Bad zero: Financial Stability in a Low Interest Rate Environment

Elena Carletti[◊] Giuseppe Ferrero[§]

18 June 2017

Abstract

The paper is divided into three parts. The first reviews the reasons behind the decline of interest rates to historical lows in the last decades. Nominal rates are decomposed into three different components (real rates, inflation expectations and premia), and each of them is analysed in detail. Particular emphasis is given to the different explanations put forward in the literature, ranging from structural to cyclical factors. Then, we analyse the implications of a persistent low interest rate environment for financial stability, focusing on the pressure on profitability of financial institutions and their current business models and search for yield. Finally, we provide a risk assessment based on ESRB (2016).

Keywords: Demographics, productivity, financial cycles, profitability, search for yields

JEL codes: E43, G2

[◊] Bocconi University and CEPR.

[§] Banca d'Italia, Economic Outlook and Monetary Policy Directorate.

This paper builds upon the contribution of the authors to the European Systemic Risk Board and the European Central Bank joint Task Force on "*Macroprudential policy issues arising from low interest rates and structural changes in the EU financial system*". The views expressed in the articles are those of the authors and do not involve the responsibility of the Bank of Italy or any other institution.

"Excuse me, what is that round and red object on the table?" It is an evening in 2016. We are sitting in a bar in Frankfurt after spending the day at a meeting of the ESRB-ECB Task Force on "Macro-Prudential Issues and Structural Change In a Low Interest Rate Environment". Close to us a group of people is engaging intensely on some matter. On their table a red object with a large hole in the center and two horns that give it a diabolical look. One guy turns and says: "This is Bad Zero!" And he starts explaining us that this strange object has appeared for a while on the stands in the city center." It represents the interest rate that banks offer on current accounts: bad zero, precisely!"

Introduction

Nominal and real interest rates have been decreasing since the mid-1980s and reached historical low levels in the aftermath of the global financial crisis. This long decline has led to intense discussions over the past few years among both policy makers and academics on the factors behind this trend.

Understanding the causes of this decline helps infer the persistence of the low interest rates environment (LIRE) in the future, and assess the implications it may have for the macroeconomic environment, in general, and for financial stability more specifically.

This decline, which involved both long and short-term nominal interest rates, is explained by the reduction of inflation expectations and inflation risk premia due in large part to the credibility of monetary policy during "the great moderation" and the slack of the economy during "the great recession", as well as by the downward trend of real interest rates and real term-premia. Several explanations have been put forward to explain the decline on these real components, ranging from "structural" to "financial-cyclical", with different implications in terms of the persistency of the process over the next years.

The "structural" explanation relies on changes in the structure and the functioning of the real side of the economy. According to Summers (2014), Eggertsson et al. (2017), Gordon (2016) and others a number of demand and supply factors – such as adverse demographic developments, falling (relative) price of investment goods, lower pace of technological innovation, rise in savings rates and scarcity of safe assets in developing countries, increasing wealth and income inequality – have led to a structural imbalance between demand for investment and supply of savings, and to the consequent reduction in equilibrium real interest rates. According to this view, the global financial crisis added further downward pressure on real interest rates. Looking forward, structural factors would continue to maintain real rates "low for long", even after the effects of the crises fade away.

The other explanation focuses on financial-cyclical factors. According to this view, deregulation of financial and credit markets, excessively expansionary monetary policies and overly optimistic expectations about future macroeconomic and financial prospects during the "great moderation" have favored an excessive increase in the supply of funds, a compression of risk premia and a reduction of interest rates. In such a context, the sharp correction in the financial cycle occurred with the outbreak of the financial crisis, followed by a persistent contraction in aggregate demand and an increase in the demand for long-term safe assets, has led to further reduction in term premia and real interest rates. Looking forward, interest rates will likely remain low for an extensive period of time but, as the deleveraging process ends and expansionary monetary policies are phased out, interest rates will return to “back to normal” levels.

A persistent LIRE (due to either structural or financial-cyclical factors) has very different implications for financial stability relative to a temporary reduction in interest rates due to business cycle recessions. In both situations, low interest rates affect financial constraints, generate externalities or lead to market imperfections that may limit the ability of the economy to reach the efficient allocation. However, in a LIRE, such effects become much more relevant: the economy operates more often under binding constraints, and both externalities and market imperfections are more pronounced. Moreover, the longer the period of low interest rates, the lower the slope of the yield curve and the higher the probability that traditional business models that rely on maturity transformation or guaranteed-return become unviable, putting at risk profitability and resilience of banks, defined-benefit pension funds and guaranteed-return life insurers. All these factors may favor excessive risk-taking, inefficient resource allocation, debt overhang and the building up of bubbles, which are usually absent during business cycle recessions.

As argued above, however, a low level of short and long-term interest rates is not the only characteristic of a LIRE: inflation, GDP growth and employment are also persistently low and exert a downward pressure on aggregate demand and on the demand of funds. When assessing financial stability risks also those aspects should be taken into account.

The objective of this paper is to discuss the implications of a low interest rate environment.[1] In doing this, we adopt a micro-macro approach. While the micro approach is crucial in order to understand the mechanisms and frictions that may generate financial stability risks when interest rates decrease, it usually focuses only on the implications of short-term (exogenous) variations in interest rates without relating them to the macroeconomic environment. By contrast, in the macro approach, interest rates are a general equilibrium concept resulting from the maximization problems of households, firms and policy makers. In this respect, while the macro approach has little focus on the different frictions, it is crucial to assess the relevance of different financial stability risks in a LIRE, depending on the factors that determine such an environment. This is the reason why in recent policy reports such as the ESRB (2016) or the IMF (2017), financial stability risks are discussed on the basis of the macroeconomic environment behind LIRE.

The paper proceeds as follows. Section 1 reviews the reasons behind the decline of nominal interest rates to historical lows and the implications in terms of persistence of the current interest rate levels. Section 2 looks at the implications of the LIRE for financial stability. The analysis identifies several categories of risks, ranging from sustainability of business models to search for yields, and

[1] The analysis is largely based on the report of the ESRB-ECB Task Force on "Macro-Prudential Issues and Structural Change In a Low Interest Rate Environment", to which we both contributed, and on the discussion in Ferrero and Neri (2017) and Ferrero, Gross and Neri (2017).

ascertains the different agents for which each risk is potentially relevant. Section 3 provides an assessment of the risks identified above. Section 4 concludes.

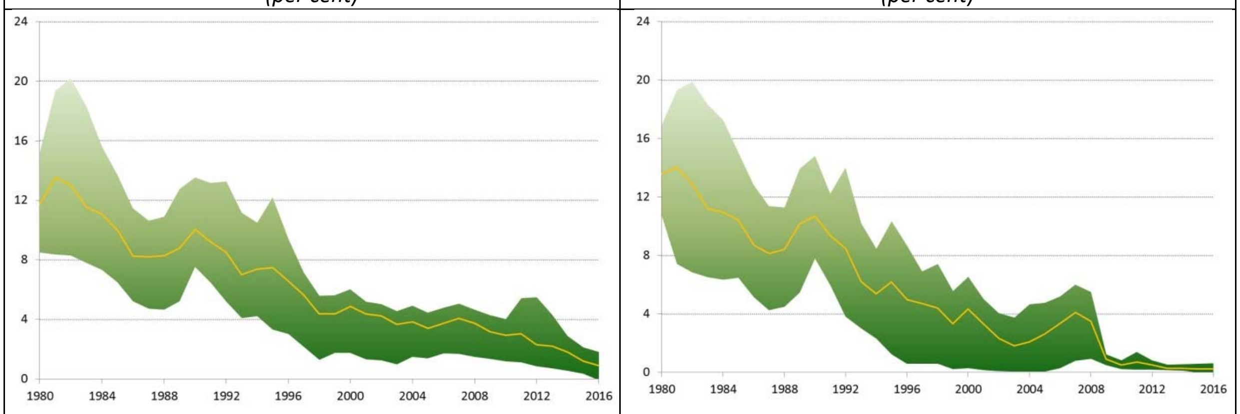
1. Identifying the causes of the low interest rates and assessing their persistence

The current macroeconomic environment is characterized by exceptionally low nominal rates in advanced economies (Figure 1). The decline of long and short-term nominal rates started in the 80s as part of a global phenomenon and accelerated with the outbreak of the global financial crisis.

In order to discuss the reasons behind this trend, we proceed in steps. We first look at the elements that define the nominal interest rates and the evolution of each component over the same sample period. Then we discuss the different explanations put forward in the literature to explain the behavior of those components and their implications in terms of the future evolution of nominal interest rates.

Figure 1 – Nominal interest rates in main advanced countries: 1980-2016

Long-term interest rates *(per cent)*	Short-term interest rates *(per cent)*



Source: European Commission, AMECO.
NOTE: The borders of the green area are the Min and Max nominal interest rates in the sample of advanced countries that includes: Germany, France, UK, Italy, Japan, US and, since 1999, the Euro area; the yellow line is the average nominal interest rate. Long-term interest rates are yields on 10-year government bonds (or on the closest maturity). Short-term interest rates are yields on 3-month deposits, or Treasury bills, depending on the period and Country.

1.1. Decomposing nominal interest rates

The (net) nominal interest rate is the monetary price that borrowers pay to lenders to use their money. As credit contracts differ in terms of (*i*) borrower's ability to repay its obligation, (*ii*) degree of liquidity (transferability) and (*iii*) maturity of the contract, the nominal interest rates that borrower j pay at time t on a credit contract with maturity z, $i_{j,t}^{z}$, can be decomposed into: a risk-free component (the theoretical rate of return of an investment with no risk of financial loss over a given period of time), $i_{RF,t}^{z}$; a risk premium component, that includes a counterparty risk premium (the extra amount of money that is required in order to bear the risk of not being repaid), $cp_{j,t}^{z}$, and a liquidity premium (to compensate for the risk of not being able to quickly transfer the contract without affecting its price), $lp_{j,t}^{z}$:

$$i_{j,t}^{z} = i_{RF,t}^{z} + cp_{j,t}^{z} + lp_{j,t}^{z} \ . \quad (1.1)$$

Absence of arbitrage in the economy also implies a relation between short and long term interest rates and between nominal and real interest rates.[2]

The long-term risk-free nominal interest rates, $i_{RF,t}^{L}$, can be decomposed into two components: the average between actual and future short-term nominal interest rates, $i_{RF,t+z}^{S}$ for $z = 0, \dots, L$, and a nominal term premium, tpi_{t}^{L}, which measures the excess return that investors require to commit to holding the long-term risk-free bond instead of a series of short-term risk-free bonds:

$$i_{RF,t}^{L} = \frac{1}{L} E_t\left[\sum_{z=0}^{L}\left(i_{RF,t+z}^{S}\right)\right] + tpi_{t}^{L} \ . \quad (1.2)$$

Finally, according to the Fisher no-arbitrage condition we may decompose the short term risk-free nominal interest rate, $i_{RF,t+z}^{S}$, into the sum of the risk-free real interest rate, $r_{RF,t+z}^{S}$, and the expected inflation, π_{t+z}; and the nominal term premia into the sum of the real term premium, tpr_{t}^{L} and the inflation risk premium, ip_{t}^{L}, which arises from the fact that investors holding nominal assets are exposed to unanticipated changes in inflation. We then have

$$i_{RF,t+z}^{S} = r_{RF,t+z}^{S} + \pi_{t+z} \quad (1.3)$$

$$tpi_{t}^{L} = tpr_{t}^{L} + ip_{t}^{L} \ . \quad (1.4)$$

Substituting (1.2), (1.3) and (1.4) into (1.1) and defining the risk premia, $rp_{j,t}^{L}$, as the sum of the four premia components described above,

$$rp_{j,t}^{L} = cp_{j,t}^{L} + lp_{j,t}^{L} + tpr_{t}^{L} + ip_{t}^{L} \ , \quad (1.5)$$

we obtain an expression for the nominal interest rate on a contract with maturity *L* which is made up by three components: the average between the current and the future expected short-term risk free interest rates, the expected inflation, and the risk premia, that is

$$i_{j,t}^{L} = \frac{1}{L} E_t\left[\sum_{z=0}^{L}\left(r_{RF,t+z}^{S}\right)\right] + E_t\pi_{t,t+L} + rp_{j,t}^{L}. \quad (1.6)$$

The following sections concentrate on the evolution of these three components over the last three decades, in order to evaluate to which extent they may have contributed to the observed decline of nominal interest rates. For those components that are not directly observable we provide also a brief description of the economic concept and the main procedures commonly used to estimate them.

1.2. Real interest rates and natural rates of interest

The real interest rate in a market economy is an equilibrium concept determined by the demand and the supply of (real) funds (Figure 2). In an overly simplified economy with no uncertainty we can think of the supply of funds as the result of the optimal saving plan of a representative household that

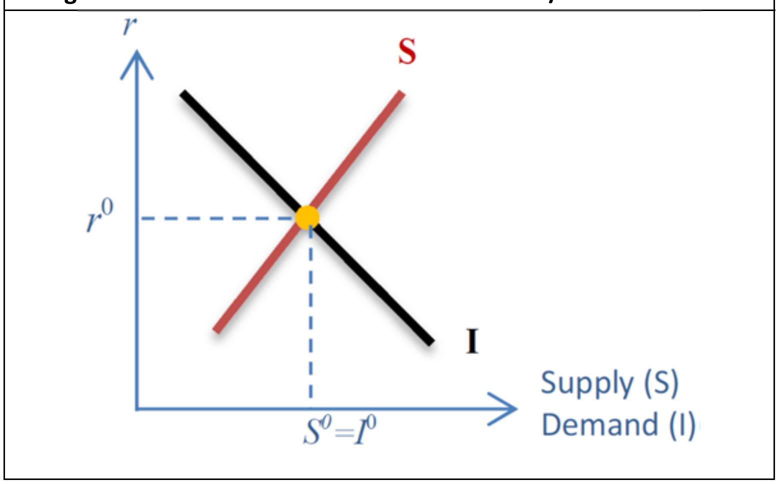
[2] When we compare short and long-term, nominal and real interest rates we are assuming that the credit contracts are similar for all the other characteristics (issuer and liquidity).

maximizes the present value of her utility in terms of current and future consumption subject to a sequence of budget constraints. The demand of funds would instead be determined by the amount of investment that maximizes profits of a firm for a given technology.

The supply of funds depends positively on nominal interest rates deflated by future inflation (as the higher the growth rate of consumer prices the larger the loss of purchasing power), while the elasticity of the supply depends on parameters characterizing the intertemporal utility function, such as the discount factor (a measure of how much people value current consumption relative to future consumption), the intertemporal elasticity of substitution (a measure of the extent to which households are willing to give up consumption today for consumption tomorrow), the level of financial wealth and the present and future discounted labour income of the household.

The demand of funds depends negatively on nominal interest rates deflated by future inflation, while its elasticity depends on parameters that characterize the production function (to a large extent parameters underlying the technological and the demographical processes) and influence the marginal product of capital per effective labor unit.

Figure 2 – The Real interest rate and the "real/structural" view

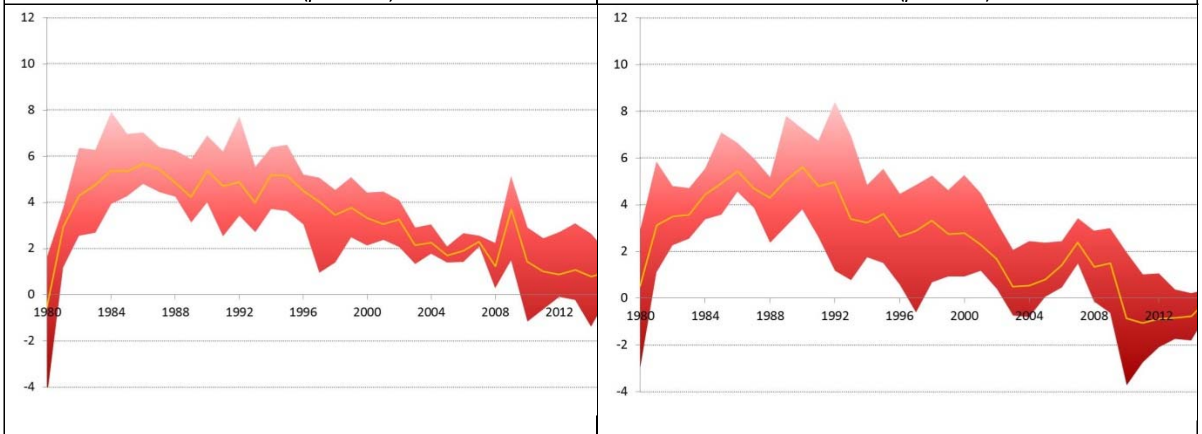


Commonly used measures for the risk-free real interest rate are obtained by deflating nominal interest rates with expected inflation obtained either from financial contracts or surveys[3]. However, since long time series of expected inflation are not always available, a common proxy for inflation expectations is either ex-post realized inflation or current inflation. Such measures of real interest rates have been decreasing since the 80s (Figure 3). This trend prevailed also with the outbreak of the global financial crisis and, in the euro area, after the sovereign debt crisis, even though in some countries, real interest rates temporarily increased.

[3] Alternatively, real interest rates may be obtained by estimating a term structure on indexed government bonds yields; however such contracts for many countries and maturities are either absent or illiquid.

Figure 3 – Real interest rates in main advanced countries

(a) Long-term interest rates (*per cent*) | (b) Short-term interest rates (*per cent*)



Source: European Commission; AMECO.
Note: Real interest rates are computed as nominal rates deflated with private consumption deflator.
The borders of the red area are the Min and Max for the sample of advanced countries that includes: Germany, France, UK, Italy, Japan, US; the yellow line is the average real interest rate.

In assessing the behavior of real interest rates over time it is common use to look also at the evolution of the natural rate of interest – which is defined as the real short-term interest rate that equates the demand and supply of funds when output is at its potential, unemployment is at its natural rate and inflation is on target – a measure of the long-run efficient level of real interest rates used to assess the monetary policy stance (an expansionary monetary policy implies a negative deviation of the market real interest rate from the natural one, while a contractionary stance leads to a positive deviation).

In the highly simplified model described at the beginning of this section, with no uncertainty, no other constraint than the intertemporal budget one and in the absence of frictions, the real interest rate would always be at its "natural" level. In models with nominal frictions (and uncertainty), the real interest rate may temporary deviate from the natural one. To the extent that the central bank is able to affect not only nominal interest rates (i.e., the lower bound constraint on nominal interest rates is not binding) but also real ones (due to the presence of nominal frictions), the central bank would lower the real interest rate below the natural rate in response to deflationary shocks in order to bring back output to its potential, unemployment to its natural level, inflation on target and the real interest rate to its natural level.

According to most of the recent analyses also the natural rate of interest decreased over the last three decades. Applying the Kalman filter to the time series of real rates and using the above definition to impose some structure to the estimating procedure, Holston, Laubach and Williams (2016) show that the natural interest rate decreased in the main advanced countries from around 3% in the 80s to close to zero in the U.S. and to negative values in the euro area in 2016. A strong decline in natural rates has been highlighted also by Curdia et al. (2015), using a more structural approach based on a dynamic stochastic general equilibrium (DSGE) model, and by Christensen and Rudebusch (2017) , using a dynamic term structure model estimated solely on the prices of inflation-indexed bonds with adjustments for real term and liquidity risk premiums.

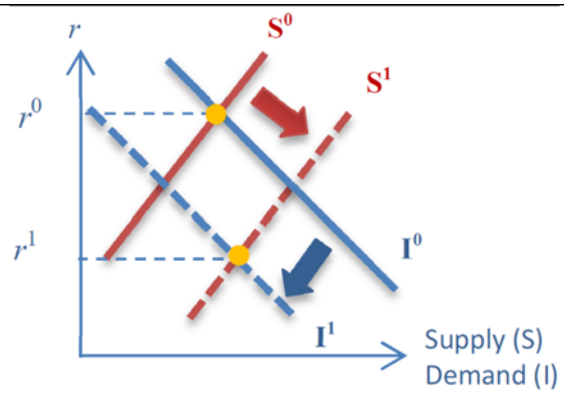
However, being the natural rate of interest an unobservable variable, there is no consensus either on how to estimate it or on its specific estimates, in particular after the outbreak of the global financial crisis. According to some analyses the sharp decline in the estimates of the natural rates between 2008 and 2016 may be overstated due to the omission of important variables and equations related to the presence of financial frictions in the estimation procedures. The strong reduction in the value of financial assets and in house prices during the global financial crisis reduced private sector income and wealth and tightened households and firms' borrowing constraints, determining a contraction of credit and aggregate demand. Since conventional models employed to estimate the natural rate do not include credit frictions, the decrease in aggregate demand would be interpreted by standard estimation procedures as a decrease in the natural rate of interest (Cukierman, 2016; Borio et al., 2016). According to others (Pescatori and Turunen, 2016 and Eggertsson et al, 2017) instead, if we take into account constraints such as the lower bound to policy rates, which limit the ability of the central banks to react to adverse shocks to inflation, the estimated natural interest rate during the financial crises would be lower than most of the estimates available in the literature.

The debate about the drivers of market real interest rates and the natural rates of interest over the past decades is on-going, in particular at the policy-making level.[4] Many explanations have been put forward in the literature, but they can be grouped into two main views: the "real/structural" and the "cyclical/financial" one.[5]

The "real/structural" view

According to this view, advanced economies suffer from a persistent imbalance resulting from an increasing propensity to save and a decreasing propensity to invest. Excessive savings act as a drag on growth and inflation, and push market and natural real interest rates downward (Figure 4).

Figure 4 – The Real interest rate and the "real/structural" view



Source: Ferrero and Neri (2017).

A number of demand and supply factors, all characterized by a high degree of persistence, have been considered: adverse demographic developments, falling relative price of investment goods, decline in investment due to missing opportunities, lower pace of technological innovation, rise in

[4] See for example IMF (2014), CEPR (2015), Council of Economic Affair (2015), and Rachel and Smith (2015).

[5] Among the "real/structural" explanations, the "secular stagnation" is the most known (Summers, 2014). As for the "financial/cyclical" explanation, Borio (2012) and Lo and Rogoff (2015) are the key references.

savings rates and relative scarcity of safe assets in emerging economies, increases in wealth and income inequality.

Demographic factors may affect real interest rates mainly through three channels (see for example Carvalho et al, 2016). First, for a given retirement age, an increase in life expectancy lengthens the retirement period and generates additional incentives to save throughout the life cycle and exert a downward pressure on real interest rates (Acemoglu and Johnson 2007; Backus et al, 2014). Second, a drop in population growth leads to a higher capital–labor ratio, which depresses the marginal product of capital and therefore the demand of investments and the equilibrium real interest rate. As growth prospects worsen, the propensity to save increases, especially among the middle-aged cohort, exerting further downward pressures on real rates (Aksoy et al., 2015). Finally, lower population growth eventually drives up the dependency ratio. Because retirees have a lower marginal propensity to save, this change in the composition of the population is akin to a "demand effect" that pushes up aggregate consumption, and puts upward pressure on equilibrium real interest rates (Favero and Galasso, 2016).

Global capital flows and the demand for safe assets also may exert a downward pressure on real interest rates. The transformation of developing countries from net borrowers to net lenders has determined an increase of the demand for safe assets issued by advanced economies and a consequent reduction of risk-free interest rates (Bernanke, 2005).

Another explanation for the low level of real interest rates focuses on the prices fall of investment goods (machines, equipment and buildings), which implies that the same amount of savings can finance more investment. However, as labour and capital are not perfect substitutes in the production of goods, the marginal productivity of an additional unit of investment decreases. The supply of investment opportunities falls, leading to a fall in the required rate of return (Thwaites, 2014).

The decline in technological innovation reduces total factor productivity and investment growth (Gordon, 2016). Lower output and productivity growth dampens the marginal product of capital and, as a consequence the real interest rate.

Finally, the contraction of real interest rates may be related to rising global inequality (Summers, 2014). As higher aggregate income shares are attributed to the households with lower propensity to consume, the interest rates decrease due to the increase in aggregate savings.

Recent analyses have tried to quantify the impact of those structural factors on real interest rates. Carvalho et al. (2016) develop and calibrate a life-cycle model to capture the salient demographic features in developed economies. Demographic trends between 1990 and 2014 reduced, ceteris paribus, the equilibrium interest rate by 1.5 percentage points. Gagnon et al. (2016) develop an overlapping-generation model with a rich demographic structure to assess the impact of the demographic changes occurred in the U.S. since the early 80s on real interest rates and real GDP growth. The model accounts for around one percentage point of the decline in both real GDP growth and the equilibrium real rate and suggests that they may remain low in a "new normal" economy. Ferrero et al. (2017), estimate a Panel VAR for the euro area countries and study the effect of demographic developments on macroeconomic variables. They conclude that if dependency ratios had remained flat, in the period 2006-2015 real short-term rates would have been higher by 0.5 p.p. on average.

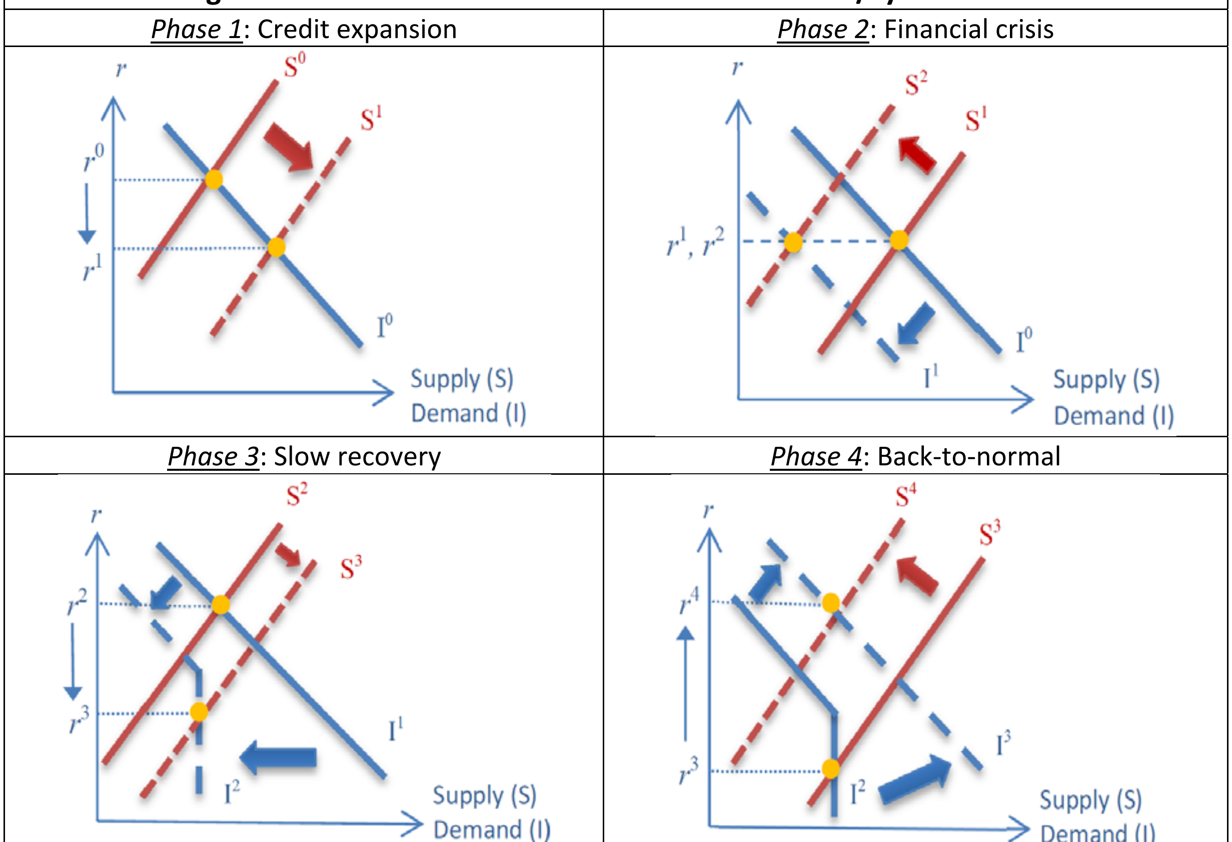
The "structural" explanation implies that also the natural interest rate has structurally declined during the last decades. This would explain why during the Great Moderation, inflation remained on target even if nominal interest rates were relatively low. During the recent years, when the natural rate further decreased, the adoption of non-standard measures was necessary in order to provide monetary accommodation after the policy rates had reached the effective lower bound.

The "financial/cyclical" view

According to this view, low real interest rates are consistent with periods of both credit expansion and credit contraction.

An extended period of steady economic growth and/or rising asset prices encourage relaxed attitudes toward leverage, deregulation in the financial sector, excessively expansionary monetary policies and overly optimistic expectations about future returns. The resulting large and persistent increase in the supply of funds compresses real interest rates and induces excessive debt accumulation (Figure 6, phase 1).

Figure 6 – The real interest rates and the "financial/cyclical" view



Source: Ferrero and Neri (2017).

As credit increases, asset prices also increase, raising their collateral value, thereby relaxing borrowing constraints and helping to expand credit and raise asset prices even more. According to Lo and Rogoff (2015) and Borio et al. (2015, 2016, 2017) this phase of the financial cycle has been observed, for example, between mid-90s and mid-2000s in the main advanced economy.

After the financial shock hits the economy, the supply and demand of funds decrease (Figure 6, phase 2). While credit reduces, the overall effect on real interest rates, in this phase, is uncertain, depending on relative effects on demand and supply (as shown in Figure 3, during the global financial crisis in some countries there was first a strong increase and then a decrease of real interest rates).

As expansionary monetary policies begins to exert a positive effect on the supply of funds, however, an extensive need for deleveraging and a high degree of uncertainty about future income dampen investment and consumption, further reducing real interest rates (Figure 6, phase 3). During this phase traditional channels of monetary policy that operate through intertemporal substitution turn out to be less effective. Even if interest rates are very low, a larger fraction of households and firms are no longer able to increase debt in order to support aggregate demand because their borrowing constraints are binding (the vertical part in the demand function in Figure 6, panel 3) or decide to reduce current demand due to the uncertainty about future income (the downward movement of the demand curve in panel 3). The result is a further reduction of real interest rates.

Concerning the effect of the deleveraging process, Rogoff (2016) argues that "*weak post-crisis growth reflects the post-financial crisis phase of a debt supercycle where, after deleveraging and borrowing headwinds subside, expected growth trends might prove higher than simple extrapolations of recent performance might suggest*". In line with this, Eggerston and Krugman (2012) formalize in a new-Keynesian framework the notion of deleveraging crises as characterized by an abrupt downward revision of views about how much debt it is safe for individual agents to have. This revision forces highly indebted agents to reduce their spending sharply, also in presence of very accommodative monetary policies.

Concerning uncertainty about future income, Bansal and Yaron (2004) show that a rise in uncertainty leads to a fall in asset prices and to an increase in precautionary saving, which reduces consumption expenditure. Basu and Bundick (2011) and Leduc and Liu (2012) show that while the increase in precautionary savings should exert a downward pressure on interest rates and output prices and thus stimulate an offsetting rise in investment, this effect does not arise in an economy with price and/or wage frictions. In such an environment prices and interest rates do not fall enough to encourage the offsetting rise in investment, and as a result, output falls. Uncertainty reduces levels of investment, hiring, and consumption, and it also makes economic actors less sensitive to changes in business conditions. This can make countercyclical economic policy less effective. For example, Bloom (2014) shows that in low-uncertainty periods, the elasticity of investment is higher compared with periods of heightened uncertainty. He concludes that the jump in uncertainty in 2008 was likely an important factor exacerbating the size of the economic contraction, "*accounting for maybe one-third of the drop in the US GDP*". Foote, Hurst, and Leahy (2000) and Bertola, Guiso, and Pistaferri (2005) show that higher uncertainty also makes consumers' durables expenditures less sensitive to demand and prices signals.

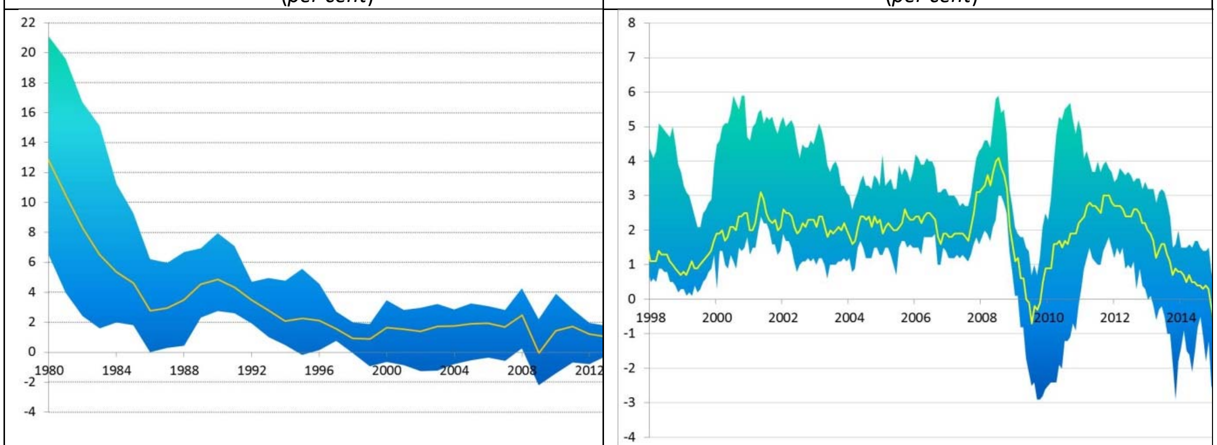
Compared with a "normal" recession, during the downturn of a financial crisis monetary policy needs to be more accommodative. Therefore, even though the natural interest rate is not affected in a permanent way under the "financial/cyclical" explanation, the risk of reaching the lower bound of policy rates and falling into a liquidity trap with persistently low inflation is high.

1.3. Inflation and inflation expectations

Inflation (and inflation expectations) also contributed to the strong decline of nominal interest rates, especially between the mid-80s and the early 90s (Figure 5, panel a). The disinflation ended in the early nineties, and until the outbreak of the global financial crisis inflation has remained stable around central banks' targets in advanced economies. After the outbreak of the global financial crisis, inflation decreased to historical low levels in all advanced countries. According to the IMF (2016), in 2015 inflation in more than 85 per cent of a sample of more than 120 economies was below the long-term expectations; about 20 percent of the countries were in deflation.

Figure 5 – Inflation in main advanced economies

(a) HICP inflation in main advanced countries (*per cent*) | (b) Inflation in euro area countries (*per cent*)



Source: European Commission, Eurostat and Bank of Italy computations.
NOTE: In Figure 5 (a) the borders of the blue area are the Min and Max of consumer price inflation for the sample of advanced countries that includes: Germany, France, UK, Italy, Japan, US; the yellow line is the average inflation. In Figure 5 (b) borders of the blue area are the Min and Max of HICP inflation for the following euro area countries: Austria, Belgium, Germany, France, Spain, Italy, Greece, Ireland, Netherlands, Portugal; the yellow line is the Euro area HICP inflation

In the euro area between 2013 and 2016, the deviation of inflation from the definition of price stability has been much more persistent and generalized across countries and items of the HICP basket than in previous cyclical downturns (Figure 5, panel b). In particular, the disinflationary phase after the sovereign debt crisis differed radically from the one that had taken place during the global financial crisis. While during both periods short-term inflation expectations declined (even though the decline after the sovereign debt crisis has been much more persistent), longer-term inflation expectations behaved differently: in 2009-10 long-term expectations remained well anchored to levels consistent with the definition of price stability, while between 2013 and 2016, there were signs of a de-anchoring of long-term inflation expectations from the level consistent with the definition of price stability.

The decline in inflation between the early 80s and the mid-90s and the period of stability in the following decade is in large part explained by improved monetary policies, which focused on maintaining stable prices, and by the stronger credibility of central banks (see Erceg and Levin, 2003, for supporting evidence).

After the outbreak of the financial crisis, several factors may instead explain the differences in the behavior of inflation in 2013-2016 with respect to the 2008-09 disinflation phase. While weakness of global demand has certainly played a key role (Ferroni and Mojon, 2016), the effective lower bound to policy rates may have also contributed to limiting the ability of monetary policy to provide the necessary monetary accommodation in the context of weakening prospects for economic activity and increasing risks of a too low inflation for too long before the launch of the APP (Conti, Neri and Nobili, 2016). The lower bound of policy rate may have also played an important role in explaining the increasing sensitivity of expectations to inflation surprises — an indicator of the degree of de-anchoring of inflation expectations – that in turns, have contributed to maintain actual inflation persistently low (IMF, 2016).

1.4. Risk premia

Risk premia include different components, which price different risks. Each component is conceptually simple to describe, but empirically difficult to estimate, as risk premia are not directly observable and numerous strategies have been developed to estimate them. The size and sign of risk premia depend on the characteristics of the security (or credit contract), the preferences of the participants to the market where the securities are traded, the constraints to the demand and the supply of funds and the type of shock hitting the economy.

In this section we focus on premia on relatively safe long-term bonds. Thus, our analysis will be centered on the term and the inflation risk premia. Even if different methodologies may yield large differences in the estimated risk premia, most of the analyses provide similar results in terms of the developments over the last three decades: both inflation and term premia have trended down since mid-80s, with the contribution of the latter to the reduction of long term interest rates being more important.

The inflation risk premium

In theoretical models where optimizing households maximize their intertemporal utility by investing in a risk-free nominal bond that pays €1 at maturity *t+k*, the price of such a bond, $q_t^{i,k}$, is given by[6]

$$q_t^{i,k} = \frac{1}{\left(1+i_{t+k}^k\right)^k} = E_t\left[\beta^k \frac{u\prime(c_{t+k})}{u\prime(c_t)} \frac{P_t}{P_{t+k}}\right] \quad (2.1)$$

where i_{t+k}^k is the *annualized* long-term interest rate on a *k*-period bond that is purchased on date *t* and matures *k* periods later, $\beta^k \frac{u\prime(c_{t+k})}{u\prime(c_t)}$ is the stochastic discount factor between period *t* and *t+k* and P_t is the price level. Assuming a CCRA utility function, $u(c_t) = \frac{c_t^{1-\sigma}}{1-\sigma}$, with risk aversion, σ, and defining the real interest rate as[7]

$$r_{t+k}^k = i_{t+k}^k - E_t\left[\pi_{t,t+k}\right], \quad (2.2)$$

the nominal interest rate can be decomposed into

[6] See for example Rudebusch and Swanson (2012).
[7] We assume a CRAA utility for simplicity; the implications would be qualitatively the same under a different utility function.

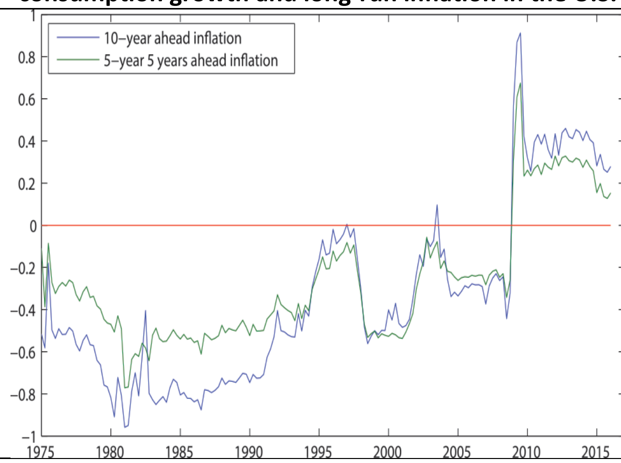
$$i_{t+k}^{k} \approx E_t\left[r_{t+k}^{k} + \pi_{t,t+k}\right] - Cov_t\left[\sigma \Delta ln(c_{t+k}), \pi_{t,t+k}\right]. \tag{2.3}$$

In periods in which consumption growth and inflation are expected to be positively correlated, the inflation premium would be negative. A positive correlation between consumption growth and inflation arises when the economy is hit by demand shocks (or when demand is expected to change persistently, due to structural changes in the economy). In a low growth and low inflation environment, nominal bonds allow investors to insure against the bad states of the world, being perfectly countercyclical. For this reason investors are willing to accept a lower return. If the correlation between consumption growth and inflation is negative, as it is the case when the economy is expected to be hit by supply shocks (or by a permanent shift in the supply), the inflation risk premium would be positive, as investors require a larger compensation to hold the nominal bond.

The empirical literature has not reached a consensus on the sign and magnitude of the inflation risk premia. Differences among estimates arise from the methodologies, sample periods and data used in the estimation. There is, however, a larger consensus on the time evolution and, in particular, on the existence of a downward trend in inflation risk premia. Concerning the U.S., Chernov and Mueller (2012) show that, independently from the model employed, the inflation risk premium has trended down since mid-80s. Similar evidence, based on a sample that includes the global financial crisis, has been documented by Chen et al. (2016), who investigate the correlation between expected long-run inflation and consumption growth since the 80s (Figure 10). The correlation has trended up over time and switched signs with the financial crisis, implying that the risk premium has trended down and turned negative after the global financial crisis. D'Amico et al. (2016) also find that the inflation risk premium estimates trended down over time and turned negative at the 5-year maturity at the peak of the global financial crisis.

The fact that the correlation between long-term inflation and output expectations, which has gradually increased since the mid-eighties, turned positive after the outbreak of the global financial crisis is consistent with the reasoning above, to the extent that the financial crisis can be interpreted as a large negative demand shock. Eggertsson (2012) shows that when policy rates reach their effective lower bound, the effects of demand shocks on inflation and output are amplified since monetary policy may be unable to offset them, while the effects of supply shocks on output are weakened because monetary policy may be unable to accommodate them. Gourio and Ngo (2016) develop a New Keynesian macroeconomic model featuring the zero lower bound (ZLB) to the nominal short-term rate and show that in normal times (i.e. sufficiently far from the ZLB) inflation risk premia are on average positive, while they are negative at the ZLB.

Figure 10 - Estimated correlations between 10-year forward consumption growth and long-run inflation in the U.S.



Source: Chen, Engstrom and Grishchenko (2016).

The term premium

In order to obtain an analytical interpretation of the term premia we apply a similar reasoning to the one used for the inflation-risk premia. The annualized long-term interest rate r_{t+k}^{k} in a long-term bond could be derived as

$$q_t^{r,k} = \frac{1}{\left(1+r_{t+k}^{k}\right)^{k}} = E_t\left[\beta^k \frac{u\prime(c_{t+k})}{u\prime(c_{t+k-1})} \frac{u\prime(c_{t+k-1})}{u\prime(c_{t+k-2})} \cdots \frac{u\prime(c_{t+1})}{u\prime(c_t)}\right] \tag{2.4}$$

or in recursive terms

$$q_t^{r,k} = E_t\left[\beta^k \frac{u\prime(c_{t+1})}{u\prime(c_t)} q_t^{r,k-1}\right]. \tag{2.5}$$

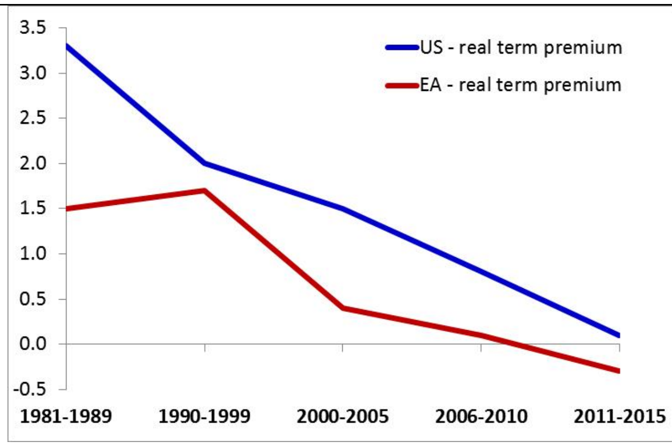
Assuming a CRRA utility function, the long-term real interest rate on a risk-free bond could be decomposed into:

$$r_{t+k}^{k} \approx \frac{1}{k}\sum_{j=1}^{k} E_t\left[r_{t+j}^{1}\right] + \frac{1}{k}\sum_{j=1}^{k-1} Cov_t\left[\sigma\Delta ln\left(c_{t+j}\right), ln\left(q_{t+j}^{r,k-j}\right)\right]. \tag{2.7}$$

The above expression states that in an economy populated only by risk neutral agents (σ=0) the *k*-period interest rate is just the average expected short-term rate over the maturity period; in that case, the "expectations theory" of the term structure postulates that the return from investing in a *k*-period bond is equal to the expected return from investing in a sequence of *k* one-period bonds.

In absence of risk neutrality, the second term on the right-hand side of eq. (2.7) is a risk premium, which may arise because on every date, the investor may wish to liquidate rather than continue holding the long-term bond. After *j* periods have elapsed, the *k*-period bond is a (*k* – *j*)-period bond. If the price of a (*k* – *j*)-period bond tends to be high when the growth rate of consumption is low, this results in a negative value of $Cov_t\left[\sigma\Delta ln\left(c_{t+j}\right), ln\left(q_{t+j}^{r,k-j}\right)\right]$, which lowers the long-term interest rate, other things equal. In this case, the period *t+j* contribution to the risk premium is negative because for that maturity the bond provides consumption insurance, being the bond price higher when consumption falls. In the opposite case, in which the covariance is positive, the bond raises the riskiness of consumption, contributing to a higher value of the long-term interest rate. To sum up, the risk premium depends on the discounted sum of the covariances between the bond price and consumption growth during the remaining life of the bond.

Figure 11 – Estimated 10-year term premia and components



Source: Hördahl, Sobrun and Turner (2016).

If highly risk averse investors such as insurance companies or pension funds are interested in maintaining long-term government bonds in their portfolio for a long period of time, they may be willing to accept a lower yield on those securities so to avoid the risks associated with rolling over their investment in a series of short-term bonds. Depending on the size of the demand of such investors over the total outstanding amount of such securities, the term premium will take different values and, especially in periods of relative scarcity of long-term government bonds, the term premia may become even negative.

Empirical evidence documents a downward trend in term premia since mid-80s both in the euro area and the US (Hordal, 2008, Gürkaynak and Wright, 2012, D'Amico et al., 2016, Campbell et al., 2017). Hördahl et al. (2016) estimate that between 1980 and 2016 the real term premium has declined by over 300 basis points in the U.S. and by almost 200 in the euro area (Figure 11).

1.5. From the explanations to the scenarios about real and nominal interest rates in the future

Looking forward, structural factors may keep real interest rates "low for long" time, even after the effects of the global financial crisis fade away. The persistence would depend on the factors behind such developments. While, for example, demographics developments are clearly highly persistent, technological progress and developments on productivity are very difficult to predict and the debate about their persistence is open. Building on the European Commission projections for dependency ratios, Ferrero et al. (2017) claim that the foreseen ageing of the population is likely to dampen economic growth and continue exerting downward pressure on short-term real interest rates, which would remain close to zero on average in the period 2016-2027. Favero et al. (2016) show that the common persistent component of the term structure of interest rates is related to the ratio of middle-aged to young population, and conclude that real interest rates will remain negative only for the next few years but will recover afterwards rather than continuing their secular decline. Rachel and Smith (2015) provide a decomposition of the decline of global real interest rates and conclude that the global neutral rate may remain low and perhaps settle at (or slightly below) 1% in the medium to long run.

Under the financial cycle explanation, interest rates will remain low for an extensive period of time, but will eventually return to pre-crisis levels as the deleveraging process ends and expansionary monetary policies are phased out. This conclusion, however, can be disputed. The reason is that financial crises that are characterized by deleveraging process, tight credit conditions, large uncertainty and changes in regulation may have long-lasting effects on potential output and real interest rates. Financial crises may create a "missing generation" effect: new firms that would have been created never appear. This reduces growth as new businesses increase competition, by innovating and capturing market shares from some less-productive incumbents. Since firm dynamics are slow, the initial effects of lower entry on aggregate variables may be small, but very persistent (see for example, Bloom, 2009, and Gourio, Messer, and Siemer, 2016). Moreover, in response to large and negative shocks to aggregate demand, firms reduce job creation, leading to a higher unemployment risk to which households respond by increasing precautionary savings, further reducing aggregate demand (Ravn and Sterk, 2016). Finally, financial crises and changes in financial regulation may have as a side effect a long-lasting restrictive effect on the financing of most innovative and risky projects, therefore permanently reducing technological innovation, factor productivity, potential GDP and real interest rates (Reifschneider et al., 2015). Therefore, it cannot be excluded that a very long period of low real interest rate may be needed before interest rates will return back to normal levels also under the financial cyclical explanation.

Two more remarks should be done before analyzing the financial stability implications of a LIRE. First, the structural and financial/cyclical views have been used mainly to explain the decline in real interest rates. However, it should be clear from the description of the evolution of the other components of the nominal interest rates that the same two explanations may also be behind the decline of inflation and inflation expectations since the financial crisis and both term and inflation risk premia since the mid-eighties. This implies that the same scenarios that we have described for the real interest rates going forward (low for long vs back to normal), may apply also for those components. In particular, the future evolution of inflation and inflation expectations will be related to the evolution of the natural rate of interest and the ability of central banks to adapt their policy framework to an environment where the room for manoeuvre of policy rates may be more limited than in the past if the natural rate will remain very low and the lower bound of policy rates may be hit. Concerning the inflation risk and the term premia, we have seen that conventional asset pricing theory suggests that risk premia are equal to the conditional covariance of the investors' stochastic discount factor with the future price of a short-term risk–free bond or with inflation. In turn, this depends on consumers' characteristics (preferences and information) and constraints that may limit their decisions and, in equilibrium, on the characteristics of the production function. Changes in structural parameters that are behind the structural view and imbalances in the demand and supply of funds related to the financial cycle may well have driven the evolution of those conditional covariances over the past decades and continue to drive the evolution of risk premia in the future.

A final remark concerns the ability of the economic system and of policymakers to adapt (and react) to the two scenarios. Fiscal and structural policies may favor a return of interest rates to higher levels also in the structural scenario. At the same time, regulation may play an important role in avoiding in the future excessive credit expansion, thus reducing the probability and the persistency of financial crises.

2. Financial stability risks in a LIRE

In order to discuss the financial stability implications of a persistent LIRE, determined by either structural or financial-cyclical factors, it should first be clarified what we mean with financial (in)stability.

2.1. Definition of financial stability

While price stability, the main objective of monetary policy, is conceptually easy to define in terms of a growth rate of a price index over a given horizon, there is no single, widely accepted definition of financial stability.

Here we consider financial stability as an environment where the supply of financial intermediation services – the provision of means-of-payment and store-of-value services that facilitate intertemporal resource allocations by transforming, pricing, and allocating economic and financial uncertainties and risks – allows the economy to grow along a stable path. From this perspective, we can define financial instability as the situation where problems in the financial system lead to a significant impairment in the supply of financial intermediation services with consequent detrimental impact on real economic activity and aggregate economic welfare (see also Rosengreen, 2011).

Based on this definition, we make three considerations.

First, a strong reduction of financial institutions' profitability, a rise in asset-price volatility or a sharp correction in risk pricing are not per se synonymous of financial instability, as they may be the result of the efficient working of market forces or the efficient incorporation of new information with no or positive effects on real economic activity.

Second, aggregate shocks are clearly the main potential sources of financial instabilities, since they hit the entire economy. However, given the high degree of financial system interconnectedness, also an idiosyncratic shock that hits one financial institution can be transmitted to other intermediaries and pose threats to financial stability.

Finally, the analysis of risks for financial stability requires both a micro and a macro approach. The former is relevant to examine the frictions and the mechanisms determining the behavior of individuals, firms and financial institutions. The latter is important to take account of the potential risks related to the interconnectedness between the financial system and the rest of the economy.[8]

2.2. LIRE and financial stability

The effects of LIRE on financial stability have to be analyzed in conjunction with the surrounding macroeconomic scenario. In fact, low interest rates are likely to be detrimental to financial stability only if they remain low for a prolonged period of time. When this is the case, their beneficial effects in terms of reduced funding costs, greater easiness to borrow for consumption and investment, and increased asset prices tend to vanish or being dominated by various vulnerabilities related to pressures on profitability, risk taking incentives and mispricing. Such vulnerabilities may impair the provision of financial services and credit, thus affecting the path of real economic activity.

We now describe the main mechanisms that may generate financial stability risks related to a LIRE. In doing this, we refer to some of the most recent academic papers on the effects of savings glut for financial fragility and volatility in financial markets, without providing a comprehensive literature review.

Profitability

The most immediate effect of a LIRE concerns the profitability of financial institutions, especially those characterized by marked maturity mismatches between assets and liabilities.

In the short run a reduction of interest rates are likely to boost profitability. To the extent that the yield curve does not flatten, lower rates translate into lower funding costs, higher asset and collateral values and lower default risk on new or repriced old loans.[9] This in turn boosts equity values of financial institutions, thus attracting investors' funding and favoring credit lending.

In the medium to long run, however, the positive effects of low interest rates are likely to fade way, threating financial stability through an increase of solvency risk. As the economy enters into a scenario where short-term nominal rates approach the effective lower bound and long term interest rates continue decreasing, the slope of the term structure of interest rates is likely to change. As seen in Section 1, long term rates are given by the sum of the expectations on the development of short term rates, inflation expectations and risk premia as determined by inflation and term premia. All these components have trended down since mid-80s. This had led to a flattening of the yield curve, as also discussed in IMF (2017).

A prolonged LIRE reduces the margins obtainable from maturity transformation, thus negatively affecting the overall profitability of financial institutions. Several mechanisms are at play. First, the flattening of the yield curve reduces the margins that institutions such as banks can obtain

---

[8] This approach is for example present in Gertler and Kyiotaki (2015) where "*balance sheet conditions not only affect the cost of bank credit, they also affect whether runs are possible. In this respect one can relate the possibility of runs to macroeconomic conditions and in turn characterize how runs feed back into the macroeconomy*."

[9] This type of mechanism resembles the idea of financial accelerator, where a reduction in interest rates relax the borrowing constraint thus reducing their default risk (Bernanke and Gertler, 1989; Bernanke, Gertler and Gilchrist, 1996).

between long term assets and short term liabilities. This reduces the net interest margin, which currently represents the most important component of banks' overall income. While this effect influences mostly new issuances of loans and other credit facilities, the use of floating rates on loans may also reduce the margins attainable from current assets. Second, the presence of an effective lower bound on nominal rates creates rigidity in the funding rates such as deposit rates or bond returns. This effect contributes to reduce the profitability of financial institutions, in particularly those that are more leveraged and deposit funded or grant floating rate loans. Third, a prolonged LIRE makes it difficult to earn high returns, particularly on fixed-income related investments, which causes problems for business models with large guaranteed values of long-term liabilities such those of guaranteed-return life insurers and defined-benefit pension funds.

An example of the trade-off deriving from a reduction in interest rates in the short and long run is analysed in Brunnermeier and Koby (2017). They show the existence of a reversal rate, that is of a level of interest rates beyond which a further reduction "reverses" its short term intended consequence in terms of improved growth and support to economic activity, thus becoming contractionary for lending and the macro-economy. The reversal rate depend on the quantity and the maturity of banks' asset holdings with fixed interest rates, the extent of interest rates pass-through to loan and deposit rates, and the capital constraints banks face. As rates start to decline, banks with long term assets paying fixed interest payments benefit in terms of increased profitability. This boosts the equity values of banks, thus relaxing also their regulatory capital constraints. As these assets mature, however, banks experience a reduction in net interest income, in particular when the zero lower bound is hit. As long as banks have spare capital, banks start substituting the matured loans with riskier ones in an attempt to still strive high profitability. However, when their risk taking ability is constrained, banks are unable to undertake the risk level required to compensate the decline in net interest income. This generates a fall in profitability and consequently in lending. The negative wealth effect can be further amplified. As banks' capital constraints are tightened, banks may be forced to dismiss risky loans and scale up safe asset holdings. This further reduces banks' profitability and consequently the amount of credit they grant.

Another channel through which a LIRE may contribute to negatively affect the profitability of financial institutions is the so-called mechanism of "debt deflation" (Fisher, 1933). When the effective lower bound on nominal interest rates become binding, the central bank can no longer reduce the policy rate in response to shocks that push inflation below its target. In terms of the monetary stance, the shock is *de facto* equivalent to an unwanted tightening of monetary conditions. This tends to increase the real value of debt and its service, thus reducing the profitability of financial institutions through an increase in the default risk of their borrowers.

Search for yield

A prolonged LIRE might affect the risk perceptions and risk aversion of financial institutions and thus induce them to engage in "search for yield" by increasing their risk profile in an attempt to boost returns. This may be due to a relaxation of credit standards on lending or increased investment in lower-quality asset classes. Search for yield may worsen the solvency of financial institution through an increase in credit risk and amplify booms and busts through mispricing and uncertainty on asset fundamental values.

A relaxation of credit standards is typically associated with a reduction in the monitoring activity of borrowers by financial institutions. In models such as Allen et al. (2011) and Dell'Ariccia et al. (2014), banks' monitoring incentives depend positively on the spread between loan and deposit rates, and on the amount of equity in banks' capital structure. When a reduction in interest rates is associated with a reduction in the spread due to either a flattering of the yield curve or the presence of an effective lower bound on deposit rates, banks' monitoring incentives reduce and the credit risk of their loan portfolio increases. Moreover, to the extent that they are constrained, a reduction in interest rates induces banks to increase leverage, thus worsening further their incentives to monitor.[10]

A reduction in interest rates due to savings gluts mechanism can also worsen the fragility of financial institutions by increasing their incentive to lever accompanied by a decrease in the supply of good quality assets. As studied in Bolton et al. (2016), an increase in savings has initially a positive effect as long as it maintains the appropriate incentives for good asset origination. However, as the savings glut continues and risk spreads are compressed, worse quality assets are produced leading to fragile banks' balance sheets due to an accumulation of non-performing assets if accompanied by a further increase in leverage.

Another mechanism leading to search for yield in a LIRE characterized by a mismatch between nominal and real rates concerns money illusion. In a context where nominal rates are low, agents may be unable to look through inflation and focus on the real returns on investment. This implies that agents may decide to irrationally overcome these through imprudent investments that promise higher nominal rates. This may lead excessive investment in risky assets and mispricing of risk.

A related mechanism leading to search for yield and mispricing in a LIRE relates to myopic behavior and financial illiteracy, in particular among households. Agents are often short-sighted and focus on the short term, neglecting the future. Low rates may induce agents to use floating-rate contracts without considering that interest rates could increase in the future. Also, agents tend to focus on returns without distinguishing between risk-free and risk-premium components. This may explain why some agents do not understand that if they want a fixed return from a portfolio that was bought in a period of high interest rates, the composition of this portfolio must be changed by increasing the proportion of risky assets.

Search for yield may affect financial stability mainly through mispricing and excess volatility risks. A recent example of this risk is analyzed in Martinez-Miera and Repullo (2017), who present a model where a LIRE generates booms and busts through a reduction in banks' monitoring incentives. In the spirit of Holmstrom and Tirole (1997), banks are assumed to intermediate between entrepreneurs and investors and to monitor entrepreneurs' projects. For a given fixed aggregate supply of savings, in equilibrium banks exert monitor and finance riskier entrepreneurs. A reduction of interest rates and spreads induced by an increase in savings reduces bank's incentives to monitor, thus

[10] Importantly, this strand of literature only focuses on lenders' incentives to monitor and disregard the positive effects that lower interest rates may have for borrowers' ability to repay or their incentives.

reducing also the market share of the banking system relative to alternative source of funding. This result rationalizes the creation of bubbles and busts. In a dynamic setting, the accumulation of savings in a boom leads to lower real interest rates and spreads. In turn this increases risk taking, thus generating a bust eventually. In a bust savings are reduced, thus pushing up again interest rates and spreads.

A final remark concerns the effects of low interest rates on the so called "risk taking channel" of monetary policy. As described in the macroeconomic literature, low interest rates influence risk-taking primarily in two ways (see, e.g., Borio and Zhu (2008) and Gambacorta (2009)). First, low interest rates may increase incentives for asset managers to take on more risks in search for yield for contractual, behavioral or institutional reasons (Rajan, 2005). For example, institutions may increase risk in an attempt to meet the promised nominal returns on long term contracts that were initiated in periods of higher interest rates. Coherently with what described in this section, the main issue of LIRE is therefore a protracted period of low interest rates and the corresponding flattening of the yield curve.

Second, short-term interest rates largely determine the term spread, which in turn affects the profitability of the marginal loan and the future net interest margin of the bank. Thus, "*continued low short rates imply a steep yield curve for some time, higher net interest margin in the future, and hence higher [supply of credit and] risk-taking capacity of the banking sector*" (see, for example, Adrian and Shin 2010). It follows that, to the extent that in a LIRE the yield curve is flatter – rather than steeper - because both the term premia and the future short term interest rates are expected to remain low for a protracted period, the supply of credit in the future will be lower, thus reducing the risk taking capacity of the banking sector. Moreover, according to recent empirical evidence macroeconomic conditions play a crucial role in assessing the relevance of the risk-taking channel. Dell'Ariccia et al (2017) show that banks' risk-taking (measured as riskiness of new loans) in response to a decrease of short-term nominal interest rates "*is more pronounced in states with economies that are less in sync with the nationwide business cycle*". In other words a LIRE where also output, income and inflation are persistently low, the relevance of the risk-taking channel should be limited.

3. Risk assessment in the macroeconomic scenarios

In the previous section we have analyzed the mechanisms through which a LIRE may pose financial stability risk. In doing this, we have abstracted from the drivers of low interest rates, as described in Section 1. In order to assess the risks for financial stability, however, it is crucial to look at such drivers for two main reasons. First, the persistence of LIRE depends on whether structural or financial cyclical explanations are predominant. As explained in Section 1, to the extent that they are determined by structural factors such as demographic trend and low productivity, nominal and real interest rates are likely to remain "low for long". In such a scenario, the risk premia are likely to remain low; the yield curve is likely to remain flat; and consumption, investment and output would stagnate. By contrast, to the extent that financial-cyclical explanations prevail, interest rates will eventually be "back to normal" levels, although the process may take a long time. In such a scenario, also the other main macroeconomic variables including output and investment will resume.

As stated in ESRB (2016), the relevance of financial stability risks differs across the two macroeconomic scenarios. Overall, such risks appear to be less substantial in the back to normal scenario mainly because of increasing economic growth should mitigate vulnerabilities.

Risks in Low for Long scenario

Under the low for long scenario, the resilience of several financial sectors and the sustainability of business models are likely to weaken. Financial institutions offering longer-term return guarantees such as guaranteed-return life insurance and defined-benefit pension fund sectors and those relying on traditional maturity transformation such as banks may experience strong profitability pressures leading to solvency risk.

A prolonged LIRE affects banks' balance sheets in various ways. First, it reduces net interest income, since the flattening of the yield curve and the existence of a lower bound on deposit reduce the net interest margin, while the low growth limits the possibility of expanding lending volumes. Second, a prolonged LIRE may relax credit standards through reduced monitoring and screening incentives, thus worsening the quality of loan portfolios. Third, asset quality may deteriorate as banks would face incentives to forbear non-performing loans extended in the past at higher lending rates, as new lending yields lower interest income. All these factors would contribute to misallocation of capital and lower profitability. Consequently, banks' ability to accumulate capital would be reduced because of lower retained earnings and difficulty to increase outside capital, raising viability concerns for weakly capitalized banks.

The main concerns related to profitability involve certain types of non-credit institutions with long term liabilities, in particular guaranteed-return life insurers and defined-benefit pension funds. The LIRE makes it difficult to earn sufficiently high asset returns to meet guaranteed values of long-term liabilities created in previous periods of higher interest rates. This puts pressure on the solvency of these institutions, thus pushing them to modify their business models towards unit-linked investments. While it may be beneficial for financial stability, the offer of the new products shifts interest rate risk to end-investors, i.e., policyholders and plan members, while the financial sector takes on the sole intermediation role of distributing investment products, with limited risk and loss participation.

In the low for long scenario, search for yield is mostly generated by profitability pressures, which induce financial institutions to reduce their credit standards and agents to boost their investment in low quality assets in search for higher returns. Moreover, there may be the risk of an abrupt price reversal in financial markets. This may occur, for example, when agents pursuing myopic behavior or being driven by money illusion reassess risk premia, thus leading to a significant re-pricing. Although this price reversal could negatively impact financial stability across several sectors, a low for long scenario characterized by low growth prospective and thus low demand for investments is unlikely to generate an excessive volatility.

Risks in Back to Normal scenario

The main risk in this scenario relates to the steeping of the yield curve after interest rates have remained low for a long period. Such a steeping could adversely affect profitability both through a reduction of interest rate margins and an increase in credit risk. Increased spreads are expected to have a negative effect on the profitability of financial institutions relying on maturity transformation if they have adjusted their business models during the period of low interest rates. For example, banks that have been originating new long-term loans at low fixed rates would face losses from reduced margins when interest rates rise. At the same time rising interest rates could also lead to a materialization of credit risk and increasing impairments, particularly if financial institutions granted floating rate loans to worse creditworthy borrowers.

Concerning volatility, interest rate increases are expected to drive asset prices down (mainly bond prices) with possible liquidity pressures if higher funding costs give rise to asset disposals. This may lead to re-pricing with consequent feedback effects on financial stability through reduced demand of credit and potential higher credit risk through impairment. This negative effect may however be countervailed by a rise in economic growth and thus improved debt sustainability.

4. Discussion

The persistence of the low interest rate environment has spurred an increasing interest among policy makers and academics on the effects that such an environment may have on financial stability.

The contributions emerged in the recent years have recognized the difference between a short and a long period of low interest rates, and have concluded that persistence of LIRE is essential in assessing financial stability risks through its effects on the flattening of the yield curve and the compression of interest margins. These lead to profitability pressures and consequent changes in agents' behavior toward riskier investments.

Some important issues remain open. First, despite the focus on the persistence of the LIRE, there is still not enough emphasis on the potential different implications of the single components of interest rates (real interest rates, inflation expectations, risk premia) for financial stability. For example, most studies do not distinguish between nominal and real interest rates, although the two may (at least temporarily) diverge and affect agent's resilience and behavior differently.

Second, there is not yet a clear understanding of which factors (demographic trends, technological innovation, regulation, etc.) drive the LIRE. Even for the same level of interest rates, the various factors affect differently demand and supply of funds in the economy, and thus may have different influence on the components of interest rates.

Finally, there is no consensus in which scenario the economy is. In fact, both the structural and the financial cycle view may be consistent with the current low level of interest rates. However, the two views will have different implications concerning the persistence of LIRE going forward. This uncertainty may itself contribute to downward pressure on interest rates and to increase vulnerabilities, while at the same time making any policy response more challenging.

References

Aksoy, Y., Basso, H. S., Grasl, T. and R. P. Smith (2015). "*Demographic structure and macroeconomic trends*", CESIFO Working Paper, No. 5872.

Allen, F., E. Carletti and R. Marquez (2011), "Credit market competition and capital regulation", *Review of Financial Studies,* 24(4), 983–1018.

Backus, D., Cooley, T. and E. Henriksen (2014), "Demography and low-frequency capital flows", *Journal of International Economics*, Vol. 92, Supplement 1, S94-S102.

Bean, C. Broda, C., Ito, T. and R. S. Kroszner (2015). "*Low for Long? Causes and Consequences of Persistently Low Interest Rates*", Centre for Economic Policy Research and International Center for Monetary and Banking Studies.

Bansal R. and Yaron A. (2004), "Risks for the Long Run: A Potential Resolution of Asset Pricing Puzzles", *Journal of Finance*, Vol. 59(4), 1481-1509.

Basu S. and Bundick B. (2011), "Uncertainty Shocks in a Model of Effective Demand", Boston College Working Papers in Economics, No. 774, Boston College Department of Economics.

Bernanke, B. and M. Gertler (1989), "Agency Costs, Net Worth and Business Fluctuations", *American Economic Review*, 79, 14-31.

Bernanke, B., M. Gertler and S. Gilchrist (1996), "The Financial Accelerator and the Flight to Quality", *The Review of Economics and Statistics*, 78, 1-15.

Bertola, G. Guiso, L. and Pistaferri L. (2005), "Uncertainty and Consumer Durables Adjustment", *Review of Economic Studies*, Oxford University Press, Vol. 72(4), 973-1007.

Bloom, N. (2014), "Fluctuations in uncertainty", The Journal of Economic Perspectives, vol. 28(2), Spring 2014, 153-175.

Bolton, P., T. Santos, and J. Scheinkman (2016), "Savings Glut and Financial Fragility", https://ssrn.com/abstract=2743700.

Borio, C. (2012), "The Financial Cycle and Macroeconomics: What have we learnt?", BIS Working Papers 395, Bank for International Settlements.

Borio, C., Kharroubi, E., Upper, C., Zampolli, F. (2016), "Labour Reallocation and Productivity Dynamics: Financial Causes, Real Consequences", BIS Working Papers 534, Bank for International Settlements.

Borio, C. Juselius, M., Disyatat P. and Drehmann M. (2017), "Monetary Policy, the Financial Cycle and Ultra-low Interest Rates", PIER Discussion Papers 55, Puey Ungphakorn Institute for Economic Research.

Borio, C., Gambacorta, L., and Hofmann, B. (2015), "The influence of monetary policy on bank profitability", BIS Working Papers, No. 514, Bank for International Settlements.

Borio, C. and H. Zhu (2008), “Capital Regulation, Risk Taking and Monetary Policy: A Missing Link in the Transmission Mechanism?”, BIS Working Papers, 268.

Brunnermeier, M. K., and Y. Koby (2017), “The Reversal Interest Rate: The Effective Lower Bound of Monetary Policy”, mimeo, Princeton University.

Campbell J.Y., Sunderam A., Viceira L. M. (2017), “Inflation Bets or Deflation Hedges? The Changing Risks of Nominal Bonds”, forthcoming in *Critical Finance Review*.

Carvalho, C. V., Ferrero, A. and F. Nechio (2016). “*Demographics and real interest rates: inspecting the mechanism*”, European Economic Review, Vol. 88(C), 208-226.

Council of Economic Advisers (2015). “*Long-term interest rate: a survey*”.

Chen, A.Y, Engstrom E.C. and Grishchenko, O.V. (2016), “Has the inflation risk premium fallen? Is it now negative?”, FEDS Notes. Washington: Board of Governors of the Federal Reserve System, April 4, 2016.

Chernov, M. and Mueller, P. (2012) “The Term structure of inflation expectations”, Journal of Financial Economics, Vol. 106(2), 367-394.

Christensen, J., and Rudebusch, G., (2017), “A New Normal for Interest Rates? Evidence from Inflation-Indexed Debt”, Federal Reserve Bank of San Francisco, Working Paper 2017-07.

Conti, A. M., Neri S. and Nobili A. (2017), “Low inflation and monetary policy in the euro area”, European Central Bank, Working Paper Series, No. 2005.

Cukierman, A. (2016), “Reflections on the natural rate of interest, its measurement, monetary policy and the zero lower bound”, CEPR, DP 11467.

Curdia, V., Ferrero A., Ngc G. C. and A. Tambalotti (2015), “Has U.S. monetary policy tracked the efficient interest rate?”, *Journal of Monetary Economics*, Vol. 70, 72–83.

D'Amico, S. Kim, D. H. and Wei M. (2016), “Tips from TIPS: the Informational Content of Treasury Inflation-Protected Security Prices” Finance and Economics Discussion Series, Divisions of Research & Statistics and Monetary Affairs, Federal Reserve Board, Washington, D.C.

Dell’Ariccia, G., L. Laeven and R. Marquez (2014), “Real interest rates, leverage and bank risk taking”, *Journal of Economic Theory*, 149, 65-99.

Dell’Ariccia, G., L. Laeven and G. Suarez (2017) “Bank Leverage and Monetary Policy’s Risk-Taking Channel: Evidence from the United States”, *Journal of Finance*, 72(2), 613-654.

Eggertsson, G. B. (2012), “Was the New Deal Contractionary?”, *American Economic Review*, Vol. 102, 524-55.

Eggersston, G.B., Mehrotra, N.R., Robbins, J.A. (2017), “A Model of Secular Stagnation: Theory and Quantitative Evaluation”, NBER Working Paper No. 23093.

Eggertsson, G. B. and Woodford M. (2003) ‘‘The Zero Bound on Interest Rates and Optimal Monetary Policy,’’ Brookings Papers on Economic Activity, 1, 212–219.

Erceg, C. J., and Levin, A.T. (2003), "Imperfect credibility and inflation persistence", *Journal of Monetary Economics*, Elsevier, vol. 50(4), 915-944.

ESRB, (2016), “Macroprudential policy issues arising from low interest rates and structural changes in the EU financial system”, ESRB Report.

Favero, C. A. and V. Galasso (2016). “*Demographics and the secular stagnation hypothesis in Europe*”, in F. Caselli, M. Centeno and J. Tavares (eds.), After the Crisis: Reform, Recovery, and Growth in Europe, Oxford University Press, Oxford.

Ferrero, G., Gross, M., Neri, S., (2017), “Secular stagnation, demographic developments and low interest rates”, Bank of Italy, Working Paper, Forthcoming.

Ferroni, F., and Mojon, B., (2016), “Domestic and Global Inflation”, mimeo.

Foote, C. Hurst, E., and Leahy, J. (2000), “Testing the (S, s) Model”, *American Economic Review*, vol. 90(2), pp. 116-119.

Gagnon, E. B. K. Johannsen and D. Lopez-Salido (2016), “Understanding the New Normal: The Role of Demographics”, Federal Reserve Board, Finance and Economics Discussion Series, No. 2016-080.

Gambacorta, L. (2009), “Monetary Policy and the Risk-Taking Channel”, BIS Quarterly Review, December.

Gertler, M. and N. Kyotaki (2015), “Banking, Liquidity and Bank Runs in an Infinite Horizon Economy", *American Economic Review*, 105(7), 2011-2043

Goodhart, C.A.E. (2006), “A framework for assessing financial stability?”, *Journal of Banking and Finance*, 30, 3415–3422.

Gordon, R.J., (2016), “The Rise and Fall of American Growth: The U.S. Standard of Living since the Civil War”, Princeton University Press Ed.

Gourio F. and Ngo, P. (2016), “Risk Premia at the ZLB: a Macroeconomic Interpretation”, Federal Reserve Bank of Chicago.

Gourio, F., Messer, T. and Siemer M. (2016), “Firm Entry and Macroeconomic Dynamics: A State-level Analysis”, *American Economic Review: Papers and Proceedings*, Vol. 106(5), 214-218.

Gürkaynak, R.S. and Wright, J.H., (2012), “Macroeconomics and the Term Structure”, *Journal of Economic Literature*, Vol. 50(2), 331-67.

Holmstrom, B. and J. Tirole (1997), “Financial Intermediation, Loanable Funds and the Real Sector," *Quarterly Journal of Economics*, 112(3).

Holston, K., Laubach, T. and Williams, J.C. (2016), "Measuring the natural rate of interest: International trends and determinants", Working Paper Series 2016-11, Federal Reserve Bank of San Francisco.

Hördahl, P., Sobrun, J. and Turner, P. (2016), "Low long-term interest rates as a global phenomenon", BIS Working Papers, No. 574.

Hördahl, P. (2008), "The inflation risk premium in the term structure of interest rates", BIS Quarterly Review, Bank for International Settlements, September.

IMF (2014), "Perspectives on global real interest rates", World Economic Outlook, Ch. 3

IMF (2016). World Economic Outlook, October.

IMF (2017), "Low Growth, Low Interest Rates, and Financial Intermediation", Chapter 2 of the April 2017 Global Financial Stability Review.

Leduc, S. and Liu, Z. (2012), "Uncertainty Shocks are Aggregate Demand Shocks", Federal Reserve Bank of San Francisco, Working Paper 2012-10.

Lo, S. and Rogoff, K. (2015), "Secular stagnation, debt overhang and other rationales for sluggish growth, six years on", BIS Working Papers, No. 482.

Martinez-Miera, D. and R. Repullo (2017), "Search for yield", *Econometrica*, 85, 351-378

Pescatori, A. and J. Turunen (2016), "Lower for longer: The neutral rate in the U.S.", IMF Economic Review, Vol. 64(4), 708-731.

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

Ravn, M. and Sterk, V. (2016), "Macroeconomic fluctuations with HANK and SAM: An analytical approach", CEPR Discussion Paper No. 11696.

Reifschneider, D., Wascher, W., and Wilcox, D., (2015), "Aggregate Supply in the United States", IMF Econ Review, 63, 71.

Rogoff, K. (2016), "Debt Supercycle, Not Secular Stagnation", Progress and Confusion: The State of Macroeconomic Policy, Cambridge: MIT Press, 19-28.

Rosengreen, E. (2011), "Defining Financial Stability, and Some Policy Implications of Applying the Definition, Keynote Remarks at the Standford Finance Forum Graduate School of Business, Standford University, available at https://www.bostonfed.org/news-and-events/speeches/defining-financial-stability-and-some-policy-implications-of-applying-the-definition.aspx

Summers, L.H., (2014), "U.S. Economic Prospects: Secular Stagnation, Hysteresis, and the Zero Lower Bound", Business Economics, Vol. 49, No. 2.