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Low long-term interest rates as a global phenomenon

Peter Hördahl, Jhuvesh Sobrun and Philip Turner*

Abstract

International linkages between interest rates in different currencies are strong, and ultra-low rates have become a global phenomenon. This paper compares how interest rates in advanced economies and in emerging economies are conditioned by two global benchmarks – the Federal funds rate at the short end and the "world" real interest rate at the long end. Real equilibrium policy rates (the natural rate) have fallen in many countries, and short-term rates worldwide have been further depressed by many years of the US policy rate close to zero. Nevertheless, changes in the Federal funds rate have less effect on longer-term rates, and thus on financing conditions, than is often supposed. The decline in the world long-term rate since 2008 has been driven almost entirely by a fall in the world term premium (negative in nominal terms since mid-2014). The world short-term rate expected over the long run has fallen only modestly over the past seven years or so, and is now just over 2% (compared with around 4% pre-Lehman).

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Contents

Introduction

Global interest rates are, according to Haldane (2015), now "lower than at any time in the past 5000 years". As the former Governor of the Banque de France noted in his recent valedictory address, "the prolonged coincidence of low interest rates and low inflation…complicate the task of monetary policy…and worsen the trade-off between price and financial stability" (Noyer, 2016).

The review by Kotz and Le Cacheux (2016) makes it clear that we cannot disentangle precisely what is secular and what is cyclical in such an extraordinary development. Nor can we be sure about the relative importance of monetary and non-monetary factors. The depth and tenacity of the long post-financial-crisis period has raised fundamental, and unresolved, questions about current macroeconomic theory. Aglietta (2016) and King (2016) both underline the importance of 'radical uncertainty,' which can lead to oversaving.

Ragot (2016) lucidly explains how inadequate aggregate demand and very low inflation have led to a recent revival of the classical theories of Keynes's nominal rigidities (eg paradox of thrift). Some stress the precautionary saving of workers. How households who face borrowing constraints react to cyclical movements in uninsurable unemployment risk might be of crucial macroeconomic importance even if such households hold only a small proportion of aggregate wealth (Challe and Ragot, 2015). Other writers focus on saving for retirement. They stress how a prolonged period of zero interest rates on "safe" assets – engineered by central banks – could make households more insecure financially about their ability to finance their retirement and even reduce spending (Artus, 2016, and Thimann, 2016).

For all these reasons, we have yet to understand the macroeconomic causes of oversaving (or underinvestment) – let alone other possible causes. There is, therefore, no simple answer to the question: what is the "new normal" for interest rates? Faust and Leeper (2015) have argued persuasively that oversimplifying complex dynamics and assuming reversion to some "normal" levels for the policy rate or for term premia in bond markets can lead to policy mistakes.

Because monetary conditions depend on interest rates at various maturities, it is essential to analyse the shape of the yield curve. The analysis in this paper will make use of three constructed variables – a shadow policy rate, the natural interest rate and the term premium in the long-term interest rate – to analyse the long-term interest rate. With more stable benchmark policy rates (and stuck at near zero since 2009), long rates have become more important in the global transmission of monetary policy.

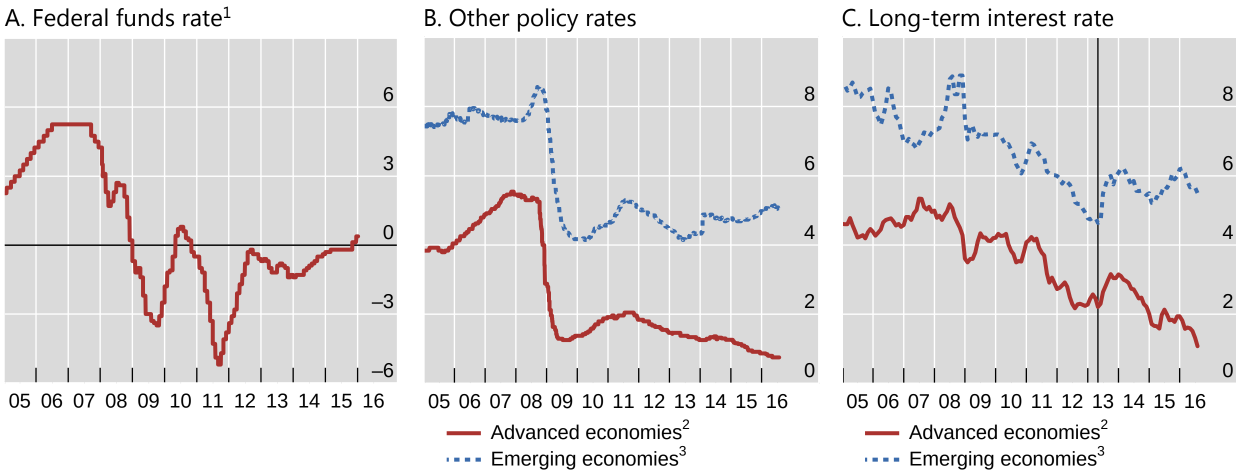
This is particularly true for emerging market (EM) economies. When most EM foreign borrowing by the private sector took the form of bank loans carrying short-term dollar interest rates, the Federal funds rate was the dominant external monetary influence on financial conditions in the emerging market economies. Many empirical studies on EMs therefore took this interest rate as the best single measure of the "foreign" interest rate. But such reliance on a single interest rate has become ever more misleading. The greater use of international and domestic bond markets has made emerging market economies much more sensitive to changes in long-term rates. BIS (2007) analysed the early phases of this development, and Sobrun and Turner (2015) document the further evolution in recent years. Many emerging markets have now joined the advanced economies in having market-driven long-term interest rates in their own currencies – usually in their domestic government bond market: see the country studies in BIS (2014).

The organising idea of this paper is that there are two global benchmarks for interest rates – at the short end, the Federal funds rate and, at the long end, a "world" real interest rate that is not controlled by any single central bank. Graph 1 summarises interest rate movements over the past decade. Panel A shows the nominal Federal funds rate. From 2008, however, the Federal funds rate has been close to zero so monetary stimulus took the form of asset purchases. The graph shows the Lombardi and Zhu (2014) estimate of the policy rate equivalent of these purchases – the so-called shadow policy rate. How and when the Fed reduces (or not) its large balance sheet will remain an important element of the stance of monetary policy for some years (Friedman, 2014, and Turner, 2015).

Short- and long-term interest rates

In per cent

Graph 1



Note: The black vertical line corresponds to 1 May 2013 (FOMC statement changing the wording on asset purchases).

[1] The Fed Funds rate shows the "shadow rate" by Lombardi-Zhu which incorporates the expansionary effect of asset purchases. [2] Australia, Canada, France, New Zealand, Sweden and the United Kingdom. [3] Brazil, Chile, Colombia, Indonesia, Korea, Malaysia, Mexico, the Philippines, Poland, South Africa, Thailand and Turkey.

Sources: Lombardi-Zhu (2014); Bloomberg; Datastream; national data.

The middle panel shows simple averages of policy rates and long-term interest rates in the currencies of 6 advanced economy (AE) central banks (France serving as the example of the euro area) and of 12 large emerging market economies with flexible exchange rates and functioning domestic government bond markets open to non-resident investors. These AE and EM averages move in a broadly parallel way over time, but EM rates are always higher. Note also that EM long-term rates rose more sharply in the two periods of bond market turbulence – in 2008 and in the 2013 taper tantrum.

At one end of the yield curve is the policy rate. A central bank with a flexible exchange rate can set its own policy rate, ensuring a degree of monetary independence. Even so, central banks outside the United States will have to take account of the level of the US policy rate – because most international short-term financial contracts (especially derivative contracts) are denominated in dollars and priced off short-term dollar interest rates and because divergence from US rates can have unwanted implications for the dollar value of their currencies. For these reasons, the Federal funds rate is the main global benchmark for short rates in most countries. Hofmann and Takáts (2015) have indeed shown that US rates affect the policy rates in other countries beyond what similarities in business cycles or global risk factors would justify – and this is true irrespective of the exchange rate regime.

At the other end of the yield curve is the interest rate on long-term government bonds. Many studies have shown that international arbitrage ensures that real long-term rates in currencies traded in international capital markets tend to move more closely together than short-term rates (Obstfeld, 2015, Sobrun and Turner, 2015, and Miyajima et al, 2016). As King and Low (2014) have argued, such strong correlations justify beginning any analysis with the concept of a "world" real long-term interest rate. Movements in the yield on 10-year US Treasuries, which is the global benchmark for markets, dominate this world real interest rate. But even US yields are partly driven by foreign forces – both non-monetary developments and the stance of monetary policy in other jurisdictions, especially the key currency areas.

There has been a significant and persistent (ie presumably non-cyclical) decline in both benchmarks – the Federal funds rate (Section 1) and the world long-term real interest rate (Section 2). In addition, the cross-country correlations of interest rates have increased sharply, which suggests that purely local determinants (including local monetary policy) have become less important (Section 3).

1. The natural rate of interest

Consider first the Federal Reserve's policy rate. The theory is straightforward: the natural or the equilibrium policy rate in a closed economy (ie that consistent with full employment and price stability in the medium term) will depend on such real economy factors as productivity, on population dynamics (which help shape saving/investment preferences), on the efficiency of financial intermediation and other structural factors.

Developing robust practical measures, however, is harder because it is difficult to quantify how such real economy factors affect the natural rate. Nevertheless, the current empirical consensus is that the natural rate of interest in most developed countries has declined in recent decades (Chetwin and Wood, 2013). Supply-side factors usually cited are lower productivity growth and an ageing population. Zhu (2016) argues that, with the exception of China, the natural rate in emerging Asia has fallen by over 4 percentage points, largely because of low-frequency demographic and global factors.

Expectations about future growth also play a role. And what appears as supply-side may reflect the longer-term effects of demand-side influences (Reifschneider et al, 2015). Macroeconomic factors (eg private sector deleveraging, impaired financial intermediation channels, contractionary fiscal policy, etc) can also have effects which persist for a long time even if they eventually subside (Rogoff, 2015).

Laubach and Williams (2015), who in effect treat the US economy as a closed economy, put the real equilibrium Fed funds rate (or the natural rate) in the range of 3 to 4% in the 1980s, noting that it then declined over the subsequent two decades to about 2%. This was the pre-financial crisis consensus of the natural rate, close to estimates of trend growth in the United States. However, non-US influences – not considered by Laubach and Williams – also play a role in determining the US's natural rate. And the quantitative impact of the various factors (eg the structural and macroeconomic factors just mentioned) remains an open question. Hence any prediction about future movements of the natural rate needs to be treated with caution.

According to their latest estimates (panel A of Graph 2), the US natural rate has been hovering around zero since 2010. Hamilton et al (2015) also describe a scenario consistent with a low natural rate in 2015. Although such estimates are of course subject to much uncertainty, the natural rate does provide a logical benchmark for translating a given interest rate into a simple measure of the stance of monetary policy. Accordingly, several central banks have used it in order to communicate their policy intentions: see for instance Yellen (2015), who pointed out that many estimates have been made and also took care to underline that, "simple rules are, well, too simple". Other measures give additional information. And there may be supply-side reasons for thinking this natural rate will rise over the next decade as a result of demographic changes (Gavin, 2015; Goodhart et al, 2015).

2. The world real long-term interest rate

There has been a similar trend decline in the real long-term interest rate, shown in panel B of Graph 2. International forces that pre-date the fiscal crisis (eg global saving glut, global banking glut, scarcity of safe or liquid assets, the habitat choices of official investors from emerging markets and so on) have held down the long-term rate, reinforcing the effect of a very low Federal funds rate. The world real long-term interest rate has been declining at least since 2000 and probably much longer. It would be implausible to attribute a trend that has lasted for decades to monetary policy alone. In an ambitious study of secular determinants of the world real long-term interest rate, Rachel and Smith (2015) attribute about two-thirds of the fall in global real rates since the 1980s to secular factors that determine desired saving and investment rates.

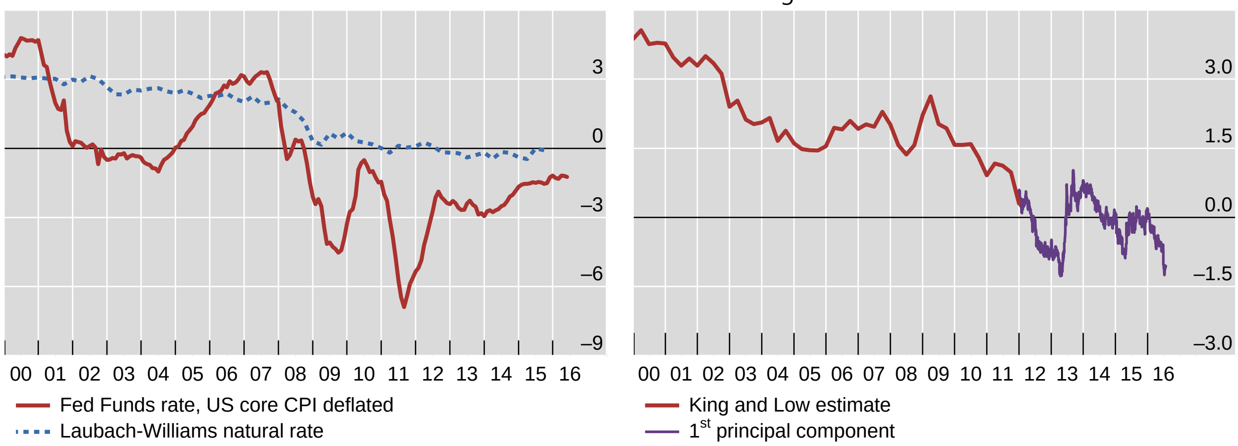
Graph 4 in Section 3 below shows that the recent very sharp decline in long-term rates has been largely driven by a further compression of the term premium – that is, the reward for holding long-dated rather than short-dated bonds – which had already been declining for some years. And expected short-term interest rates, which dropped sharply following the collapse of Lehman Brothers in 2008, have fallen only marginally in recent years.

Table 1 shows average estimates of 10-year nominal term premia over the past 35 years, along with its two components, ie the real term premium and the inflation risk premium. The table shows a persistent decline in the nominal term premium during the past decades: the US 10-year premium was 3% on average in the 1980s, whereas during the most recent five years the average stood at only 0.5%. The corresponding figures for the euro area were 2.4% (for Germany) in the 80s and -0.3% on average during 2011-15. Table 1 also makes clear that much of this decline has been due to a fall in the real term premium, which has dropped by over 300 basis points in the case of the United States and by almost 200 basis points in the euro area. In other words, the substantial decline in premia over the past few decades has affected nominal as well as real yields.

Real interest rates

In per cent | Graph 2

A. Short-term dollar rates[1] | B. "World" long-term rate[2]



[1] Since 2008, the Fed Funds rate is the "shadow" Lombardi/Zhu rate. [2] The real 10-year yield for recent months is based on the 1st principal component from inflation-linked French, UK and US Treasuries.

Sources: King and Low (2014); Laubach and Williams (2015); Lombardi and Zhu (2014); Bloomberg; national data; authors' calculations.

The estimates in Table 1 are based on the macro-finance model proposed by Hördahl, Tristani and Vestin (2006) and extended by Hördahl and Tristani (2014). At the core of the model is a small-scale macroeconomic model in the New Keynesian tradition, which includes a forward-looking Phillips curve and a consumption-Euler equation that describe the evolution of inflation and the output gap, respectively. The model also includes a forward-looking Taylor rule to describe how the central bank sets its policy rate as a function of expected inflation, the output gap, and the inflation objective of the bank (which is allowed to vary over time). On top of this, the model adds a pricing kernel that allows real and nominal bonds to be priced consistently in a manner that precludes arbitrage opportunities. The advantage of using this approach is that model-implied bond prices – and hence premia estimates – are consistent with how we think the macro economy works and with the way the central bank conducts monetary policy. The model is estimated using nominal and real (index-linked) bond prices, in addition to macroeconomic data (inflation and output gap estimates). It also includes survey data on inflation and interest rate expectations to ensure consistency with such data.

10-year term premia estimates and its components (in %)

Table 1

		1981–89	1990–99	2000–05	2006–10	2011–15
United States:	Nominal term premium	3.0	1.7	1.3	0.9	0.5
	real term premium	3.3	2.0	1.5	0.8	0.1
	inflation premium	–0.3	–0.3	–0.2	0.1	0.4
Euro area[1]:	Nominal term premium	2.4	2.2	0.8	0.4	–0.3
	real term premium	1.5	1.7	0.4	0.1	–0.3
	inflation premium	0.9	0.5	0.4	0.3	0.0

[1] Prior to 1999, based on data for Germany; as of 1999, based on yield data for France and macroeconomic data for the euro area.

The discussion above, therefore, shows clearly that the long-term interest rate has moved for reasons other than changes in expected future short rates. One recent monetary policy contribution to the sharp decline in term premia is the massive central bank purchases of bonds under Quantitative Easing (QE) in the AEs. Large-scale forex intervention by some EM central banks – notably China and commodity-exporting countries –had a similar effect. As their forex reserves reached new highs, many central banks lengthened the maturity of their bond purchases. Note that increased QE by the ECB as the Federal Reserve had ended new purchases drove the euro term premium well below that in the dollar. There is evidence that this ECB policy shifted the portfolio preferences of international bond investors towards dollar bonds and led US companies to issue more euro-denominated bonds relative to dollar-denominated bonds. These market reactions put downward pressure on the dollar term premium even in the face at imminent Fed tightening. To restate: a central bank setting its policy rate according to its own economic environment can find its long-term rate, set in global markets, moving in the opposite direction.

There is, however, no obvious or simple microeconomic explanation for the persistence of a negative risk premium in holding long-dated paper. Normally, a private investor would see risks in buying assets (in this case, bonds) whose prices have been temporarily boosted by – and yields depressed by – official purchases. Why have they not seen more risks in buying bonds at such low yields? One hypothesis is that the Great Moderation (low inflation thanks to more credible macroeconomic policy frameworks) made investing in government bonds look safer. But the problem with this explanation is that bond yields have become more, not less volatile even as the policy rate became much more stable. The (surprising) increase in the variability of long-term interest rate changes that Mark Watson noted in 1999 has actually persisted (Table 2). He took as the basis of this comparison the period January 1965 to September 1978. The standard deviation of monthly changes in 10-year yields was 23 basis points over the period from January 1999 to July 2016, compared with 19 basis points in the base period.

One clue to the attraction of holding bonds could be the higher term spread (2.38 percentage points in the recent period compared with 0.85 percentage points in Watson's base period). Other things equal, such a large spread would have made interest rate carry-trades (ie borrowing short and lending long) more attractive. The higher volatility of bond yields that Watson noted would make carry-trades riskier – but the lower volatility in the Fed funds rate and in the term spread may have reassured investors. If volatility rises sharply, however, such carry-trades can be abruptly reversed. Interest rate carry trades could well be a key – but very volatile – transmission channel of the policy rate to the long-term rate (Turner, 2015).

Standard deviations of US interest rate changes[1]

Table 2

	Fed funds	3-month T-bill	10-year nominal yield	10-year real yield	Term spread	Term spread average[2]
1965.1 to 1978.9	0.45	0.37	0.19	0.20	0.33	0.85
1986.1 to 1998.12	0.24	0.20	0.25	0.25	0.23	1.94
1999.1 to 2016.7	0.17	0.18	0.23	0.18	0.27	2.15
Memorandum:						
1999.1 to 2006.12	0.20	0.19	0.22	0.16	0.27	1.86
2007.1 to 2016.7	0.15	0.17	0.23	0.20	0.26	2.38

[1] Standard deviation of the first differences (ie $R_t - R_{t-1}$) of the monthly averages of daily observations of interest rates measured in percentage points. [2] 10-year nominal yield less 3-month Treasury bill rate.

Sources: Datastream; National data; BIS calculations (following Watson, 1999).

Table 3 shows how key interest rates have moved in recent years. In the 1980–99 period, the real Fed funds rate averaged 3.7%, almost a percentage point above the Laubach-Williams (LW) natural rate. Since then, the Federal funds natural rate is down by about 1½ percentage points. Significant and sustained monetary stimulus is indicated by the much-sharper fall in the actual rate (adjusted for the presumed impact of QE). There has been a similar decline in real long-term interest rates. US potential growth is also much lower. There are no reliable figures for potential world GDP; but trend growth has declined a little.

Real interest rates in dollars (in %)

Table 3

	1980–99	2000–03	2004–08	2010–15
Fed funds rate[1]	3.7	1.5	1.3	–2.9
Laubach-Williams (LW) natural rate	2.9	2.8	2.1	0.1
10-year yield of US Treasuries	4.7	3.2	2.0	0.2
World real long-term rate	4.4	3.1	1.8	0.2
Memo:				
Global savings rate	23.1	22.9	24.6	25.5
Global growth trend	3.2	3.9	4.1	3.5
US potential growth rate	3.1	3.4	2.4	1.5

[1] Deflated by the year-on-year US core CPI (from 2008, the shadow Lombardi/Zhu rate has been used).

Short-term rates influence but do not determine long-term rates. A simple regression of the world real long-term rate – reported in the annex – reveals significant serial correlation in even annual data. The long-term rate moves slowly. The estimated coefficients on each of the main economic determinants all have the signs that economic theory would predict. But there are large standard errors. The stance of Federal Reserve policy, measured by the deviation of the actual (or shadow) Federal Funds rate from the Laubach-Williams estimate of the natural interest rate, is a significant explanatory variable. It suggests that a 100 basis points increase in this rate adds 25 basis points to the world real long-term rate in the immediate period (and ultimately about double that amount). Stronger world growth tends to drive up the real long-term rate: a one percentage point rise in the ratio of world GDP to its trend adds 50 basis points to the world real interest rate. It is telling that the real yield on 10-year US Treasuries does not appear to react to the ratio of US GDP to potential – but it does react to the cyclical movements in world GDP. Hence a US economy close to full employment but a world economy with significant slack would mean low yields on US Treasuries. In addition, a higher global saving rate does appear to reduce the long-term yield. The estimated coefficient on the proxy for inflation uncertainty is positive but not statistically significant.

3. Long-term interest rates: greater international convergence

Table 4 shows simple regressions of changes in long-term interest rates in 6 advanced economies and in 12 large emerging market economies on: changes in the yields on US Treasuries (10YUS); the difference between the local policy rate (R) and the shadow Federal funds rate (FF); and the 3-month local money market yield. The interpretation of these correlations is simple. The first line, for instance, says that a 100 basis point rise in 10YUS is associated with a 79 basis point rise in the yield on AE bonds in that quarter.

It is striking that the AE and EM coefficients on the 10-year US yield are so similar. The influence of long US rates, always important for other AEs, now dominates also in EM bond markets which have become closely integrated with global markets. Equally striking is that, once account is taken of movement in US long-term rates, the local policy rate relative to the Federal funds rate (that is, R-FF in the Table) has a very small impact.[1]

Because local monetary conditions depend on the whole yield curve, and not just the policy rate, this finding is important. This is consistent with the limited impact on bond and other markets of the much-advertised 25 basis points increase in the Fed funds rate in December 2015. It is also consistent with Bowman et al (2014) who find that US monetary policy shocks **that lower US Treasury yields** (emphasis added) lower the yields on EM bonds.[2] Changes in the local three-month interest rate (R3M, usually the yield on government paper, which may include credit and liquidity risk premia absent in the policy rate) are more important for emerging economies than for advanced economies.

[1] Recall that the variable FF from 2008 is the shadow Federal funds rate to more accurately measure US monetary policy over this period.

[2] Koepke (2016) argues that it is rises in the Federal funds rate which **take markets by surprise** that cause crises in emerging market economies.

Correlations between quarterly changes of local currency bond yields and other interest rates

Table 4

	10YUS	*TERM*	*ERUS*	*R – FF*	*R3M*	*€ – $*	*Adj R^2*	*Durbin-Watson*	*F*	*Number of observations*
AEs	0.79 (23.4)			0.07 (5.2)	0.14 (6.0)		0.72	1.53	231.3	270
EMs	0.69 (9.5)			0.06 (2.5)	0.28 (8.2)		0.26	1.78	63.7	540
AEs		0.89 (23.6)	0.61 (13.3)	0.04 (2.8)	0.18 (7.5)		0.75	1.68	198.1	270
EMs		0.84 (9.9)	0.45 (4.5)	0.02 (0.9)	0.30 (8.9)		0.28	1.85	51.7	540
AEs	0.78 (24.3)			0.05 (3.8)	0.13 (5.6)	0.28 (4.9)	0.74	1.56	194.7	270
EMs	0.68 (9.4)			0.1 (2.0)	0.28 (8.2)	0.24 (1.9)	0.26	1.78	48.9	540

These equations were estimated over the period 2005 Q1 to 2016 Q1. All variables are expressed in first differences between quarters, t-statistics are given in parentheses. See the note in the Annex.

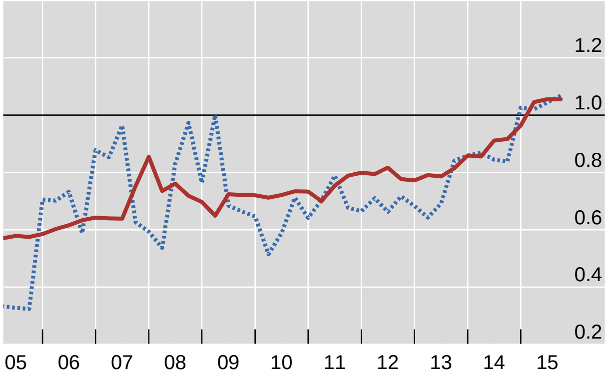
To examine whether yields on euro area bonds added anything to the determination of other international bond yields over this period, a new variable (€ – $) was added. This variable is the residual from a regression of first differences in 10-year French yields (the proxy for the euro area) onto the first differences of the 10-year US yield and a constant term. This variable hardly alters the estimated impact of 10YUS. Regressions of the individual country data (not shown), however, revealed it exerted a large and significant impact only in the case of Poland and Sweden.

Next look a little deeper at the long-term rate of interest. The yield on US Treasuries can be broken down into the average of expected future 3-month rates over the 10-year life of the bond (ERUS) and the term premium (TERM as calculated by the BIS following the methodology of Hördahl and Tristani, 2014). Apart from a negligible cross-product term, 10YUS = TERM +ERUS. This separation shows that the term premium in US Treasuries matters more than the average of expected future short-term rates, especially for the emerging economies. Albagli et al (2015) detect an even more marked difference in the transmission to emerging compared with advanced economies: they find that changes in expected US short rates drive most of the changes in AE yields, it is changes in the term premium that dominate changes in EM yields. Chan et al (2015) find that QE in the United States has had more impact on emerging economies than advanced economies.

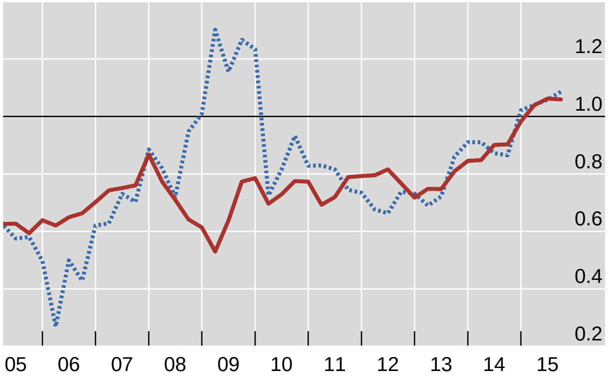
The regressions shown in Table 4 simply measure the average over this sample of the effects registered in different countries and over different periods. In practice, of course, such effects are not likely to be constant either across countries or over time. For instance, the coefficient on 10YUS is likely to depend on macroeconomic variables in the particular EM economy (Bowman et al, 2014, identify such effects). EM financial market reactions during the 2013 taper tantrum did vary according to differences in fundamentals (Shaghil et al, 2015). Separating the emerging market sample used in these regressions geographically – not included in this paper – shows that the influence of 10YUS is much higher for bonds from Latin America than for bonds from emerging Asia, where local short-term rates have a greater impact.

Regression coefficients of local bond yields on 10-year US Treasuries[1] Graph 3

A. 10-year yields



B. The term premium in the 10-year yield



Advanced economies[2] Emerging economies[3]

[1] The coefficients indicate the results of a pooled regression over a 3-year moving window of first differences, based on quarterly observations. The specification is summarised in the annex. [2] Australia, Canada, France, New Zealand, Sweden and the United Kingdom. [3] Brazil, Chile, Colombia, Indonesia, Korea, Malaysia, Mexico, the Philippines, Poland, South Africa, Thailand and Turkey.

Source: authors' calculations.

In addition to the average relationship over the period of the sample, the development over time is also of interest. Graph 3 shows how correlations have moved over successive 3-year windows. Two conclusions stand out. One is that correlations with US dollar yields have been rising over time – from around 0.6 in the mid-2000s to around 1 currently. Before 2010, however, the emerging market correlations appear to be much more volatile than advanced economy correlations – a reflection perhaps of the comparative illiquidity in EM bond yields. BIS (2007) noted a similar volatile pattern that was not present in AE bond markets. The second conclusion is that the term premium in dollar bond markets has become a more important determinant of long-term interest rates in other currencies than expected future US short-term rates.

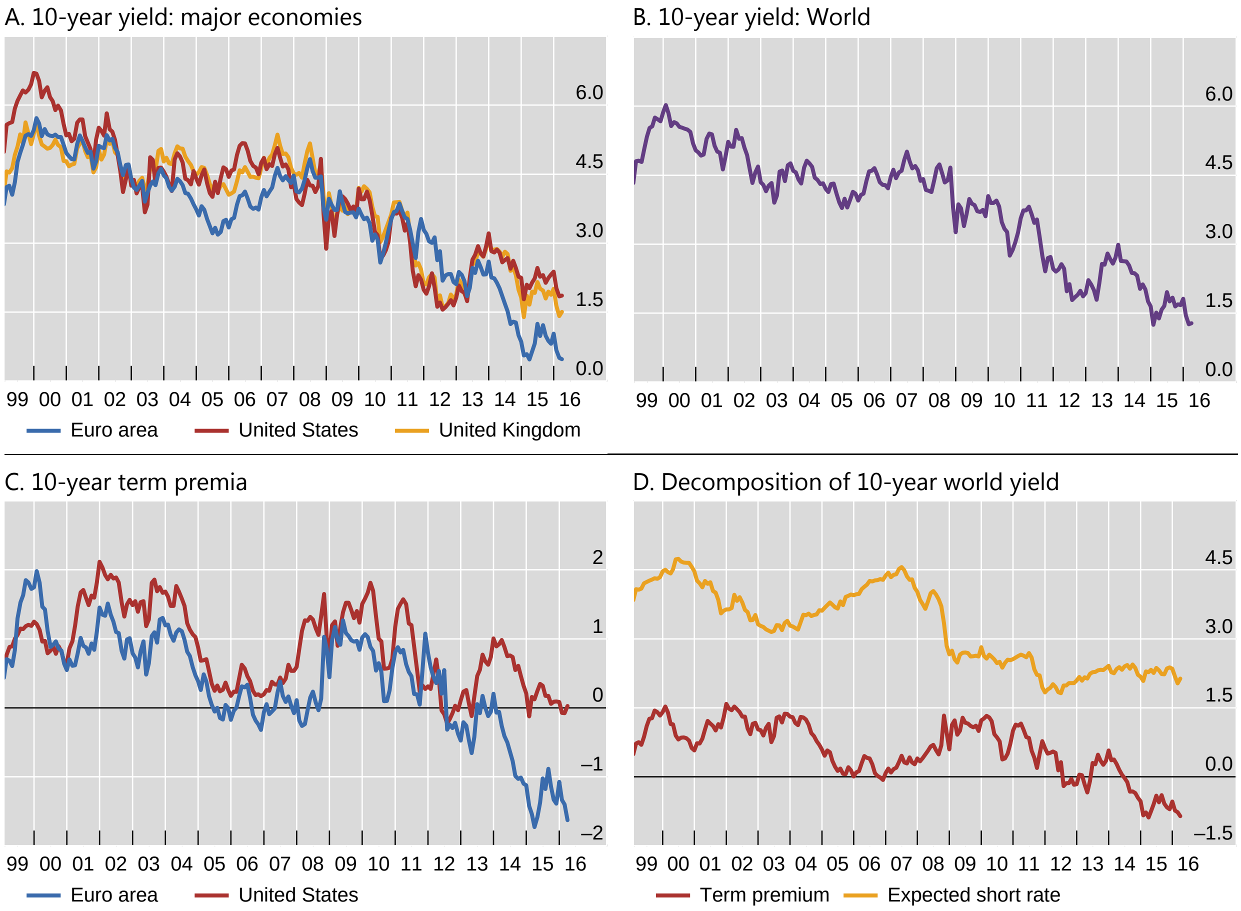
It is possible that bond markets in individual countries around the globe react not only to US financial conditions, but to some notion of "world" financial conditions. Although US bond yields, term premia and other market prices are sure to play a prominent role for any measure of world financial conditions, other large economies, such as the euro area and the United Kingdom, will also matter. A simple way of constructing a world long-term bond yield, a world term premium, and a world expected short-term interest rate, is to use principal component (PC) analysis on the corresponding variables for the United States, the euro area, and the United Kingdom. This is, of course, a simplification: further research using term premia calculations from bond markets in other currencies – if not distorted by dominant domestic influences – could improve on this "world" estimate.[3]

[3] Another natural candidate to include would be Japan. We exclude Japan, however, as the Japanese bond market has traditionally been very much domestically focused. Iwata (2015) gives estimates of the term premium in Japanese government bonds.

Graph 4 shows our estimates of these world variables (Annexes 2 and 3 contain tables with monthly estimates).[4] Unsurprisingly, the world long-term yield as well as the world term premium have been trending downwards over the past few decades. The graph also shows that whereas the world expected short-term interest rate fell quickly immediately after the collapse of Lehman Brothers in 2008, since then this expectations component has drifted downwards only marginally. The continued decline in the world long-term yield over the past seven or eight years has therefore been almost entirely driven by a fall in the world term premium.

World 10-year yield, term premium and expected short rate

In per cent — Graph 4



Sources: Bloomberg; Datastream; authors' calculations; Bank of England.

We can use these estimated world long-term yields, term premia and expected policy rates to examine how yields in individual countries react to world financial conditions, instead of US conditions. Table 5 shows the results. Because the estimated world bond yield, world term premium and world short rate expectations are highly correlated with the corresponding US variables, the parameter estimates in the first three columns in Table 5 are relatively similar to those in Table 4. For these variables, the US measures capture very similar information to the world measures. There is,

[4] The "world" series show the first principal component for each variable, rescaled in order to preserve the mean of the individual series. The UK term premium used in the construction of the world term premium is estimated by the Bank of England; we are grateful to Bank of England staff for making these estimates available to us.

however, one important difference between the US and the world results. In Table 4, the difference between the local policy rate and the federal funds rate (column 4) is statistically significant in three out of four cases. By contrast, in Table 5, the corresponding difference between the local policy rate and the world short-term interest rate (as estimated by principal component analysis) is insignificant in all cases. The conclusion is therefore that, for the determination of long-term bond yields across the globe, differences in the stance of US monetary policy (as measured by the Federal funds rate) and local policy do matter, whereas the average policy rate across major economies does not.

Correlations between quarterly changes of local currency bond yields and other interest rates

Table 5

	10yWorld	*WTerm*	*ERWorld*	*R-rWorld*	*R3M*	*Adj* R^2	*Durbin-Watson*	*F*	*Number of observations*
AEs	0.85 (21.7)			0.01 (0.8)	0.17 (5.6)	0.70	1.81	207.7	270
EMs	0.68 (8.3)			0.01 (0.3)	0.30 (6.3)	0.23	1.84	56.0	540
AEs		0.85 (17.1)	0.86 (10.3)	0.01 (0.2)	0.17 (3.8)	0.69	1.81	155.2	270
EMs		0.84 (8.4)	0.39 (2.9)	-0.06 (-0.9)	0.35 (6.9)	0.24	1.85	44.4	540

These equations were estimated over the period 2005 Q1 to 2016 Q1. All variables are expressed in first differences between quarters, t-statistics are given in parentheses. See the note in the Annex.

Conclusion

Central banks in small economies have only a very limited ability to influence the long-term interest rate in their own currencies. The direct influence of changes in their policy rate relative to that of the Federal Reserve is small. And a rise in the Federal funds rate (other interest rates constant) has a much smaller direct effect than often assumed. A 100 basis point rise in the Federal funds rate adds directly only 6 or 7 basis points to long-term rates overseas.

In both advanced and emerging economies, short-term correlations with US long-term yields have increased substantially over the past decade. On average over the period 2005 to date, a 100 basis point rise in the US 10-year yield is associated with a 70 to 80 basis point rise in the yields in other bond markets – swamping the effects of changes in short-term rates. In the past three years, this correlation has been much larger than it was in the mid-2000s. As the Governor of the Central Bank of Iceland recently pointed out (Gudmundsson, 2016), the interest rate channel of monetary policy transmission in small, open economies has been weakened.[5]

In addition, world long-term real interest rates fall when the Federal Reserve eases monetary policy – suggesting that bond markets have become more important

[5] He added that relying more on the exchange rate channel of monetary transmission would lead central banks down a "bumpy road, full of financial stability risks." The risk-taking channel of currency appreciation has received attention in several recent BIS papers: see, for instance, Hofmann et al (2016).

in international monetary transmission. However, subpar global growth and higher global savings also hold down long-term rates: the long-term interest rate is not fully under the control of policy-makers.

US long-term yields can be broken down into two elements: the average of expected future short-term rates and a term premium. The term premium seems to matter more for international correlations than the average of expected future short rates, and this is particularly true for the emerging markets. There is no consensus on what determines the term premium, but medium-term factors in the real economy shaping the underlying propensities to save and to invest (demographic, expected productivity, etc.) have probably been important.

Because the underlying determinants of the term premium are uncertain, forecasting its future value is hazardous. There has been a long trend decline in both the natural short-term interest rate in most advanced economies and the world long-term interest rate. Secular factors have played a big part in this. But cyclical or reversible elements have also exerted an important influence. Interest rate carry-trades taking advantage of near-zero short-term rates – an example of how financial risk-taking can magnify the impact of monetary policy – have probably depressed long-term rates. One imponderable is the nature and timing of central bank bond sales as monetary policy in advanced economies is normalised, and as several major EM central banks are confronted with external financing pressures.

It would be gratifying to be able to conclude by answering the question at the beginning of this paper about the "new normal" for global interest rates. Gratifying but unrealistic. The paper is less ambitious. It argues that recent estimates of unobserved constructions such as the shadow policy rate, the natural rate and the term premium in the long-term rate suggest the "new normal" is lower than in the past. Such model-based constructions can of course be challenged and will in any case change as new data become available. In any event, policy-makers should recognise that the "new normal" will become clear only as events unfold and that, whatever the new normal, they will face "abrupt, discontinuous shocks" that cannot be foreseen.

References

Aglietta M (2016): "Perspectives monétaires et financières : stagnation séculaire ou mutation du capitalisme ?" in "Les défis d'une économie à taux zéro", *Revue d'économie financière*, vol 121, March, pp 159–171.

Albagli, E and L Cebullos, S Claro and D Romero (2015): "Channels of US monetary policy spillovers to international bond markets: advanced versus emerging market economies", Central Bank of Chile.

Artus, P (2016): "Déflation et taux d'intérêt zéro : causes profondes, conséquences sur les politiques économiques et le secteur financier" in "Les défis d'une économie à taux zéro", *Revue d'économie financière*, vol 121, March, pp 187–194.

Bank for International Settlements (2007): "Financial stability and local currency bond markets", *CGFS Papers*, no 28, June.

——— (2014): "The transmission of unconventional monetary policy to the emerging markets", *BIS Papers*, no 78, August.

Bowman, D, J M Londono and H Sapriza (2014): "US unconventional monetary policy and transmission to emerging market economies", Board of Governors of the Federal Reserve System, *International Finance Discussion Papers*, Number 1109, June.

Challe, E and X Ragot (2015): "Precautionary saving over the business cycle", *Economic Journal,* 126, February, pp 135–164.

Chan, Q, A Filardo, D He and F Zhu (2015): "Financial crisis, US unconventional monetary policy and international monetary spillovers", *IMF Working Paper,* WP/15/85, April.

Chetwin, W and A Wood (2013): "Neutral interest rates in the post-crisis period", *Reserve Bank of New Zealand Analytical Notes,* AN 2013/07.

Faust, J and M Leeper (2015): "The myth of normal: the bumpy story of inflation and monetary policy". Federal Reserve Bank of Kansas City. Jackson Hole Symposium. August 2015.

Friedman, B M (2015): "Has the financial crisis permanently changed the practice of monetary policy? Has it changed the theory of monetary policy?" *The Manchester School*, Volume 83, Supplement S1, pp 5–19, June 2015.

Gavin, M (2015): "The natural interest rate – past and prospective", *Barclays Global Insights,* March.

Goodhart, C, M Pradhan and P Pardeshi (2015): "Could demographics reverse three multi-decade trends?" *Morgan Stanley Research*, September.

Gudmundsson, M (2016): "Global financial integration and central bank policies in small, open economies", *Singapore Economic Review*, vol 16, no 2, March.

Haldane, Andrew G (2015). "Stuck" speech by Chief Economist, Bank of England, Open University, Milton Keynes, 30 June 2015.

Hamilton, J D, E S Harris, J Hatzius and K D Wars (2015): "The equilibrium real funds rate: past, present", Hutchins Center of Fiscal and Monetary Policy at Brookings, Working Paper, no 16.

Hofmann, B and E Takáts (2015): "International monetary spillovers", *BIS Quarterly Review,* September.

Hofmann, B, I Shim and H S Shin (2016): "Sovereign yields and the risk-taking channel of currency appreciation", *BIS Working Papers,* no 538, January.

Hördahl, P, E M Remolona and G Valente (2015): "Expectations and risk premia at 8:30am: macroeconomic announcements and the yield curve", *BIS Working Papers,* no 527, November.

Hördahl, P and O Tristani (2014): "Inflation risk premia in the euro area and the United States", *International Journal of Central Banking* 10(3), pp 1–47.

Hördahl, P, O Tristani and D Vestin (2006): "A joint econometric model of macroeconomic and term structure dynamics", *Journal of Econometrics* 131 (1–2), pp 405–44.

Iwata, Kazumasa (2015): "Monetary policy, at the zero lower bound and beyond from the Japanese Perspective", speech at The 6th Annual Conference Organized by the Central Reserve Bank of Peru and the Reinventing Bretton Woods Committee on "Monetary policy and financial shifts", Lima, Peru, 6 October.

King, M (2016): *The end of alchemy: money, banking and the future of the global economy,* W W Norton & Company, Ltd.

King, M and D Low (2014): "Measuring the 'world' real interest rate", *NBER Working Paper*, 19887, February.

Koepke, R (2016): "Determinants of emerging market crises: the role of US monetary policy", *IIF Working Paper*, July.

Kotz, H-H and J Le Cacheux (2016): "Introduction" in "Les défis d'une économie à taux zéro", *Revue d'économie financière*, vol 121, March, pp 11–25.

Laubach, T and J C Williams (2015): "Measuring the natural rate of interest redux", Hutchins Center of Fiscal and Monetary Policy at Booking. Working Paper, no 15.

Lombardi, M and F Zhu (2014): "A shadow policy rate to calibrate US monetary policy at the zero lower bound", *BIS Working Papers,* no 452, June.

McCauley, R N, P McGuire and V Sushko (2015): "Global dollar credit: links to US monetary policy and leverage", *BIS Working Papers,* no 483, January.

Miyajima, K, Mohanty, M S and J Yetman (2014): "Spillovers of US unconventional monetary policy to Asia: the role of long-term interest rates", *BIS Working Papers,* no 478, December.

Noyer, C (2016): "Thoughts on the zero lower bound in relation with monetary and financial stability," *Farewell Symposium for Christian Noyer*. Banque de France, 12 January.

Obstfeld, M (2015): "Trilemmas and tradeoffs: living with financial globalisation", *BIS Working Papers*, no 480, January.

Rachel, L and T D Smith (2015): "Secular drivers of the global real interest rate", *Bank of England Staff Working Paper,* no 571, December.

Ragot, X (2016): "Le retour de l'économie keynésienne" in "Les défis d'une économie à taux zéro", *Revue d'économie financière*, vol 121, March, pp 173–185.

Reifschneider, D, W Wascher and D Wilcox (2015): "Aggregate supply in the United States: recent developments and implications for monetary policy", *IMF Economic Review,* vol 63, no 1.

Rogoff, K (2015): "Debt supercycle, not secular stagnation", VOX, CEPR, 22 April.

Shaghil, A, B Coulibaly and A Zlate (2015): "International financial spillovers to emerging market economies: how important are fundamentals?" *Federal Reserve Board,* International Finance Discussion Papers, no 1135, August.

Sobrun, J and P Turner (2015): "Bond markets and monetary policy dilemmas for the emerging markets", *BIS Working Papers*, no 508, August.

Thimann, C (2016): "L'assouplissement quantitatif : un défi pour l'épargne à long terme et la sécurité financière des ménages" in "Les défis d'une économie à taux zéro", *Revue d'économie financière*, vol 121, March, pp 213–224.

Turner, P (2015): "The consequences of exit from non-conventional monetary policy", *Journal of Financial Perspectives,* vol 3, issue 2, pp 43–59.

Watson, M W (1999): "Explaining the increased variability of long-term interest rates", Federal Reserve Bank of Richmond, *Economic Quarterly,* 85/4.

Zhu, F (2016): "Understanding the changing equilibrium real interest rates in Asia-Pacific", *BIS Working Papers,* no 567, June.

Annex 1: Regression details

The regression mentioned in the text for the real world long-term interest rate (WR) was:

$$\underset{}{WR} = \underset{(2.3)}{-27.2} + \underset{(4.0)}{0.25\,(FF-FFLW)} + \underset{(3.1)}{50\,WGDP_{-1}} - \underset{(3.9)}{0.84\,WS\%Y} + \underset{(0.5)}{0.46\,INFL} + \underset{(3.3)}{0.39\,WR_{-1}}$$

Annual data: 1981 to 2015. Adj $R^2 = 0.89$; F=49.1

where:

FF–FFLW = The shadow Federal funds rate minus the LW natural rate, deflated by the year-on-year change in the core CPI.

WGDP = World real GDP relative to its trend

WS%Y = World saving ratio

INFL = Variance of the US inflation forecasts summarised by Consensus Economics

The variable INFL was used to test for an inflation risk premium in the real long-term interest rate. The coefficient has the correct sign (that is, increased inflation uncertainty raises the real long-term rate), but it was not significant.

A comparable regression with FF, rather than FF–FFLW, produced a slightly less good fit but did not alter the conclusion.

A similar regression with real 10-year yields on US Treasuries (rather that the world real rate) as the independent variable (not reported) produced very similar results, but with a greater influence of US short-term rates and a smaller influence of the world saving ratio. WGDP remained significant but the ratio of US GDP to potential, when used instead of WGDP, was not significant.

In Table 4, the use of the actual rather than the shadow Federal funds rate did not materially change the results. As to be expected, however, the size of the coefficients on US bond yield terms rose (because the shadow rate allows for the effects of asset purchases).

The estimated results of alternative specifications mentioned above (and in Section 3) are available from the authors on request.

Annex 2: Proxy for World long-term nominal term premium

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1999	0.5	0.7	0.7	0.7	0.9	1.1	1.3	1.3	1.4	1.4	1.3	1.4
2000	1.5	1.4	1.1	1.1	0.9	0.8	0.9	0.9	0.8	0.8	0.6	0.6
2001	0.7	0.7	0.8	1.0	1.2	1.2	1.1	1.0	1.1	1.1	1.3	1.6
2002	1.5	1.4	1.5	1.5	1.4	1.3	1.3	1.0	0.9	1.2	1.2	1.0
2003	1.0	0.9	1.1	1.2	0.8	0.9	1.3	1.3	1.2	1.4	1.4	1.3
2004	1.3	1.2	1.1	1.3	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6
2005	0.5	0.6	0.5	0.3	0.2	0.1	0.2	0.1	0.1	0.2	0.1	0.0
2006	0.1	0.1	0.3	0.4	0.4	0.4	0.3	0.1	0.0	0.0	–0.1	0.1
2007	0.2	0.1	0.2	0.2	0.3	0.5	0.3	0.3	0.4	0.3	0.3	0.4
2008	0.3	0.4	0.5	0.6	0.7	0.7	0.6	0.5	0.7	1.3	1.0	0.6
2009	1.1	1.2	0.9	1.0	1.3	1.2	1.2	1.1	1.1	1.1	1.0	1.2
2010	1.3	1.3	1.3	1.2	0.9	0.9	0.8	0.4	0.4	0.5	0.7	1.0
2011	1.1	1.1	1.2	1.0	0.9	0.8	0.6	0.4	0.2	0.5	0.8	0.6
2012	0.5	0.5	0.5	0.5	0.1	0.3	–0.2	–0.1	–0.1	0.0	–0.2	–0.2
2013	0.0	0.0	–0.2	–0.3	–0.1	0.3	0.3	0.5	0.3	0.3	0.3	0.6
2014	0.4	0.4	0.3	0.1	0.0	0.0	–0.1	–0.3	–0.3	–0.4	–0.5	–0.5
2015	–0.8	–0.8	–0.9	–0.8	–0.6	–0.4	–0.6	–0.4	–0.6	–0.7	–0.7	–0.5
2016	–0.7	–0.8	–0.9									

Note: Based on the re-scaled first principal component of 10-year nominal term premia estimates for US, euro area, and UK bonds.

Annex 3: Proxy for World long-term expected nominal short rate

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1999	3.8	4.1	4.1	4.1	4.2	4.2	4.3	4.3	4.3	4.3	4.3	4.5
2000	4.5	4.4	4.4	4.5	4.7	4.7	4.7	4.7	4.7	4.7	4.6	4.5
2001	4.3	4.2	4.1	4.3	4.2	4.2	4.0	4.0	3.8	3.6	3.6	3.6
2002	3.6	3.7	4.0	3.8	3.9	3.8	3.6	3.6	3.4	3.4	3.5	3.3
2003	3.3	3.3	3.2	3.2	3.1	3.2	3.3	3.3	3.2	3.3	3.4	3.3
2004	3.3	3.2	3.2	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.6	3.6
2005	3.7	3.7	3.8	3.7	3.7	3.7	3.8	3.7	3.9	3.9	4.0	3.9
2006	4.0	4.0	4.1	4.1	4.2	4.3	4.2	4.3	4.3	4.3	4.3	4.4
2007	4.4	4.3	4.4	4.4	4.5	4.6	4.5	4.4	4.3	4.3	4.1	4.0
2008	3.8	3.8	3.6	3.8	4.0	4.0	4.0	3.9	3.7	3.3	2.8	2.7
2009	2.7	2.6	2.5	2.7	2.7	2.7	2.7	2.6	2.6	2.6	2.6	2.8
2010	2.6	2.6	2.7	2.6	2.5	2.5	2.5	2.4	2.5	2.5	2.5	2.6
2011	2.6	2.6	2.7	2.6	2.6	2.7	2.6	2.3	2.2	2.2	1.9	1.8
2012	1.9	1.9	2.0	1.9	1.8	1.8	2.0	2.0	2.0	2.0	2.0	2.1
2013	2.2	2.1	2.2	2.1	2.2	2.3	2.3	2.3	2.3	2.3	2.4	2.4
2014	2.3	2.3	2.3	2.4	2.3	2.4	2.4	2.3	2.4	2.4	2.2	2.2
2015	2.1	2.3	2.3	2.3	2.3	2.4	2.3	2.2	2.2	2.4	2.4	2.4
2016	2.2	2.0	2.1									

Note: Average expected short-term nominal interest rate over the next 10 years; based on the re-scaled first principal component of 10-year zero-coupon bond yields for the United States, euro area, and the United Kingdom, less the corresponding nominal term premia estimates from Annex 2.

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