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Economic Watch

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Economic Analysis

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How Sensitive are Economic Indicators to Monetary Policy?

- **The pure effect of a change in real long-term interest rates on aggregate expenditures is small**
- **Residential investment exhibits the largest negative response to an increase in long-term interest rates and is central to the transmission of interest rate shocks**
- **A positive rate of increase in equity market is a necessary condition for a successful downscaling of LSAP**

Prior to the Great Recession, when the federal funds rate was indeed the main policy tool, economists persisted in asking the redundant question: "does monetary policy affect real economic activity?"[i] The unconventionality of current monetary policy, with direct impact on long-term interest rates coupled with stable inflation expectations, has made the outcome of current monetary policy actions on real output, specifically residential investment and consumption, less disputable. Nonetheless, how big is the impact of a change in real interest rates on real economic activity as measured by the GDP growth rate, consumption, and investment expenditures? In fact, the isolated effect of a change in real long-term interest rates on aggregate expenditures is not large.

Real effect of long-term interest rates

There are indeed pair-wise long-run sustainable relationships between the real rate on the 10-year Treasury note and both real GDP and personal consumption expenditures, as well as between the 30-year mortgage real rate and real residential investment. Those relationships are substantial in the size of their co-movement and as expected are negative, meaning that a decline in the long-run interest rates positively affects real economic growth, consumption, and investment.

$$1\%\ \text{change in 10Y Treasury Rate} = -6.3\%\ \text{change in Real GDP}$$

$$1\%\ \text{change in 10Y Treasury Rate} = -4.4\%\ \text{change in Real Consumption}$$

$$1\%\ \text{change in 30Y Mortgage Rate} = -5.0\%\ \text{change in Real Residential Investment}$$

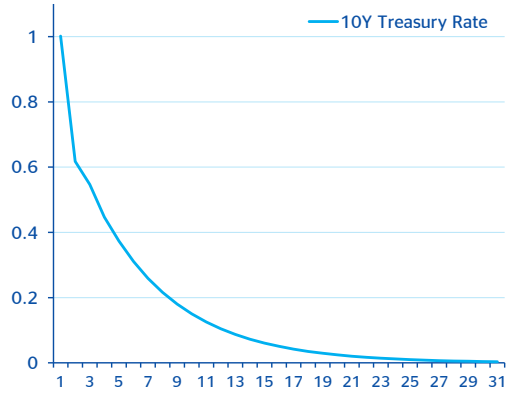
However, shocks to long-term interest rates have a lasting but small effect on the aggregates of real economic activity. The one year cumulative decline due to a 1% increase in the 10-year Treasury rate is minor – measuring at 0.006% for GDP and 0.012% for consumption. The response of real residential investment expenditures to the 1% increase in the 30-year mortgage rate is larger and much more lasting with a 0.58% one year cumulative decline. Also, in line with the common economic knowledge, those effects while slightly persistent are transitory and do not affect the potential level of economic growth. Equally important is the fact that changes in the potential level of GDP, consumption, and the investment growth rate have a permanent effect on long-term interest rates.

Table 1
Impulse Response Summary for Pair-Wise long-run relationships

Shock			Shock		
1% increase in 10-year Treasury Rate	Half-life	3Q	1% increase in 30-year Mortgage Rate	Half-life	3Q
	GDP	Consumption		Residential Investmetn	
Immidiate impact	0.001%	-0.003%	Immidiate impact	-0.09%	
Full impact	-0.002%	-0.004%	Full impact	-0.2%	
Half-life	7Q	6Q	Half-life	18Q	

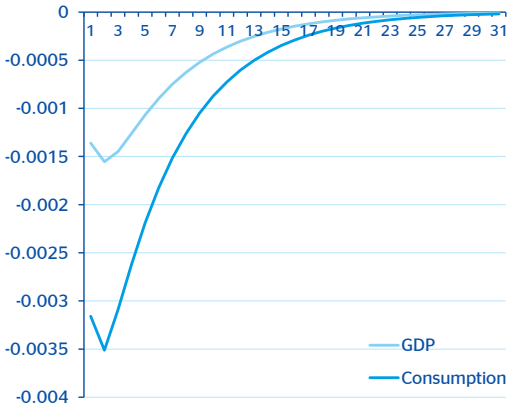
Source: BBVA Research

Chart 1
Transitory Shock to 10-Year Treasury Rate (%)



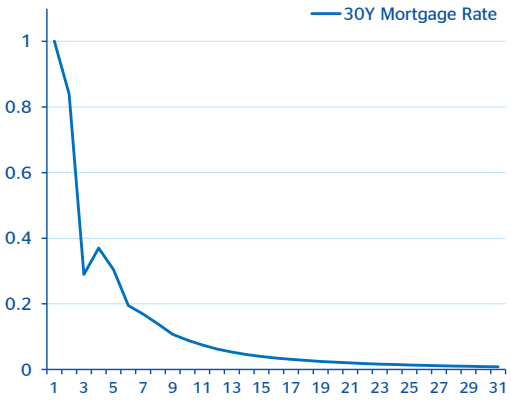
Source: BBVA Research

Chart2
Real GDP and Consumption Response Functions (%)



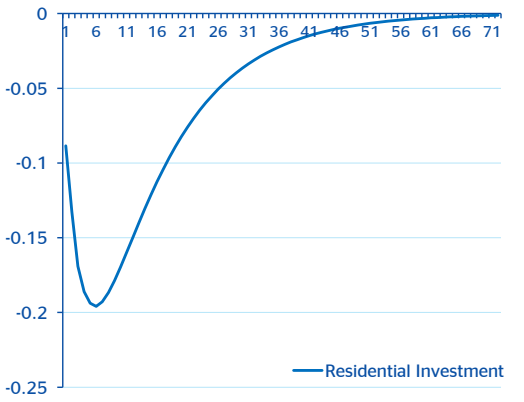
Source: BBVA Research

Chart 3
Transitory Shock to 30-Year Mortgage Rate (%)



Source: BBVA Research

Chart 4
Real Residential Investment Response Function (%)

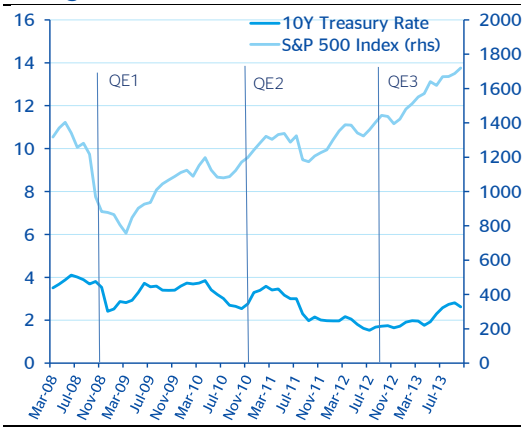


Source BBVA Research

Unconventional measure of LSAP

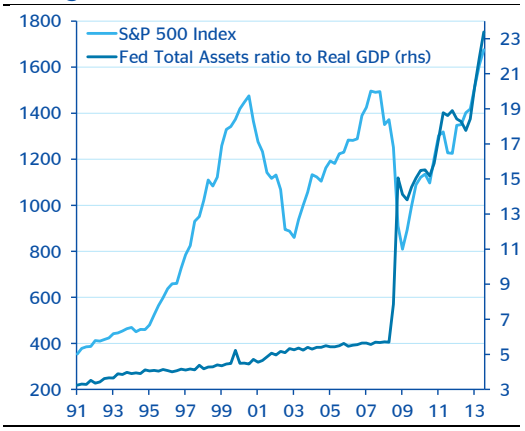
Today's economic and business environment can be highlighted with two hard to ignore facts – long-term interest rates are at their historic low and the stock market is at a historic high. For the last seven years, the Fed has kept downward pressure on long-term interest rates with its extraordinary measure of Large Scale Asset Purchases (LSAP). Since the start of Quantitative Easing (QE), the positive relationship between a ballooning Fed balance sheet, a flattened yield curve, and increasing stock market prices is obvious. In fact, since January 2010, the quarterly rate of increase in the ratio of the Fed balance sheet to real GDP averages 3.1% and almost exactly matches the 3.0% quarterly average rate of increase in the S&P 500 index.

Chart 5
10-Year Treasury Yield and S&P 500 Index (M Avg. and %)



Source: FRB, S&P & BBVA Research

Chart 6
S&P 500 Index vs. FRB Assets to GDP Ratio (M Avg. and %)



Source: FRB, S&P & BBVA Research

Long-term interest rates transmission to stock market

Looking further into the dynamics between long-term interest rates, real economic aggregate demand indicators, and equity markets, real residential investment is central to the transmission of interest rate shocks to real GDP growth as well as to the stock market. Similar to the pair-wise dynamics between long-term interest rates and the indicators of economic activity, residential investment exhibits the largest negative response to an increase in either the 10-year Treasury rate or the mortgage rate and also exhibits the slowest adjustment back to the pre-shock level.

The long-term equilibrium relationships between the 10-year Treasury note, the 30-year conventional mortgage, real GDP, personal consumption expenditures, residential investment, and the S&P 500 index are described below:

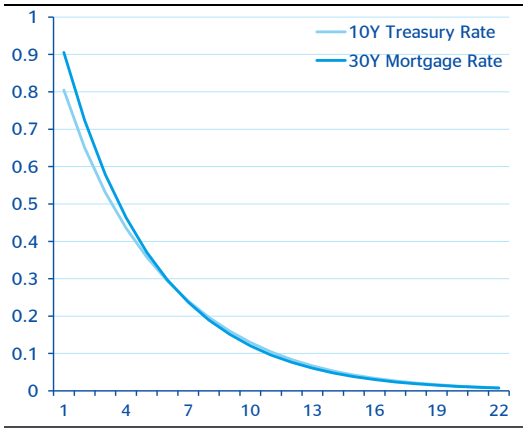
1% change in 10Y Treasury Rate = –5.5% change in Real Residential Investment

1% change in 30Y Mortgage Rate = –5.3% change in Real Residential Investment and –0.3% change in S&P 500

1% change in Real GDP growth = –0.8% change in Consumption and –0.05% change in S&P 500

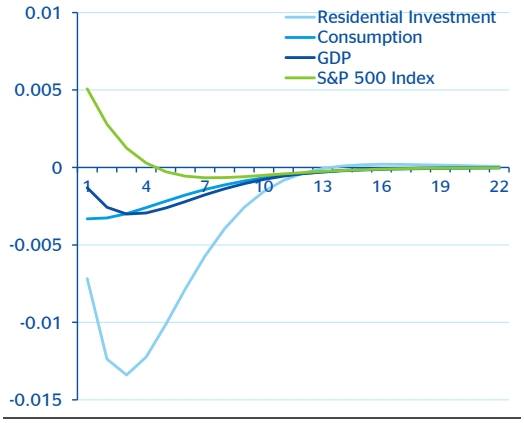
There is a measurable impact of the change in real long-term rates on the S&P 500 index. While we see an inverse relationship as one would expect, the change in the S&P 500 index due to long-term interest rate shocks is small and explains only a small part of the full spectrum effect of LSAP on the equity markets. Whereas, the permanent rise in the stock market, which could be explained by a positive shock to the potential GDP growth rate, in return cause an increase in the potential levels of economic indicators as well as in interest rates.

Chart 7
Transitory Shock to Long-Term Interest Rates (%)



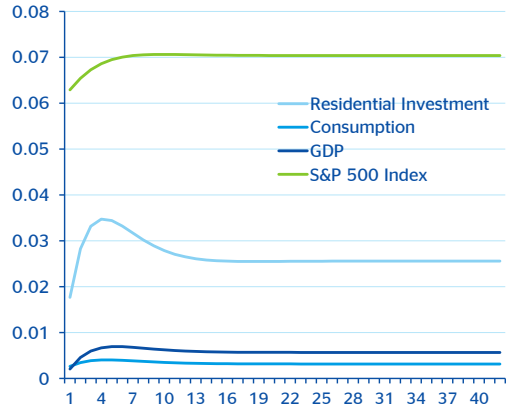
Source: BBVA Research

Chart 8
GDP, Consumption, Residential Investment and S&P 500 Index Response Functions (%)



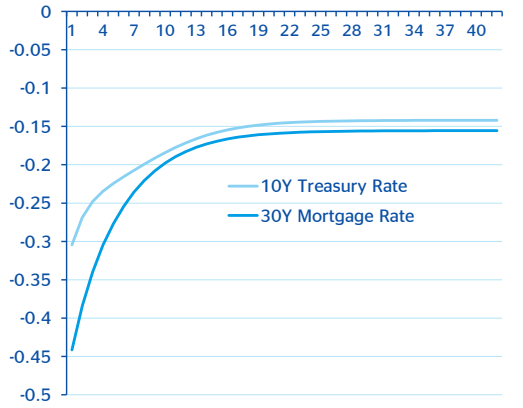
Source: BBVA Research

Chart 9
Permanent Shock to S&P 500 Index and Response Functions of GDP, Consumption, and Residential Investment (%)



Source: BBVA Research

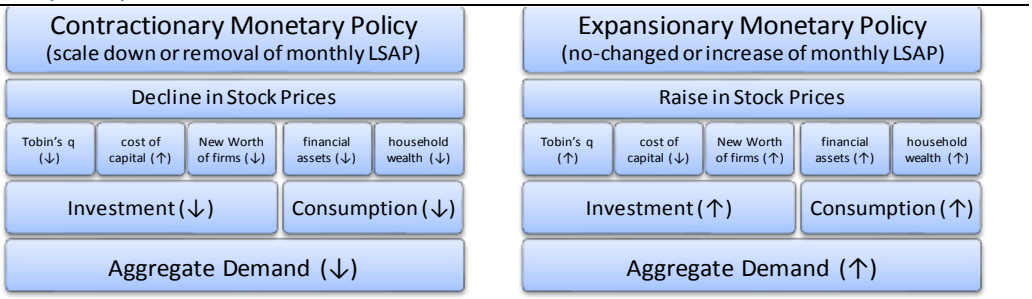
Chart 10
Response Functions of Long-Term Interest Rates (%)



Source: BBVA Research

The relationship between the LSAP and increasing equity market prices that is currently seen is desirable from a monetary policy perspective, since stock prices are an important monetary policy transmission channel. The subsequent channel has been often praised by the Fed for its positive effect on economic growth. However, a large portion of the recent increase in S&P 500 index remains unexplained by neither real economic indicators nor real long-term interest rates. Further risks to real economic growth arise from possible adverse shocks to the equity market, as shocks to the equity index have a permanent effect on the potential levels of real economic activity and interest rates.

Chart 11
Monetary Policy Transmission Chanel



Source: Mishkin (2001) & BBVA Research

Bottom Line: Sustainable potential growth is necessary for low-impact LSAP downscaling

LSAP's impact on both long-term interest rates and equity prices is a double-edged sword. Fed considers that even a slight reduction in LSAP is expected to slow economic growth due to an increase in long-term rates. Reduction of monthly pace of LSAP, or as little as taper-talk by itself, causes a raise in long-term interest rates. However the impact of interest rates on real economic activity while lasting but are not substantial.

The true obstacle for the taper-start is a positive relation between the equity market growth and the escalation of the Fed balance sheet, since any minor negative economic effects from downscaling the Fed's monthly pace of asset purchase can be further magnified if it were to be accompanied by a simultaneous downward movement in equity markets. Thus, the positive rate of increase in equity market supported by real growth in the economic fundamentals is a necessary condition for a successful and low-impact downscaling of LSAP by Fed.

Overall, the residential investment is the most sensitive to changes in long-term interest rates and is at the core of transmitting the interest rate effect to more aggregate levels of economic activity. All together, the cumulative effect of the change in real economic activity is small and varies between -0.006% for GDP and -0.58% for residential investment.

Methodological Appendix

We employ cointegrated vector autoregression analysis (CVAR) to study the long-term real interest rates effect on real economic activity indicators. In particular, we study the long-run equilibrium dynamics between the 10-year Treasury note yield, the 30-year conventional mortgage rate, GDP, personal consumption expenditures, residential investment, as well as the S&P 500 composite index. The CVAR methodology allows for application of identification restrictions on the variables of interest to further examine the structural relations between the series and their responses to two different types of shocks – permanent and transitory shocks. In some cases CVAR restrictions employed also identify the origination of the shocks making certain inference regarding the transmission path of the shocks.

The first section of our analysis examines pair-wise long-run equilibrium relations between the 10-Year Treasury note real rate and both real GDP and personal consumption expenditures, as well as between the 30-Year mortgage real rate and real residential investment. Further, we search and study long-run equilibrium relationships for a bigger system including all the variables of interest: real interest rate for 10-year Treasury note and 30-year conventional mortgage, real GDP, personal consumption expenditures, residential investment, and the S&P 500 composite index. The time series examined are assumed to follow a first order integrated process. The results of a Dickey-Fuller unit root test with GLS de-trending (DF-GLS) and Modified Akaike Information Criterion (MAIC) is reported in the Table 1. The DF-GLS test together with MAIC has a track record of improved size and power performance over the standard Augmented DF test.

Methodology

The general form of the k th order vector autoregressive model, VAR(k) is:

$$x_{it} = \Pi_1 x_{it-1} + ... + \Pi_k x_{it-k} + \Phi D_t + \varepsilon_{it}, \quad t = 1,...,T$$

where $x_{it} = x_{1t}, x_{2t},..., x_{pt}$ are the variables of interest, D_t is the deterministic term, which contains permanent impulse dummies and the constant of the model, $\Pi_1,...,\Pi_k, \Phi$ are parameters of the model, $\varepsilon_{it} \sim iidN(0,\Omega)$ and k is the lag length. The corresponding vector error correction model (ECM) is:

$$\Delta x_{it} = \Gamma_1^{(m)} \Delta x_{pt-1} + \Gamma_2^{(m)} \Delta x_{pt-2} + ... + \Gamma_{k-1}^{(m)} \Delta x_{pt-k+1} + \Pi x_{t-m} + \Phi D_t + \varepsilon_{it}$$

where $\Pi = -I + \sum_{j=1}^{k} \Pi_j$, m is an integer between 1 and k, Π matrix summarizes the long run effects in the system and stays unchanged regardless the chosen lag m and $\Gamma_i^{(m)}$ for $i = 1,...,k-1$ contains short-run effects of the model and depends on the chosen lag m within the model.

$\Pi = \alpha\beta'$ decomposition lets us identify the adjustment mechanism in the system examined. Assuming that r is the cointegration rank in the model and that p is the number of variables in the model, β' is described by an $r \times p$ matrix, where $\beta' x_{it}$ is the derivation of each variable i from the steady state of the system, and α is a $p \times r$ matrix that shows the speed of adjustment to the steady state for each of the variables in the system. β' represents the common long run relations in the system with corresponding α factor loadings

Determination of cointegration rank is based on the Johansen Likelihood Ratio (LR) trace test. The VAR model lag length is determined according to the Schwartz Information Criteria (SIC) test.

The long-run identification problem translates into the identification of a β matrix that will explain the best the relationship between the variables of interest. This objective is achieved by posing testable restrictions on vectors in the β matrix and comparing the significance of the tests. In order for the restrictions on β to be testable, the restrictions should be over-identifying where number of the restrictions on each vector β_i is bigger than $r-1$. Long-run restrictions on β are tested with the LR test.

Equally important is to identify a structure that best characterizes the α matrix the best, since the structure of common trends depends on α. There are two important properties of α that we test for: weak exogeneity and a known vector. The weak exogeneity condition is tested for by the LR test described in Johansen and Juselius (1990), where the hypothesis of zero row restriction in α tests whether the cumulative residuals of the variable (corresponding to the zero row) are a common driving trend in the system. If the hypothesis is accepted, that variable affects the long run stochastic path of the other variables while at the same time is not affected by them. A know vector in α is tested for with the LR test described in Johansen (1996) which tests whether one of the variables is exclusively adjusting to one cointegrating relation, while the other variables are exclusively adjusting to the remaining cointegration relations.

CVAR Model Selection

The Johansen LR trace test finds 1 cointegrating relation, and thus one long-run steady-state relation, for both pair-wise analyses of the relationship between the 10-year real interest rate and real GDP; and between the 10-year real interest rate and real personal consumption. At the same time, there is no cointegrating relation found between real residential investment and the 10-year real interest rate. In fact, the trace test rejects cointegration between real residential investment and any other medium or long-run real interest rates. The only long-run equilibrium found is between real residential investment and the 30-year mortgage real rate. Structural analyses show that real GDP and real residential investment are weakly exogenous, with 0.263 and 0.527 p-values respectively. Consequently, in line with the common economic knowledge, we find that long-term real interest rates have a transitory effect on the aggregate indicators of real economic activity. While the p-value for weak exogeneity test of real consumption is low (0.003), the row parameter for consumption is estimated near zero (0.001).

Johansen LR trace test finds 3 cointegrating relations, and thus 3 long-run steady-state relations, for the model including all the variables of interest: the real interest rates for the 10-year Treasury note and 30-year conventional mortgage, real GDP, personal consumption expenditures, residential investment, and the S&P 500 composite index. Testing restrictions on the long-run relations, we fail to reject the structural model below with (p-value=0.71). The analysis shows that S&P 500 index is weakly exogenous with a corresponding p-value of 0.263 and thus is a common driving trend for the remaining variables in the model.

Table 2
Test for Lag Length Selection

10Y Treasury and Real GDP				10Y Treasury and Real Consumption				30Y Mortgage and Real Res. Investment			
Model	Lag	Observations	SIC	Model	Lag	Observations	SIC	Model	Lag	Observations	SIC
VAR(4)	4	138	-9.206	VAR(4)	4	138	-9.562	VAR(4)	4	126	-6.362
VAR(3)	3	138	-9.259	VAR(3)	3	138	-9.59	**VAR(3)**	**3**	**126**	**-6.422**
VAR(2)	**2**	**138**	**-9.279**	VAR(2)	2	138	-9.598	VAR(2)	2	126	-6.373
VAR(1)	1	138	-9.223	**VAR(1)**	**1**	**138**	**-9.626**	VAR(1)	1	126	-5.827

Source: BBVA Research

Table 3
LR Trace Test Statistics

10Y Treasury and Real GDP					
r	**p - r**	**Eigenvalue**	**Trace**	**95% Critical Value**	**P-Value**
2	0	0.136	20.777	15.408	0.006
1	**1**	**0.006**	**0.859**	**3.841**	**0.354**
10Y Treasury and Real Consumption					
r	**p - r**	**Eigenvalue**	**Trace**	**95% Critical Value**	**P-Value**
2	0	0.191	31.482	15.408	0
1	**1**	**0.018**	**2.437**	**3.841**	**0.119**
30Y Mortgage and Real Res. Investment					
r	**p - r**	**Eigenvalue**	**Trace**	**95% Critical Value**	**P-Value**
2	0	0.122	18.675	15.408	0.015
1	**1**	**0.016**	**2.066**	**3.841**	**0.151**

Source: BBVA Research

Table 4
Lag Length Selection and LR Trace Statistics for 6-Variable VAR

Test for Lag Length Selection				Trace Test Statistics					
Model	Lag	Observations	SIC	r	p - r	Eigenvalue	Trace	95% Critical Value	P-Value
				6	0	0.636	257.568	95.514	0
VAR(5)	**5**	137	-31.789	5	1	0.278	115.128	69.611	0
VAR(4)	4	137	-32.673	4	2	0.264	69.12	47.707	0
VAR(3)	3	137	-33.484	**3**	**3**	**0.106**	**25.818**	**29.804**	**0.138**
VAR(2)	2	137	-34.188	2	4	0.052	10.087	15.408	0.279
VAR(1)	**1**	**137**	**-34.697**	1	5	0.018	2.56	3.841	0.11

Source: BBVA Research

Table 5
Long-Run Restrictions for 6-Variable VAR

	10Y Treasury	30Y Mortgage	Res. Investmen	Consumption	GDP	S&P 500 Index
β_1	1	0	5.549	0	0	0
β_2	0	0	0	-0.792	1	-0.045
β_3	0	1	5.293	0	0	0.285

Source: BBVA Research

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i Title of Benjamin M. Friedman work (Friedman, 1996)