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Natural Interest rate: uncertainties and policy implications

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- **Structural factors explain the secular decline in the natural interest rate**
- **Although the natural interest rate will edge up, it will remain below historical average**
- **Monetary policy normalization will be achieved with a low federal funds rate**

Monetary policy and the natural interest rate

Ever since the Federal Reserve started to increase interest rates in December 2015, the Federal Open Market Committee (FOMC) has indicated that if economic conditions evolve as expected, the pace of normalization would be gradual and the return of the federal funds rate to its long-run level would take some time. After four 25 basis points (bp) increases market participants speculate how many more interest rate hikes remain.

From a theoretical perspective, the long-run level of the federal funds rate is equal to the sum of the equilibrium real rate of interest (also referred to as the natural or neutral interest rate) plus long-run expected inflation. The natural interest rate is such at which real GDP is equal to potential output and prices are stable. Therefore, if the Fed raises interest rates to their long-run level, monetary policy would be neutral and, all else equal, economic growth would neither overheat or slow down.

However, the natural interest rate is unobservable and thus it has to be estimated. Between 1960 and 2007, the federal funds rate averaged 6.1%, inflation[1] 3.6% and the ex-post real interest rate 2.4%. Meanwhile, between 2008 and 2017, these averages were 0.4%, 1.6% and -1.2%, respectively. According to the latest FOMC Summary of Economic Projections, the median forecasts for the federal funds rate –currently at 1.1%- and inflation in the long-run are 3% and 2%, respectively. This implies that a return of inflation back to 2% and the economy achieving full employment would require increasing the federal funds rate over the next two years by 200bp to 225bp, assuming a neutral interest rate of around 1%. This reflects a sharp deviation from both the historical average and recent trends, and suggests that Fed officials expect a transition to a new equilibrium path that is significantly lower than in the pre-crisis period but higher than in recent years. This view is also shared by many economists some of whom have described this environment as the *new normal*.

However, this endeavor not only carries risks but is also requires a narrow confidence interval for the estimates of the neutral interest rate. If the Fed increases the real federal funds above the natural level, it risks slowing down economic

[1] Measured as the year-over-year percentage change in the core PCE price index

growth. Alternatively, if the Fed keeps real federal funds below their neutral level, the economy could overheat and inflation spike out of control.

Estimating the real equilibrium interest rate can yield different results. For example, differences in the median estimates between semi-structural state-space, dynamic stochastic general equilibrium and time-varying parameter vector autoregressive models could be as wide as 100bp, with bands of more than 400bp at the 90% confidence levels. Moreover, there is no consensus on the factors that explain the apparent sharp decline in equilibrium real interest rates after the 2008 financial crisis, the likelihood that this rate will edge back up nor the level that will prevail after the Fed achieves monetary policy normalization.

In fact, some overlapping-generation models suggest that both economic growth and real interest rates will remain low for decades due to slower labor force and population growth. This view aligns with Samuelson's (1958) consumption-loan model, who argued that the neutral interest rate would be equal to the rate of population growth. According to the Census Bureau, between 2018 and 2030, annual working age population growth will average 0.3%. This is one-fifth the average rate between 1960 and 2007. Applying this markdown in population growth to the historical average real rate of interest would imply an equilibrium rate close to 0.5%.

In this scenario, the pace of increases in the federal funds rate would be more muted than currently anticipated by the FOMC. In fact, according to the federal funds futures market, the Fed will only increase rates between 50bp and 75bp by June 2020. Given that expected inflation from Treasury securities is around 1.6%, the implied real interest rate is between 0.1% and 0.4%. Not surprisingly, some economists have called for massive fiscal spending as a way to boost demand and increase potential output, or eliminate paper money and pay negative interest rates on deposits (Krugman, 2013).This view stems from the idea that in an environment where nominal interest rates are constrained by the zero lower bound, monetary policy cannot bring real interest rates down enough to reignite investment and offset disinflationary pressures, and thus secular stagnation (Hansen, 1939) becomes the norm.

Estimating the equilibrium real rate of interest

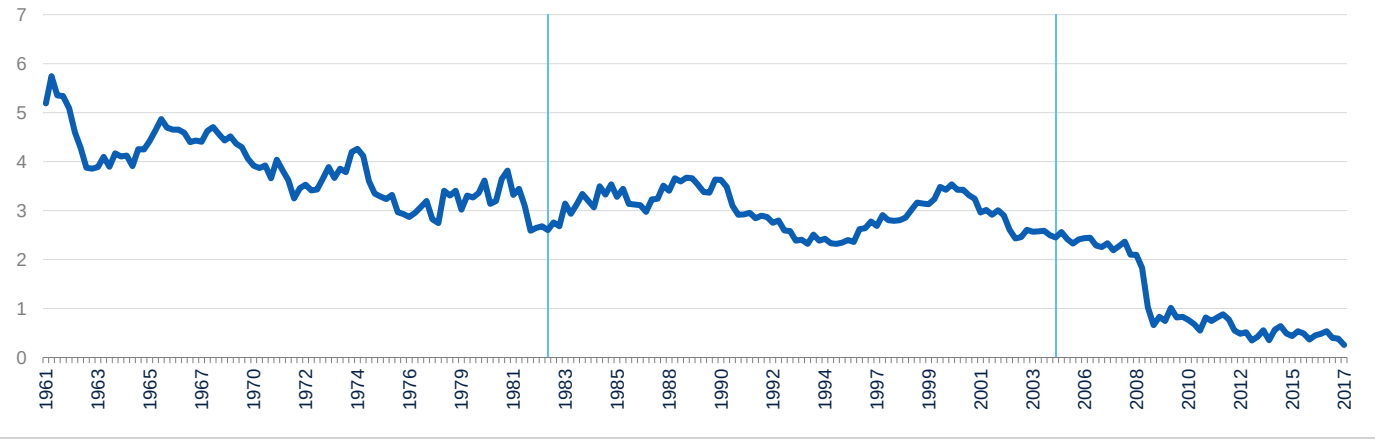
The existing literature has identified several factors that determine the neutral rate of interest including output growth, supply and demand for safe assets, and households' attitude toward risks and uncertainties (Galesi et al., 2017). Therefore, from a general-equilibrium perspective, credible estimates of trend economic growth and the natural interest rate should be consistent. In this brief, we adopt the commonly-used methodology developed by Laubach and Williams (LW, 2003), where we jointly estimate the growth rate of potential output and the natural interest rate with the following two equations:

$$\tilde{y}_t = a_{y,1}\tilde{y}_{t-1} + a_{y,2}\tilde{y}_{t-2} + \frac{a_r}{2}\sum_{j=1}^{2}\left(r_{t-j} - r^*_{t-j}\right) + \epsilon_{1,t} \quad (1)$$

$$\pi_t = b_\pi \pi_{t-1} + b_y \tilde{y}_{t-1} + \epsilon_{1,t} \quad (2)$$

where $\tilde{y}_t$ denotes the gap between actual real GDP and unobserved potential GDP, r_t is the real federal funds rate, r_t^* is the natural interest rate, and π_t denotes consumer price inflation. We conduct the maximum likelihood estimation using the Kalman filter.

Figure 1. Natural Interest Rate 1961- 2017 (%)



Source: BBVA Research

Figure 1 shows the estimation results where we can identify three distinct periods. The first one runs from the early 1960s until 1982, the year when the economy stepped out of the last recession before the start of the Great Moderation. During this period, the natural interest rate decreased steadily from almost 6% to slightly over 2.5%. Key contributors to the decline were the abuse of expansionary fiscal policies and the lack of independence of the central bank. In addition, despite the economic success of the early 1960s, the economy was later troubled by repeated recessions in the 1970s.

The second period, from 1983 to 2004, mostly overlaps with the Great Moderation. During this time, the economy enjoyed remarkable economic growth and stable inflation, which resulted in a relatively stable natural interest rate at around 3%. In the final period, starting in 2005, the natural interest rate has been decreasing with few signs of stabilization. Most notably, after the sharp drop from 2% to 0.5%, as a result of the Great Recession, the natural interest rate has failed to rebound even though the unemployment rate has reached its lowest level since 2001.

Table 1. Summary statistics for r^* (%)

Period	Max	Min	Mean	Standard deviation
1961 - 1982	5.7	2.6	3.8	0.7
1983 - 2004	3.7	2.3	3.0	0.4
2005 - 2017	2.6	0.2	1.1	0.8

Source: BBVA Research

Notwithstanding these results, it is important to note that the definition and estimation of the natural interest rate in the literature is not completely unambiguous. For example, in LW, the authors define the natural interest rate as the real

short-term interest rate “consistent with output equaling its natural rate and stable inflation.” In other words, the study takes a long-run perspective on the estimation of the natural interest rate, and therefore it should be considered as the real interest rate in an economic equilibrium.

However, the federal funds rate, particularly in the modern era, is a policy tool that reflects the Federal Reserve's perception of the economy (Bernanke and Blinder, 1992), which by definition carries systematic biases. For example, the decline in the natural interest rate after the Great Recession may be driven by the significant decline in the nominal federal funds rate and in the term-premium, as a consequence of the Fed’s quantitative easing. Therefore, estimates of r^* based on the federal funds rate will be affected by policymakers’ beliefs and capabilities.

In addition, due to the specific use of the federal funds rate, estimates of r^* may not represent the real interest rate that would prevail in the absence of nominal rigidities and price and wage shocks. This reasoning, originated by Wicksell (1898) more than a century ago, saw the natural rate of interest as something resembling the real yield of capital in production:

> *There is a certain rate of interest on loans which is neutral in respect to commodity prices, and tends neither to raise nor to lower them. This is necessarily the same as the rate of interest which would be determined by supply and demand if no use were made of money and all lending were effected in the form of real capital goods. It comes to much the same thing to describe it as the current value of the natural rate of interest on capital (1898, p. 102).*

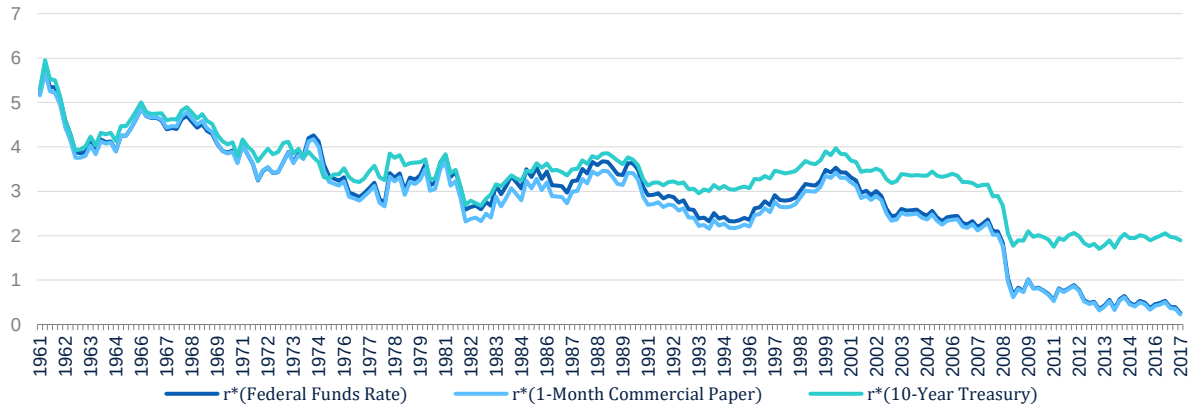
That is, a natural rate can be seen as an “intertemporal” price or a ratio of prices between present consumption and future consumption (as embodied in capital goods), and is wholly and directly determined by capital investment in the real sector of the economy.[2]

Alternative estimates of the natural interest rate

To obtain alternative estimates of the natural interest rate we use two extra measures for r_t to reduce the possible bias introduced by policymakers and incorporate more information from capital markets. One option is the yield on 1-month financial commercial paper. The second alternative is the yield on 10-year Treasury notes. While these rates may still exhibit downward pressures from unconventional actions taken by the Fed, they serve as better proxies for a market-determined cost of capital.

[2] For a detailed discussion on the differences between the neutral and the natural interest rate see for example Garrison (2006).

Figure 2. Alternative Natural Interest Rates 1961- 2017 (%)



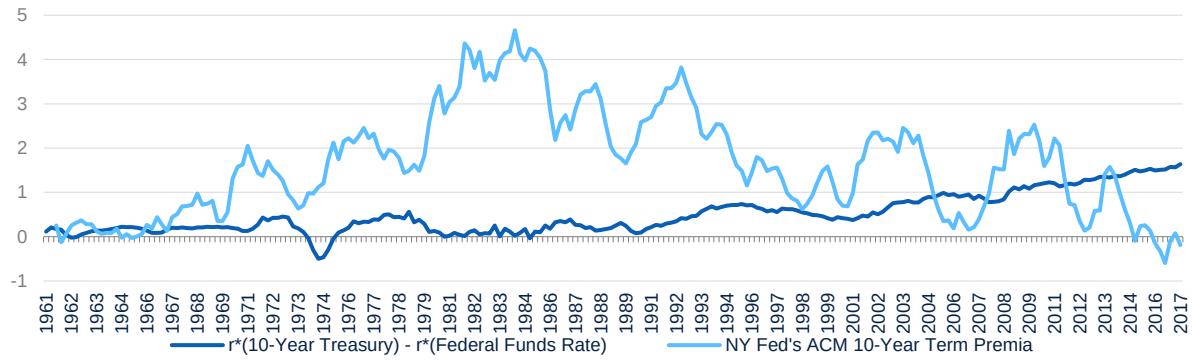
Source: BBVA Research

Figure 2 shows that, throughout the 1960s and 1970s, all three estimates behave similarly. During the 1980s, although a small gap developed, it remained stable up until the start of the next decade. Thereafter, during the 1990s and 2000s, the gap persistently widened and became more acute after the Great Recession.

Importantly, as shown in Figure 3, the divergence between r^* 10-year Treasuries and r^* federal funds cannot be explained by the term premium, which peaked in the early 1980s and declined gradually thereafter, in contrast to a persistently increasing gap between the two real interest rates. Moreover, since the 10-year Treasury yield can be seen as the sum of expected future short-term rates plus the term premium, the widening gap seems to come from a large discrepancy between policymakers and market participants on the expectations of short-term interest rates.

In addition, it is worth noting that the estimated natural interest rate, with 10-year Treasuries yields as r_t, remains mostly stable at 2% after 2008. This is in sharp contrast to the estimate using the federal funds rate, which maintains a downward trend during the same period. Such difference supports the notion that unconventional monetary policy after the Great Recession may have introduced a systematic bias into the estimation of the natural interest rate when using the federal funds rate as r_t. This begs the question. Is the gap going to narrow, and if so, when and how?

Figure 2. The gap between two natural interest rate estimates and the term premium (%)



Source: BBVA Research and NY Fed

Explaining the decline in the natural real interest rate

In order to know what could happen going forward it is crucial to understand what brought us to this point. Thus, we investigate the potential factors that have contributed to the secular decline in the equilibrium real rate of interest during the post crisis period. Bernanke (2005) has argued for more than a decade that the world's savings glut and the resulting excess of unneeded savings explain the sharp decline in interest rates. According to Summers (2014), the slowdown in population growth, a decline in debt-financed investment, changes in the distribution of income, disinflation, a shift in the relative price of capital goods and consumer durables, and an increase in the demand for safe assets have pushed down real interest rates. Meanwhile, Yellen (2017) has indicated that the decline in the real neutral interest rate might be explained by slowing population growth, weak productivity growth and headwinds left over from the financial crisis, highlighting that this has happened in many advanced economies predating the financial crisis.

Table 2. Regression Results

	Federal Funds Rates			10-Year Treasury Yields		
	r* (1)	z (2)	g (3)	r* (4)	z (5)	g (6)
Employment/ Population	0.166***	0.059***	0.107***	0.166***	0.025***	0.141***
	(0.018)	(0.011)	(0.015)	(0.013)	(0.005)	(0.012)
Capital Price	5.708***	1.666***	4.042***	2.816***	-0.520***	3.336***
	(0.202)	(0.117)	(0.166)	(0.145)	(0.058)	(0.127)
Debt Payment/ Disposable Income	0.354***	0.076**	0.278***	0.190***	-0.037**	0.227***
	(0.042)	(0.024)	(0.035)	(0.03)	(0.012)	(0.027)
R sq.	0.887	0.672	0.853	0.852	0.395	0.892

Notes:
(1) The numbers in parentheses are the standard errors of means.
(2) *, **, and *** indicate statistical significance at the 10%, 5% and 1% levels.

Source: BBVA Research

Following LW, we define $r_t^* = g_t + z_t$, where g_t is the growth rate of potential output, and z_t is the aggregate change of non-growth factors, such as individuals' preferences over risks and liquidity. This decomposition is especially helpful, as observed variables in the real world often send mixed signals on both growth and non-growth factors. Therefore, we regress the natural interest rate and the components from our previous estimation on three variables that are commonly mentioned in the literature.

Our results, shown in Table 2, confirm that the labor market has a significant effect on the natural interest rate. The employment to population ratio, which takes into account key issues such as unemployment, labor participation, and aging, is positively significant in all of our regressions. This result is consistent with Summers (2014) and Yellen (2017), who argue that demographic changes have been a major headwind for the economy. Our regressions also show that the relative price of capital (intermediate) goods and the overall debt level are positively correlated with the natural interest rate, which is consistent with existing literature.

However, one interesting finding from our regressions (equation 5) is that the capital price and debt to income ratio have negative effects on the non-growth factor, z_t, when using the 10-year Treasury yield as r_t . That is, in the long-run, market participants expect the risk premium to increase when the capital price or the debt level are low. Combining these findings with the results from equation (2), where the dependent variable is derived from the federal funds rate, we can conclude that momentum or inertia plays a major role in the short-term, but over the long run, market participants expect the risk premium to be mean-reverting. In addition, the negative sign between debt and real interest rates when using the 10-year Treasury yield as r_t is also consistent with the idea that debt overhangs can result in lower growth and keep real interest rates flat or even lower than in periods of lower indebtness. Moreover, it suggests that the hoarding of safe assets will eventually wane down.

Finally, our regressions show that the growth rate of potential output, g_t, plays a dominant role in determining the natural interest rate. All independent variables have much larger coefficients for g_t than for the non-growth variable z_t. Furthermore, the R-squares for g_t are also higher. These findings support the notion that economic fundamentals, rather than sentiment in capital market, are more important determinants of the natural interest rate. According to our estimation, since year-end 2009, the labor market recovery added 27bp to the natural interest rate while lower prices for capital goods and household deleverage have brought reductions of 31bp and 68bp, respectively.

Bottom line

According to our models, the decline in the natural interest rate for almost two decades responds mainly to demographic changes and lower potential output growth. Therefore, in an environment of slow population growth and lack of swift policy actions to boost productivity and investment, the ongoing economic recovery and a return of inflation close to 2% will not be enough to bring the natural interest rate back to its historical level.

From a policy perspective, our models suggest that the natural interest rate should edge up modestly after monetary conditions are normalized. This will narrow the gap among alternative estimates of the natural interest rate. Going forward, with real GDP growth and inflation hovering around 2%, the natural interest rate should edge closer to 1% and the target federal funds rate could reach almost 3%. However, if inflation stays persistently below 2% and the natural interest rate remains near current levels, the FOMC will achieve monetary policy normalization with a target rate near 2%. Therefore, the ability and willingness of policymakers to boost potential output and real interest rates become more relevant in determining the path of monetary policy.

References

Bernanke, B.S. (2005). “The Global Saving Glut and the U.S. Current Account Deficit.” Remarks at the Sandridge Lecture, Virginia Association of Economists, Richmond, Virginia. March 10. https://www.federalreserve.gov/boarddocs/speeches/2005/200503102/default.htm

Bernanke, B. S., & Blinder, A. S. (1992). The federal funds rate and the channels of monetary transmission. *The American Economic Review*, 901-921.

Federal Open Market Committee. (2017). Summary of Economic Projections. Board of Governors of the Federal Reserve System. June 14. https://www.federalreserve.gov/monetarypolicy/fomcprojtabl20170614.htm

Galesi, A., Nuño, G., & Thomas, C. (2017). The natural interest rate: concept, determinants and implications for monetary policy. *Economic Bulletin*, (1/2017).

Garrison, R. (2006). “Natural and neutral rates of interest in theory and policy formulation.” *Quarterly Journal of Austrian Economics*, 9(4), 57–68.

Hansen, A. H. (1939). "Economic Progress and Declining Population Growth," *The American Economic Review*. 29:1-15

Krugman, P. (2013). “Secular Stagnation, Coalmines, Bubbles, and Larry Summers.”The New York Times. https://krugman.blogs.nytimes.com

Laubach, T. and J. C. Williams. (2003). “Measuring the Natural Rate of Interest.” *Review of Economics and Statistics*, November, vol. 85, no. 4, pp. 1063–1070.

Samuelson, P. A. (1958). “An Exact Consumption-Loan Model of Interest with or without the Social Contrivance of Money.” *Journal of Political Economy.* Vol. 66, No. 6 (Dec.) pp. 467-482

Summers, L. H. (2014). “U.S. Economic Prospects: Secular Stagnation, Hysteresis, and the Zero Lower Bound.” Keynote Address at the NABE Policy Conference, February 24.

Wicksell, K. ([1898] 1936). “Interest and Prices: A Study of the Causes Regulating the Value of Money,” trans. R. Kahn, London. Macmillan and Co. Ltd.

Yellen, J. L.(2017). “Transcript of Chair Yellen’s Press Conference.” Board of Governors of the Federal Reserve System. March 15.