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Markus Demary and Michael Hüther

When Low Interest Rates Cause Low Inflation

A new theory of interest rates, the Neo-Fisherian theory, predicts a low inflation rate due to a central bank's low interest rate. After several years of near-zero interest rate policies and low and even negative inflation rates in the eurozone and in the US, this theory gained momentum in academic circles. Indeed, central banks have had a hard time reaching their inflation targets. This paper argues that it is not the low central bank policy rate which causes low inflation but rather the low equilibrium real interest rate, the economy's real interest rate under full employment and stable prices, in combination with the zero lower bound on nominal interest rates, which restricts the effectiveness of monetary policy and causes low inflation. In order to stabilise inflation in the medium term, higher equilibrium real interest rates are necessary. Since monetary policy cannot move the equilibrium real interest rate, structural policies are needed.

Ever since central banks embarked on their near-zero interest rate policies and their large-scale asset purchase programmes, inflation hawks have predicted high and unsustainable inflation rates for the future. Reality has proved them wrong. Up to now, we have seen trends towards deflation rather than inflationary pressures. The US inflation rate had its most recent peak in September 2011 at 3.8 per cent, while eurozone inflation last peaked at 3.0 per cent in November 2011. Both inflation rates have steadily fallen since then, reaching their low points in January 2015 with values of -0.2 per cent in the US and -0.6 per cent in the eurozone. Inflation rates have only improved slightly since then. Most recently, in October 2015, the inflation rate was 0.2 per cent in the US and 0.1 per cent in the eurozone and hence far below their medium-term target values of approximately two per cent (see Figure 1).

Of course, one major driver of this global disinflationary process is the remarkable reduction in the prices of oil and other important raw materials. However, there has been a decline not only in headline inflation but also in core inflation, which excludes energy and food (1.1 per cent in October 2015 in the eurozone). Despite a slight increase in core inflation compared to the first half of 2015 (0.6 per cent), the ongoing decline in the oil price affects the overall price structure and price level in the eurozone (due to the trickle-down effect via relative prices and wage

negotiations). However, central banks do not like the core inflation concept due to its insufficient transparency.

All in all, it seems that central banks are experiencing difficulties in reaching their inflation targets. Contrary to the past, it is not high inflation causing central bankers headaches but inflation rates which seem to be stuck at low values with a tendency towards deflation. Realising that the conventional inflation measures overstate the ongoing increase of the price level by 0.5-1.0 percentage points, central banks decided to fix the inflation target not close to zero but close to two percent, thereby incorporating a safety margin to guard against deflationary risks. Even in times of "normal" inflation, i.e. in line with the inflation target, studies show that a target above one per cent should be adequate in this sense.¹

Why monetary policy contributes so little to inflation

The determinants of inflation can be deduced from the aggregate supply relationship as it is given in Galí² and De Grauwe:³

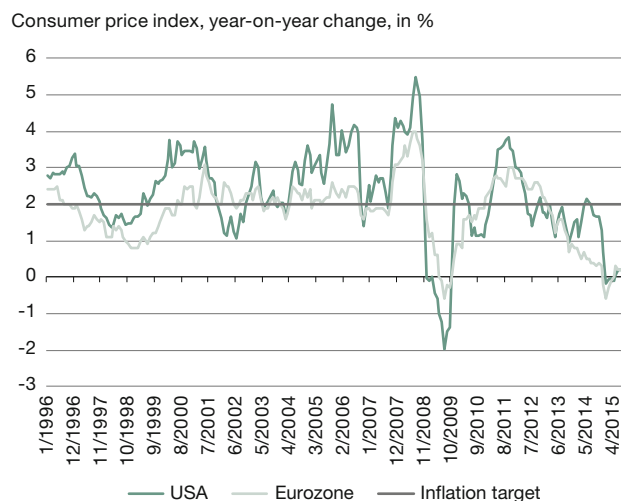
$$\pi_t - \pi^* = \alpha(\pi_{t-1} - \pi^*) + (1 - \alpha)(E_t \pi_{t+1} - \pi^*) + \beta y_t + \varepsilon_t, \alpha \in (0, 1), \beta > 0, \quad (1)$$

- 1 See ECB: The ECB's monetary policy strategy, Press Release, 8 May 2003, and O. Issing: Evaluation of the ECB's monetary policy strategy, Presentation, 8 May 2003.
- 2 J. Galí: Monetary policy, inflation, and the business cycle: An introduction to the new Keynesian framework, Princeton 2008, Princeton University Press.
- 3 P. De Grauwe: The scientific foundation of dynamic stochastic general equilibrium (DSGE) models, in: Public Choice, Vol. 144, No. 3, 2010, pp. 413-443; P. De Grauwe: Animal spirits and monetary policy, in: Economic Theory, Vol. 47, No. 2-3, 2010, pp. 423-457; P. De Grauwe: Booms and busts in economic activity: a behavioral explanation, in: Journal of Economic Behavior and Organization, Vol. 83, No. 3, 2012, pp. 484-501.

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Figure 1
Inflation rates trend downwards



Sources: European Central Bank; Federal Reserve Bank of St. Louis.

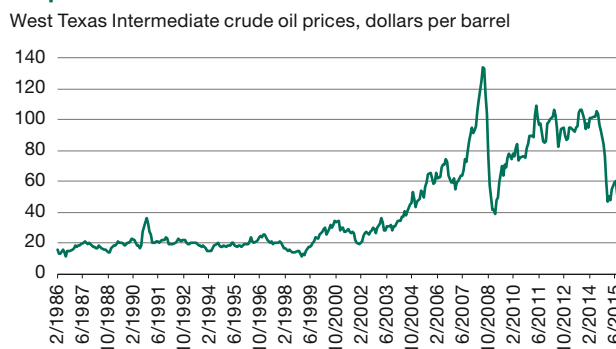
where π_t is the current rate of inflation, π_{t-1} is the inflation rate in the previous period, π^* is the central bank's inflation target, $E_t \pi_{t+1}$ is the expected inflation rate in the next period, y_t is the output gap and ε_t is the aggregate supply shock. According to this equation, inflation will exceed its long-term target value if, *ceteris paribus*, at least one of the following conditions is met:

- the rate of inflation exceeded its target value in the recent past, i.e. $(\pi_{t-1} - \pi^*) > 0$
- the public expects inflation to exceed its target value in the future, i.e. $E_t \pi_{t+1} - \pi^* > 0$
- the economy is overheating, and thus the output gap (the deviation of output from potential output) is positive, i.e. $y_t > 0$
- there are negative supply shocks, e.g. oil price shocks, ε_t .

Currently, none of these conditions are met. On the contrary, the US and eurozone inflation rates have remained below their target values since March 2013.

Additionally, in both the US and the eurozone, inflation expectations lie below the inflation target. The Eurozone Survey of Professional Forecasters yields aggregated inflation expectations of 1.3 per cent for 2016 and 1.6 per cent for 2017, figures which lie below the European Central Bank's (ECB) inflation target of close to but below two per cent. In addition, the ECB staff projections lie below the Survey of Professional Forecasters inflation outlook. The US Federal Reserve projects 1.7-1.9 per cent inflation

Figure 2
Oil price shocks



Source: Federal Reserve Bank of St. Louis.

for 2016 and 1.9-2.0 per cent for 2017, which is also a pessimistic inflation outlook, since the Fed's inflation target is defined as a medium-term average inflation rate of two per cent, which means that US inflation has to overshoot two per cent in the distant future for the Fed to meet its target.

Furthermore, output gaps are still negative, with US actual output 2.4 per cent below potential output and eurozone output 2.7 per cent below potential.

Finally, there were positive aggregate supply shocks due to declining oil prices. West Texas Intermediate crude oil reached \$105.79 per barrel at its recent peak in June 2014 but has since depreciated to \$42.87 per barrel as of August 2015 (see Figure 2).

Although several factors can lead to low inflation, the question arises why central banks' large-scale asset purchases and ultra-low interest rates have contributed so little to inflation dynamics and been unable to stem the risks of deflation.

One explanation could be that monetary policy is not expansionary enough, although policy rates are near zero and central banks' balance sheets are larger than ever. Another explanation could be that monetary policy instruments have recently lost their power to affect inflation. A third explanation, known as the Neo-Fisherian theory, claims that inflation is low because interest rates are low and that inflation will rise only when central banks begin to target higher policy rates.⁴

⁴ J. Cochrane: Monetary policy with interest on reserves, in: Journal of Economic Dynamics and Control, Vol. 49, 2014, pp. 74-108; J. Cochrane: Whither Inflation?, 31 August 2015, The Grumpy Economist; S. Schmidt-Grohé, M. Uribe: The making of a great contraction with a liquidity trap and a jobless recovery, NBER Working Paper No. 18544, 2012.

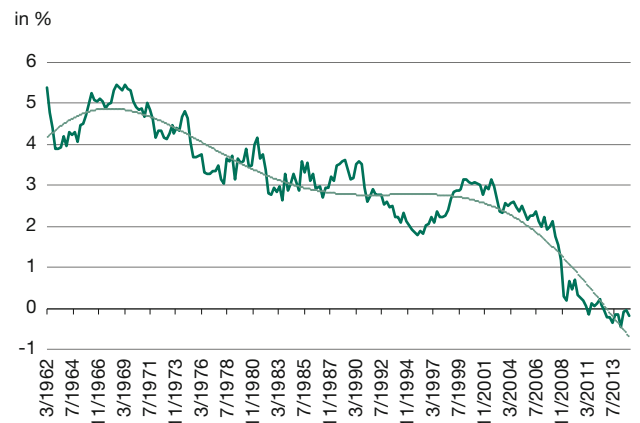
The Neo-Fisherian theory turns Irving Fisher's theory of interest rates, which explains movements in interest rates by movements in expected inflation, on its head by reversing the standard inflation-to-interest rates causality, claiming instead that the causality runs from interest rates to inflation. In simple words, this theory states that monetary policy cannot move the equilibrium real interest rate, which is the interest rate that would prevail under full employment and stable prices. Thus, under higher central bank interest rates, inflation is the only economic variable that can help to restore the long-run economic equilibrium, at least as long as sovereign debt is sustainable. The rationale behind this theoretical result is that forward-looking economic agents deduce a low inflation target from a prolonged period of low central bank interest rates, which leads to low inflation expectations and consequently materialises in low inflation.⁵ This theoretical result, however, stands in contrast to the efforts of the Federal Reserve and the ECB trying to reach their unchanged explicit inflation targets while policy rates are stuck at the zero lower bound and inflation expectations worsen.

In contrast to Cochrane⁶ and Schmidt-Grohé and Uribe,⁷ who argue that the central bank's policy rate has to increase for inflation to increase, we argue in this paper that it is the equilibrium real interest rate which has to increase for monetary policy to leave the zero lower bound constraint and for inflation expectations and inflation to stabilise.

The equilibrium (or natural) real interest rate is unobservable in reality, but it was estimated by Laubach and Williams⁸ and is continuously updated by the authors and published on John Williams' homepage at the Federal Reserve Bank of San Francisco (see Figure 3). This real interest rate concept, which goes back to the Swedish economist Knut Wicksell, defines the real interest rate by equilibrating investment and savings at full employment and stable prices. It is the economy's long-run real interest rate on capital goods, which can be different from the inflation-adjusted yields on financial assets in the short run. Since monetary policy is neutral in the long run, it cannot move the equilibrium real interest rate. It can only move the inflation-adjusted yields on financial assets in the short run by changing its policy interest rate or by

- 5 M. Garcia-Schmidt, M. Woodford: Are low interest rates deflationary? A paradox of perfect foresight analysis, Presentation Slides, Conference on Deflation, Sveriges Riksbank, 2015.
- 6 J. Cochrane: Monetary policy ..., op. cit.; J. Cochrane: Whither Inflation? ..., op. cit.
- 7 S. Schmidt-Grohé, M. Uribe, op. cit.
- 8 T. Laubach, J. Williams: Measuring the natural rate of interest, in: The Review of Economics and Statistics, Vol. 85, No. 4, 2003, pp. 1063-1070.

Figure 3
Estimated equilibrium real interest rate and its trend in the US



Source: Federal Reserve Bank of San Francisco.

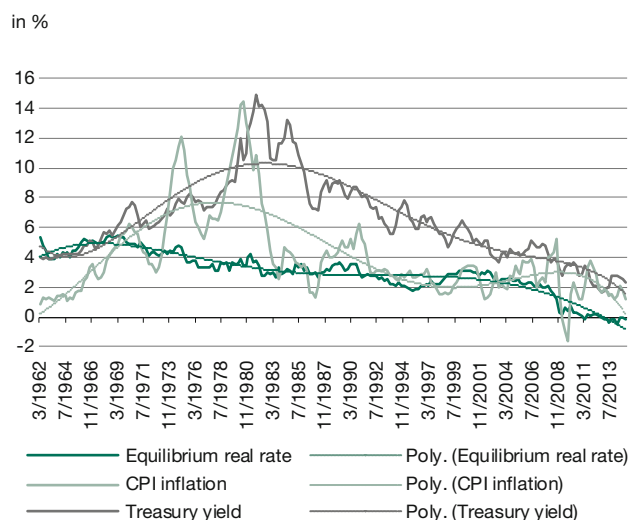
purchasing or selling financial assets. In the language used in yield curve modelling, the equilibrium real interest rate can be seen as a level factor to all bond yields in the economy, i.e. the equilibrium real interest rate determines the level around which the yields on financial assets fluctuate in the short run.⁹ Since monetary policy cannot move the equilibrium real interest rate, inflation-adjusted interest rates on sovereign or corporate bonds are only affected cyclically by monetary policy.¹⁰

Although neglected by academic research during the time of the "Great Moderation", the equilibrium real interest rate is again attracting attention from academics.¹¹ As a level factor, it has important implications for monetary policy, since it defines the average interest rate level of the economy, which can be a constraint to monetary policy at the zero lower bound for nominal interest rates.

Figure 4 yields additional evidence for the declining real interest rate as a determinant and constraint to nominal interest rates. It can be seen that the trend in yields on ten-year US Treasury bonds was mostly driven by inflation and thus by monetary policy in the past. Since approximately 1996, however, the trend has been driven by

- 9 See G.D. Rudebusch, T. Wu: A Macro-Finance Model of the Term Structure, Monetary Policy and the Economy, in: Economic Journal, Vol. 118, No. 530, 2008, pp. 906-926; and M. Demary: Yield curve responses to market sentiments and monetary policy, in: Journal of Economic Interaction and Coordination, online first, September 2015.
- 10 Ibid.
- 11 L. Summers: Reflections on the 'New Secular Stagnation Hypothesis', in: C. Teulings, R. Baldwin (eds.): Secular stagnation: facts, causes, and cures, 10 September 2014, voxEU.org; C. Weizsäcker: Public debt and price stability, in: German Economic Review, Vol. 15, No. 1, 2014, pp. 42-61.

Figure 4
Trends in US interest rates and inflation

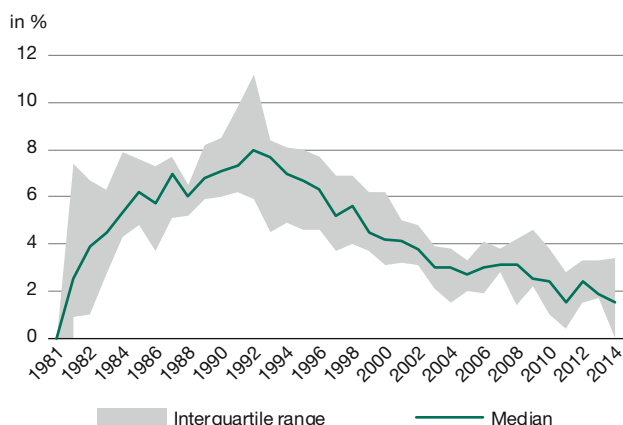


Sources: Federal Reserve Bank of St. Louis; Federal Reserve Bank of San Francisco; Cologne Institute for Economic Research.

the equilibrium real interest rate and hence by a factor mostly independent of monetary policy. The equilibrium real interest rate has shown a declining trend since approximately 1965, while the treasury yield and inflation both first trended upwards and then downwards, which was mostly due to the oil price shocks in the 1970s and the disinflationary monetary policy of then Fed chairman Paul Volcker. Since approximately 2005, inflation has had a flat trend, which corresponds mostly to an inflation target of two per cent. But instead of staying flat, as the inflation target would suggest, the treasury yield has continuously trended downwards, as has the equilibrium real interest rate. Summing up, the most recent trend in the Treasury yield is only partly due to monetary policy. It is also due to a downward trend in the equilibrium real interest rate. Since the equilibrium real interest rate is a level factor to all interest rates in the economy, the low equilibrium real interest rate seems to restrict the conduct of monetary policy.

From Figure 5 we can infer that the median real interest rate on long-term bonds as well as the 25 per cent and 75 per cent quantiles are declining for the industrialised economies, indicating that declining real interest rates and the zero lower bound problem for monetary policy are not exceptional to the US and the eurozone and will possibly become a problem for many other countries. Estimates by the Bank of England economists Rachel and Smith show that the global real interest rate declined by four percentage points in the last 25 years to a value close to zero, mostly due to increasing global sav-

Figure 5
The secular decline in long-term interest rates in advanced economies



Note: Countries included are Australia, Belgium, Canada, Switzerland, Germany, Spain, Finland, France, the United Kingdom, Greece, Italy, Japan, Norway, Portugal, Sweden, the United States.

Sources: World Bank; Cologne Institute for Economic Research.

ings and declining global investments.¹² Summers¹³ and Weizsäcker¹⁴ predicted this development based on the demographics of ageing societies. This has an impact on the trend of productivity as well as on the dominant time preference in society. When future needs become not only more important but also more valued, then a close-to-zero real interest rate is in line with the traditional theory of interest.¹⁵ Another factor is the changing role of emerging markets due to lower investment activity and the savings glut.

Policy rates have to be seen in relation to the equilibrium real interest rate, with monetary policy only being expansionary when the inflation-adjusted policy rate is below the equilibrium real interest rate, and restrictive when the inflation-adjusted policy rate is above the equilibrium real interest rate. With the US federal funds target rate at 0.00 to 0.25 per cent and the ECB's main refinancing rate at 0.05 per cent, both central banks' monetary policies seem to be expansionary at first sight (Figure 6) but are actually restrictive or at best neutral when compared to the equilibrium real interest rate (Figure 3).

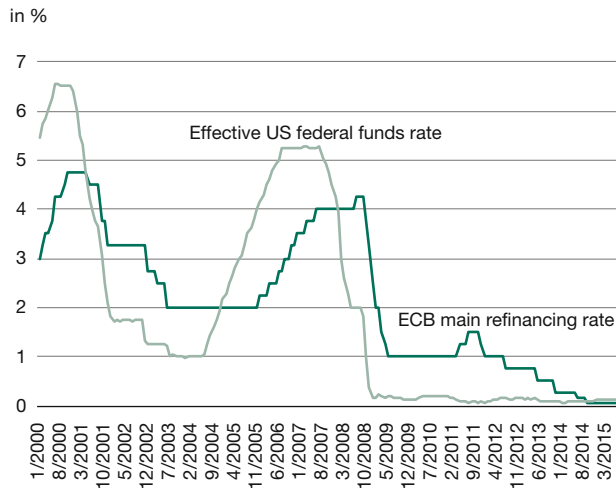
12 L. Rachel, T. Smith: Drivers of long-term global interest rates – can changes in desired savings and investment explain the fall?, 28 July 2015, Bank Underground.

13 L. Summers, op. cit.

14 C. Weizsäcker, op. cit.

15 Ibid.

Figure 6
Central banks' policy interest rates at the zero lower bound



Sources : European Central Bank; Federal Reserve Bank of St. Louis.

The zero lower bound problem can be seen from the aggregate demand relationship as given in Galí¹⁶ and De Grauwe:¹⁷

$$y_t = \gamma y_{t-1} + (1 - \gamma) E_t y_{t+1} - \theta (i_t - E_t \pi_{t+1} - r^*) + \rho_t, \gamma \in (0, 1), \theta > 0,$$

where i_t is the central bank's policy interest rate, r^* is the equilibrium real interest rate and ρ_t is the aggregate demand shock. Note that the central bank's policy interest rate cannot fall below zero, i.e. it is restricted by the zero lower bound. The equilibrium real interest rate can, however, be negative, as can be seen from Figure 2. Low or even negative equilibrium real interest rates bring the central bank closer to the zero lower bound and restrict its conduct of monetary policy.

As long as the zero lower bound is not binding, a central bank can react to a normal recession by lowering its real policy interest rate $i_t - E_t \pi_{t+1}$ below the equilibrium real interest rate, r^* , thus stimulating aggregate demand. Inflationary pressures then arise from a positive output gap. In the case of a binding zero lower bound, the central bank cannot cut its policy rate below zero, even if it is necessary to stabilise the economy. Hence, the central bank's potential to stimulate aggregate demand is limited at the

zero lower bound.¹⁸ In case of a zero equilibrium real interest rate and a binding zero lower bound, conventional monetary policy cannot prevent aggregate demand from falling when deflationary expectations arise,

$$-E_t \pi_{t+1} > 0.$$

In the case of a negative equilibrium real interest rate, worsening inflation expectations can be sufficient for aggregate demand to fall.¹⁹

When we move from a partial equilibrium analysis to a general equilibrium analysis, we come to the result that a low or even negative equilibrium real interest rate as well as a binding zero lower bound for the central bank's policy rate lead the public to expect that the central bank has lost control over aggregate demand and thus inflation, which leads the public to expect deflation. Deflationary expectations worsen aggregate demand, which will materialise in actual deflation. Eggertson and Woodford suggested that central banks have to stabilise inflation expectations when their policy rates hit the zero lower bound.²⁰ The ECB's survey of professional forecasters revealed expected inflation rates of only 1.3 per cent for 2016 and only 1.6 per cent for 2017. Although the public's inflation outlook improved after the ECB started its large-scale asset purchase programme in the beginning of 2015, inflation expectations improved too little, causing the ECB to announce increases in the volume and the length of its programme, if necessary, at its press conference in September 2015.

Taking all developments together – declining equilibrium real interest rates, central bank interest rates at the zero lower bound as well as worsening inflation expectations – it seems that the low equilibrium real interest rates restrict monetary policy and lead to low and even negative inflation rates.

Why higher real interest rates can stabilise inflation and how real interest rates can rise

In light of a negative equilibrium real interest rate and the zero lower bound on the nominal central bank rate, the Neo-Fisherian theory, which states that inflation rises when interest rates rise, can lose its counter-intuitiveness when it is expressed as a theory of the equilibrium real

16 J. Galí, op. cit.
 17 P. De Grauwe: The scientific ..., op. cit.; P. De Grauwe: Animal spirits ..., op. cit.; P. De Grauwe: Booms and busts ..., op. cit.

18 M. Demary, M. Hüther: Does the ECB's unconventional monetary policy endanger the exit from the low interest rate environment?, IW Policy Paper No. 7, 2015.
 19 Ibid.
 20 G. Eggertson, M. Woodford: The zero bound on interest rates and optimal monetary policy, in: Brookings Papers on Economic Activity, Vol. 1, 2003, pp. 139-211; G. Eggertson, M. Woodford: Optimal monetary policy in a liquidity trap, NBER Working Paper 9968, September 2003.

interest rate and inflation. Instead, it implies that inflation is low since the equilibrium real interest rate is low and it predicts inflation to normalise when the equilibrium real rate increases.

Let us examine an instance of a higher equilibrium real interest rate rather than a higher central bank rate. In this situation, conventional monetary policy can be expansionary, since the inflation-adjusted policy rate can be lower compared to the equilibrium real interest rate without being constrained by the zero lower bound. Inflation expectations would improve, since the public would no longer believe conventional monetary policy to be constrained. Unconventional monetary policies would no longer be needed, at least in the medium term. And the central bank policy rate could also rise as inflation improves. It seems that a higher equilibrium real interest rate is key for monetary policy to exit from low inflation, low interest rates and unconventional monetary policy measures.

The analysis above has revealed that a low equilibrium real interest rate restricts the conduct of monetary policy by bringing the central bank's policy rate too close to the zero lower bound. The US Federal Reserve and the European Central Bank are currently restricted by this zero lower bound and have therefore switched to unconventional monetary policy measures like large-scale asset purchases and forward guidance. In the case of persistently low or even negative equilibrium real interest rates, these unconventional monetary policy measures will become the new normal. Low or even negative equilibrium real interest rates might be problematic for the conduct of monetary policy. Higher rates are therefore necessary for solving the zero lower bound problem and for preventing it from becoming a permanent challenge for monetary policy.

That leads us to the question of how the real interest rate could be increased. Since monetary policy cannot move the equilibrium real interest rate, it is structural policies that are needed here. Policy makers have to address the determinants of the real interest rate, like productivity, demographic trends and low infrastructure investment. Up to now, it seems that economic policy lacks a convincing answer to this challenge. We see surprisingly low productivity figures despite the global trend towards digitisation, which is supposed to provide a boost to productivity. Furthermore, the ageing in industrialised countries is no longer counterbalanced by the emerging economies because of severe economic problems and governance deficiencies in the latter (middle-income trap). Therefore, the hypothesis is not unfounded that the real interest rate restriction will affect monetary policy for a longer time.