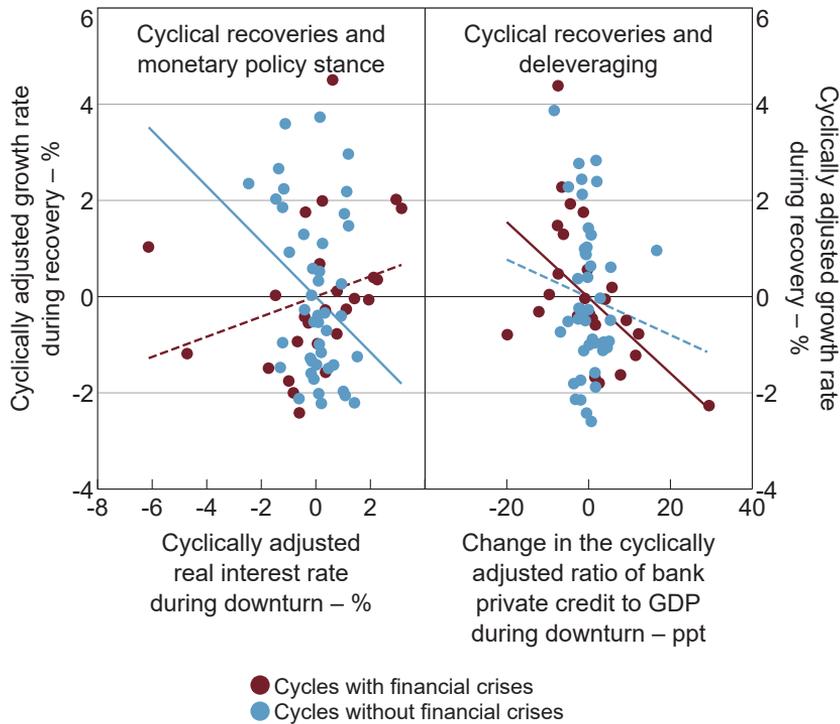
In the wake of the GFC, a growing literature has sought to assess whether financial crisis-related headwinds influence the effectiveness of monetary policy. Since periods of financial stress are usually also periods of low interest rates, this literature also speaks to the question of whether transmission 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 (i.e. for the policy rate) and unconventional policy (i.e. 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, Maddaloni and Peydró (2013) suggest that the estimated effects of a monetary policy shock in the euro area increase when the GFC period (2007–11) is added to their sample. More generally, Dahlhaus (2017) 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, Potjagailo and Wolters (2015) for a sample of 20 advanced economies based on panel vector autoregression (VAR) analysis. They find that the effect 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 as it can reduce 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, Gambacorta and Kharroubi (2014) find that 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 (Figure 4, left-hand panel). Instead, deleveraging seems to be the key factor determining the speed of recovery (Figure 4, right-hand panel). Overall, these results support the relevance of balance sheet-related headwinds in reducing monetary policy effectiveness once the acute crisis phase is over.

Figure 4: Monetary Policy, Deleveraging and Economic Recoveries

Notes: The solid (dashed) regression lines indicate that the relationship is statistically significant (insignificant); 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; data covers 65 cycles, including 28 with a financial crisis just before the peak; data 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

Source: Bech *et al* (2014)

Other studies test directly for the effect of specific types of headwind, in particular, debt overhang and heightened uncertainty.²³ Specifically, Alpanda and Zubairy (2017) 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),²⁴ significantly reduces the responsiveness of investment to demand conditions, which in turn depend on the monetary policy stance.

23 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, Jordà and Kuersteiner (2013) find that US policy rate hikes have larger effects on the economy than rate cuts. Similarly, Barnichon and Matthes (2016) and Tenreiro and Thwaites (2016) suggest that monetary policy shocks have larger effects in expansions than in 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; Lo and Piger 2005), the analysis of Tenreiro and Thwaites (2016) finds the opposite.

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

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 effect of uncertainty on investment but acknowledge that other mechanisms might also be at work since the response of consumption drops significantly too. This suggests that the relationship between uncertainty and monetary transmission may itself be state dependent: while monetary policy may be more effective in the acute crisis phase where it can work to lower the elevated level of uncertainty and tail-risk perceptions, heightened uncertainty in general seems to sap monetary policy effectiveness.

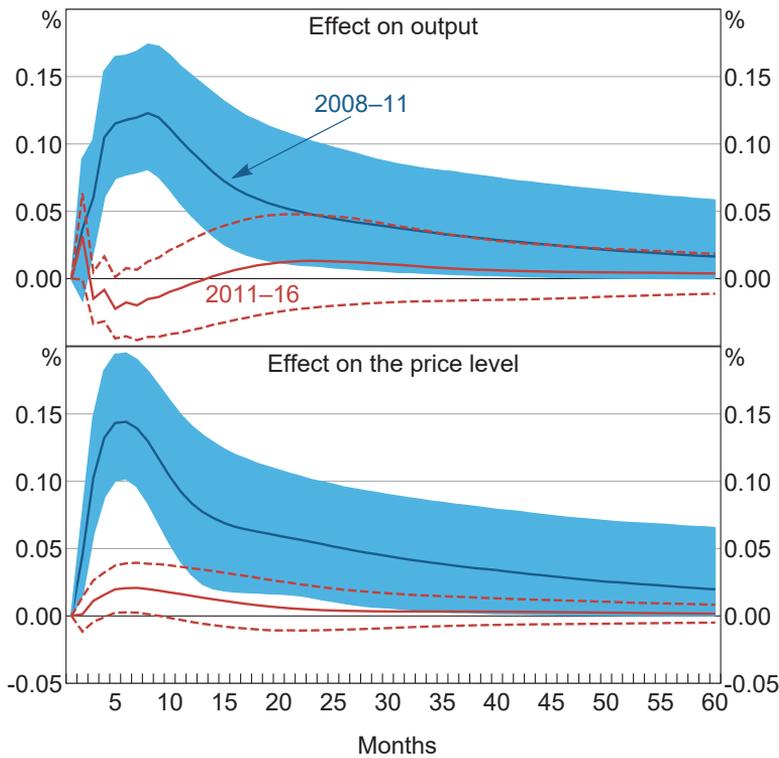
The literature on the effectiveness of unconventional monetary policies implemented in the wake of the GFC should also give us some clues about monetary policy effectiveness in environments of persistent headwinds and low interest rates. Indeed, the lacklustre recovery from the GFC has raised doubts 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 effect 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 any time series analysis of the extraordinary measures' effect 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, Hofmann and Weber (2017) suggests that, at least for the United States, there is some indication that the effectiveness of large-scale asset purchase programs (LSAP) has fallen (Figure 5).²⁵ The authors find that, while an unanticipated increase in LSAP1 and LSAP2 purchases had a significant positive effect on real GDP and the price level, the effects of the same sized shock were much smaller for the maturity extension program (MEP) and LSAP3. Similar evidence is reported in Haldane *et al* (2016). They find that 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 Hesse *et al* (2017). Panizza and Wyplosz (2016) explore the decreasing effectiveness hypothesis for the core advanced economies that implemented large-scale asset purchases (United States, euro area, Japan and United Kingdom), also based on sub-sample analysis, and come to inconclusive results. For some empirical exercises they find decreasing effectiveness, but not for others.

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

Figure 5: The Macroeconomic Effect of Asset Purchase Shocks in the United States

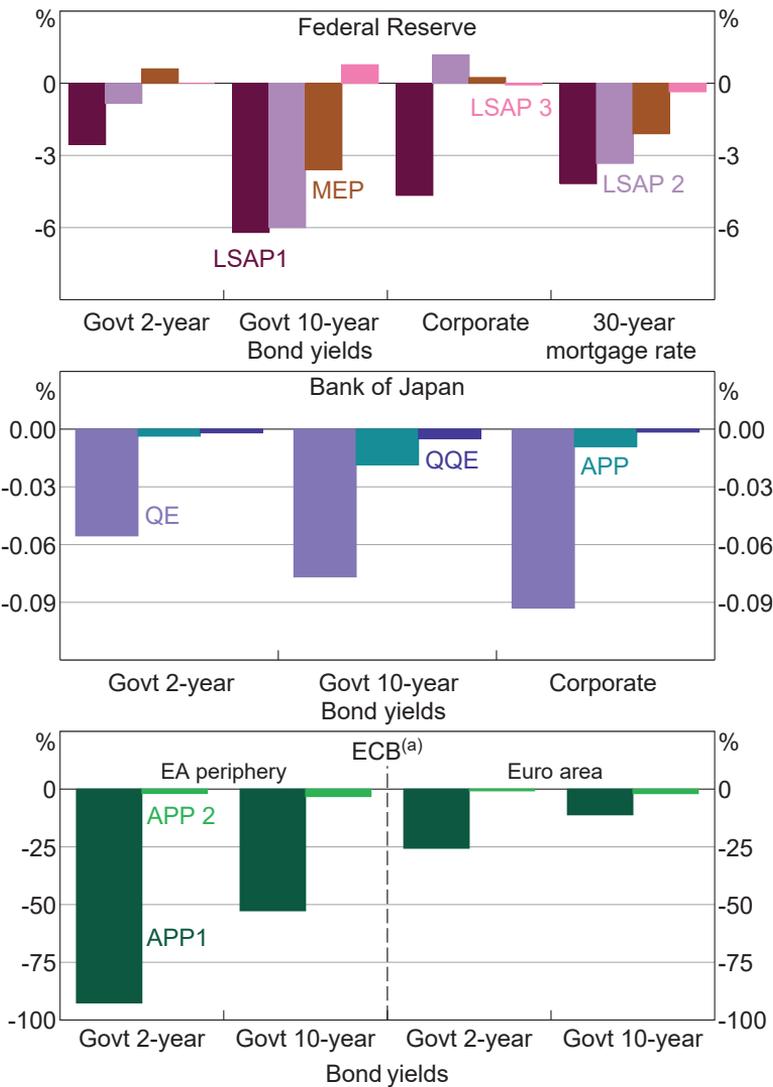


Notes: Impulse responses to the unexpected component of a US\$100 billion asset purchase announcement in a Bayesian VAR for the United States, consisting of log real GDP, log CPI, the cumulative size of the announced asset purchases, the 10-year Treasury yield and the log S&P 500 (the set-up closely follows that of Weale and Wieladek (2016)); the asset purchase shock is identified using a recursive identification scheme with the variables ordered as they were listed before; the figure shows the median and 68 per cent probability range of impulse responses; the two sub-samples considered are January 2008 to June 2011 (covering LSAP1 and LSAP2) and July 2011 to June 2016 (covering MEP and LSAP3)

Source: Hesse *et al* (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 limits to how far risk premia can be compressed, expectations guided and interest rates pushed into negative territory. Indeed, the consecutive programs seem to have had a progressively smaller effect on financial market prices (Figure 6). The reduction in bond yields and loan rates per dollar spent in the programs have consistently fallen over time in the G3 economies. This might simply reflect the fact that the programs were increasingly well anticipated by market participants. But the alternative possibility cannot be excluded either.

Figure 6: Financial Market Impact of Asset Purchase Announcements
 Effect per 100 billion units of local currency



Notes: APP denotes asset purchase program, LSAP denotes large-scale asset purchases, MEP denotes maturity extension program, QE denotes quantitative easing and QQE denotes quantitative and qualitative monetary easing; for each program, the cumulative two-day change in basis points around the announcement dates, divided by the total size of each program in local currency; for open-ended programs, it is divided by the estimated size of the program assuming an unchanged pace of purchases until December 2017; for terminated programs, it is divided by the total amount of purchases at the time of termination

(a) Government bond yields for the ECB are weighted averages based on rolling GDP and PPP exchange rates of the economies listed: EA periphery includes Greece, Ireland, Italy, Portugal and Spain; euro area includes Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain

Sources: Bank of America Merrill Lynch; BIS calculations; Bloomberg; National data sources

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 headwinds that tend to blow when rates are generally low.

3.2 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.

3.2.1 Net interest margins, bank profitability and bank lending

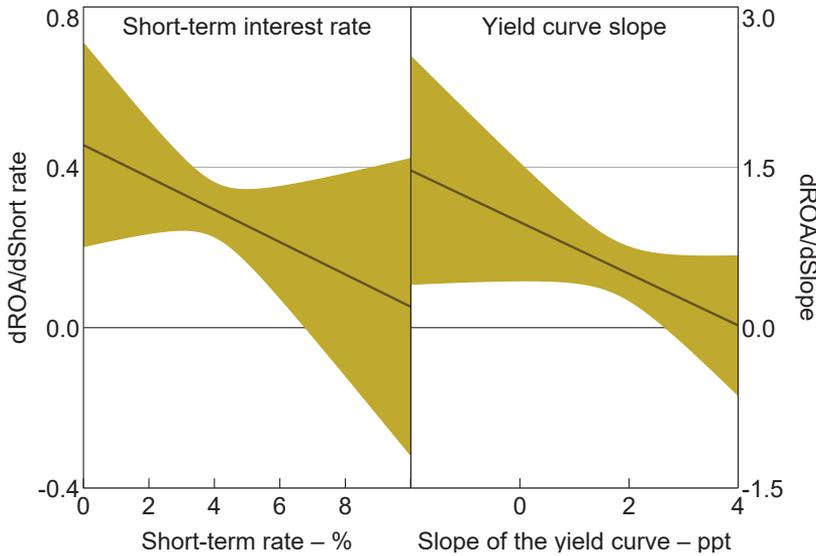
The positive link between interest rates and bank profitability has been long established in the academic literature (Samuelson 1945; Flannery 1981; Hancock 1985). English (2002) studies the link between interest rate risk and bank interest rate margins in ten industrialised countries. He finds that, 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 point change in the interest rate on net interest margins is very small, close to 7 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.²⁶

Borio *et al* (2017) 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 when rates are lower or the yield curve is flatter (Figure 7). The estimated effect is significantly larger than in studies that do not allow for

²⁶ Using capital market prices, rather than financial statements, English, Van den Heuvel and Zakrajšek (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.

nonlinearities.²⁷ Taken at face value, the results indicate that, in the sample of banks covered, the combined effect was, on balance, positive in the first two years post-GFC (2009–10), increasing ROA by an estimated cumulative 0.3 percentage points. The effect turned negative in the following four years (2011–14), lowering ROA by an estimated cumulative 0.6 percentage points, equivalent to one year of profits for the average bank in the sample.

Figure 7: Interest Rate Effects on Bank Profitability



Notes: Horizontal axes show possible values for the level of the short-term interest rate (3-month interbank rate) and the slope of the yield curve (the difference between the 10-year government bond and the 3-month interbank rate), respectively; vertical axes show the derivative of bank profitability (return on assets) with respect to the short-term rate and the slope, respectively; shaded areas indicate 95 per cent confidence bands

Source: Borio *et al* (2017)

In another recent paper, Claessens, Coleman and Donnelly (2016) confirm the findings of Borio *et al* (2017) based on a sample of 3 418 banks from 47 countries for the period 2005–13. 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 per cent (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 effect of a decrease in the short-term interest rate is statistically larger in low-rate regimes.

27 Specifically, an increase in the short-term rate from 0 per cent to 1 per cent 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 per cent to 7 per cent (Figure 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 effect of changes in the slope (e.g. a 1.2 percentage point decline in ROA for increases in the slope from –2 to –1 percentage points, compared with 0.1 to 0.7 percentage point decline in the ROA in linear specifications). Here, however, comparisons are even harder given the different slope measures used in the literature.

These findings suggest that, over time, bank capital is negatively affected by lower interest rates and that the effect is larger when rates are low. This could then 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.²⁸

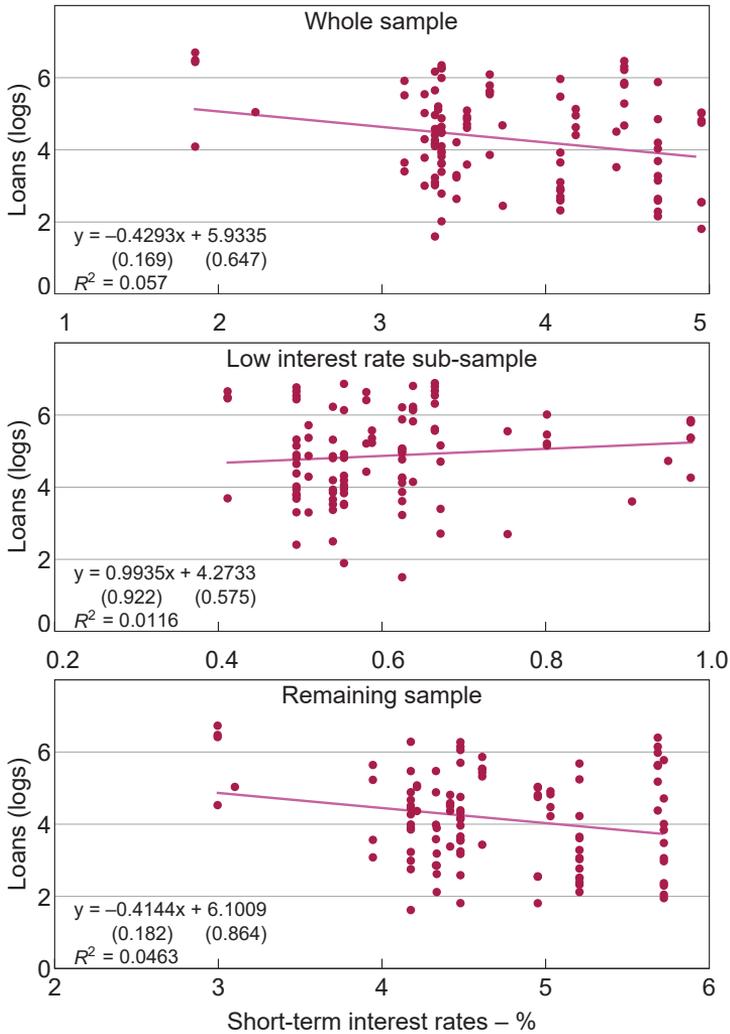
Borio and Gambacorta (2017) directly address the question of the effect of low interest rates on bank lending. They find evidence that lending becomes less responsive to reductions in short-term interest rates when interest rates are already low. Figure 8 conveys this point in a simple way based on raw data. The figure plots the average log level of lending to the non-financial sector of 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 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 Figure 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 effect of lower rates on net interest margins. A simple back-of-the-envelope calculation suggests that the reduction of net interest income caused by the low-rate environment could explain one-third of the subdued evolution of lending in the period 2010–14.²⁹ 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 profitability may in turn inhibit lending. How relevant this effect is for aggregate macroeconomic outcomes remains an open question.

28 A positive association between bank capitalisation and credit supply had already been found in previous studies, for example 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.

29 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 (e.g. so as to remain attractive to investors while seeking to maximise some managerial objective).

Figure 8: Semi-elasticity of Bank Lending to the Short-term Interest Rate



Notes: Shows the average level of lending (in logs) against the level of the short-term interest rate for a group of 108 international banks, the dots thus refer to semi-elasticities; the interest rate is the average for the currencies in which each bank obtains funding; whole sample covers 1995–2014, low interest rate sub-sample covers only periods in which the average interest rate was very low (bottom quartile of the distribution, below 1.25 percentage points), and remaining sample covers the rest of the sample; standard errors are shown in parentheses

Source: Borio and Gambacorta (2017)

3.2.2 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, Cliffe (2015) 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 how they would react to negative interest rates in the future. According to this survey, 31 per cent of respondents had changed their behaviour, albeit possibly only their portfolio decisions. Of those that did change their behaviour, some 38 per cent said that they had saved less. However, as many as 17 per cent 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.³⁰ The analysis is 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.³¹

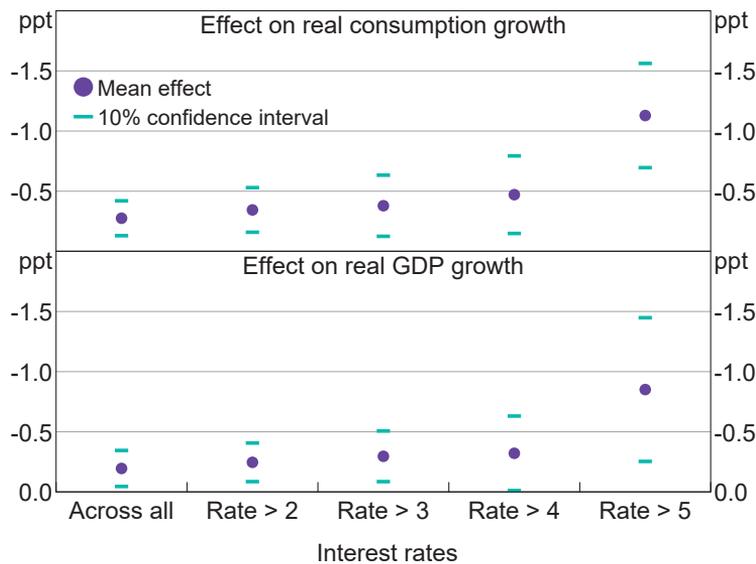
The results yield two main insights. First, real consumption growth seems to be linked to the level of *nominal* rates rather than *real* rates, pointing to the empirical relevance of money illusion or specific transmission channels working through, or proxied by, the nominal interest rate.³² Second, there is evidence that the interest rate elasticity of consumption growth increases with the level of the interest rate (Figure 9). The magnitude of 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 per cent 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.

30 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, Magnusson and Mavroeidis (2016) for a review and an empirical assessment of the various extensions of the baseline equation for the United States.

31 The controls included in the regressions comprise: country and time fixed effects; the real GDP growth rate; real house and stock price increases; the level of per capita income; the credit-to-GDP ratio; and the dependency ratio.

32 One important transmission channel of the nominal rate is the debt-servicing 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-servicing ratio and consumption growth (e.g. 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).

Figure 9: Interest Rate Semi-elasticity of Consumption and GDP Growth
Inverted scale



Notes: Estimated semi-elasticities from reduced-form empirical Euler equations linking real consumption and real GDP growth to the level of the nominal short-term interest rate; 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)

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). 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.

3.2.3 Resource allocation

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, Hoshi and Kashyap (2008) find that after the asset price crash of the late 1980s and 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, Andrews and Millot (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 zombie firms 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* (2017) find that the interest rate sensitivity of loan-loss provisions increases at low rates, which might reflect evergreening (i.e. keeping afloat weaker borrowers). But in both cases the link between interest rates and loan charge-offs could also reflect other mechanisms, notably the effect of monetary conditions on default probabilities through aggregate demand.

Closely related evidence on possible misallocations comes from a recent paper by Acharya *et al* (2017), who study the effects of the ECB's Outright Monetary Transactions 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 effect 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.

4. 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 (e.g. debt overhang, an impaired banking system, high uncertainty, resource misallocation); and (ii) inherent nonlinearities linked to the level of interest rates (e.g. effect 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 effect 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 scarcer 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.³³

³³ 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, that is, boom-bust cycles in credit and asset markets that then usher in balance sheet recessions and persistently low interest rates. See Borio (2014a, 2014b) for a more detailed exposition of this view.

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