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Economic Analysis

Colombia

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The natural interest rate in Colombia

We expect monetary policy to remain neutral until the end of 2015

- We have estimated the natural interest rate (NIR) for Colombia from 2000 to 2015

The NIR is a variable that cannot be observed: it represents a monetary policy rate that is neither expansionary nor deflationary. This rate changes over time. Therefore, it is useful to estimate its value continuously to ascertain whether monetary policy is appropriate for the needs of economic activity.

- The NIR estimate suggests monetary policy was expansionary in September 2013

The reference rate can be classified as expansionary or deflationary, depending on whether it is lower or higher than the NIR, respectively. According to our estimates, in September 2013 the NIR stood at a real rate of 1.9% (in an estimation range from 1.31% to 2.90%), this represents an expansionary stance with regards to the current nominal level of 3.25% (1% real with total inflation: 0.75% with non-food inflation;-0.1% with inflation expectations).

- The NIR will increase from a real rate of 1.9% in September 2013 to 2.25% in 2015 as the FED increase its reference rate and a narrowing of the output gap is achieved

According to our estimates, the NIR will be on an upward path over the coming years. Considering the gradual narrowing of the output gap and, in particular, the FED starting to increase its reference rate, the neutral rate should reach around a real rate of 2.25% in 2015. The policy rate will converge to the NIR in late 2015, creating a neutral monetary stance.

Natural interest rate (NIR)

The concept of the NIR was created by Wicksell (1898), who defined it as the real interest rate that balances savings and investment whilst being price neutral (non-inflationary). In this paper, we define the NIR as an interest rate consistent with output being at its potential over the medium term, given a system of stable prices only affected by real factors.

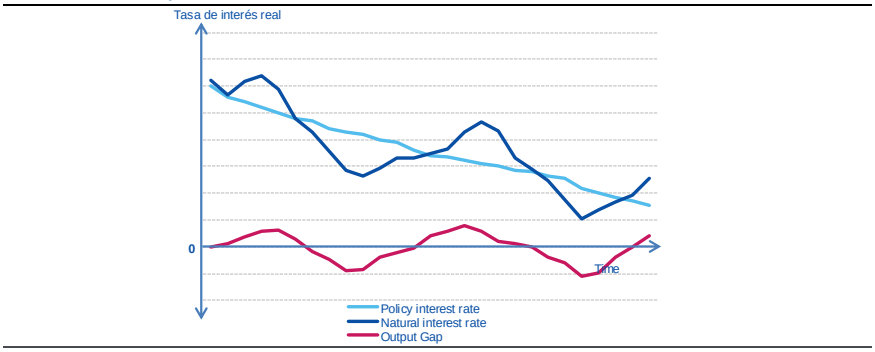
Monetary policy in Colombia uses the reference rate as a short-term tool to establish the tone of policy, with central bankers comparing the real policy rate with the NIR to establish their monetary position. In general terms there are two methodologies for estimating the NIR, one static and one dynamic. In this study, we estimate five methodologies, all of which are dynamic. The reasons for these are set out below.

Variability of the NIR over time

The level of the neutral rate depends on external and domestic conditions, some of which are unpredictable. The determining factors for the NIR are variable over time, generating a NIR that is contingent on economic conditions, subject to the following factors:

- The NIR depends positively on international interest rates, local risk premiums and expectations of devaluation (due to interest-rate parity in small economies that are open to capital). It is contingent on medium-term turbulence that may alter the output gap and that requires a change in the interest rate to achieve full employment (Yellen, 2005); and on the capacity for monetary transmission to general interest rates in the economy (i.e. macroprudential controls that affect the credit channel of monetary policy).
- The stability of the output gap depends on changes in the NIR in accordance with the output cycle (chart 1). When the only distortion is inefficient prices, stability in the output gap is guaranteed by concentrating monetary policy on price stability, producing a constant NIR. If there are any imperfections in the financial markets in the form of excessive leveraging, exposure to risky assets, externalities affecting the exchange rate or variability in risk premiums, stability in the output gap is not guaranteed, causing temporary variations in the NIR.

Chart 1
Theoretical NIR cycle



Source: Bernhardsen & Gerdrup (2007) and BBVA Research

- Colombia is a small, open economy. Its economic performance depends on a number of global factors that can impact the output gap and the NIR. Uncovered interest rate parity estimates the domestic NIR as the sum of international interest rates, expectations of devaluation of the domestic currency and a risk premium. These factors vary over time.
- The central bank —BanRep— adopted an inflation target approach in 1991. However, a price stability objective does not in itself guarantee macroeconomic and financial stability. Therefore, it has, on occasions been necessary to apply macroprudential tools to achieve both objectives. The purpose of macroprudential tools is to maintain the

stability of the financial system and reduce systemic risk. Both policies must be coordinated, as otherwise, their interaction might decrease their individual and joint effectiveness. Therefore, when macroprudential tools do not achieve their objective, or when they are not coordinated with the monetary stance, the output gap is not stable, and the NIR varies over time.

- Macroprudential policies can alter the monetary policy transmission mechanism, the credit channel, the output gap and, therefore, the level of the NIR (Bernhardsen & Gerdrup (2007)). This is the case when deposit reserve requirements, capital controls and limits on currency mismatches are put in place (all of which have occasionally been used by BanRep).
- The lack of use of *forward guidance* when the reference rate is low reduces potential output via expectations of the reference rate and economic activity, leading to changes in the NIR (See Woodford (2013) for more details).
- The NIR may not accurately reflect the policy position, if the monetary transmission mechanism is weak. This is the case in financial markets with short-term segmentation (different interest rates for different sectors of the economy), exchange rates that are not very flexible, high concentration of the banking market, low levels of financial brokerage or a monetary policy framework that is still developing: in general, where monetary policy rates do not reflect financial market fundamentals.

Estimating the NIR

We mainly followed Magud and Tsounta (2012) in estimating the NIR. These authors used a range of methodologies and models to estimate variable and static rates in a number of Latin American countries. These methodologies include semi-structural models (variants over time), which, unlike statistical filters, return a NIR that changes gradually, and do not depend significantly on the monetary stance at the time.

Five estimates of the NIR were made, based on two semi-structural models. The first of these is the IS model, which focuses on the aggregate demand and supply equilibrium. The second is the common stochastic trend model (CST), which is based on the IS model, but assumes a shared trend between short-term and long-term interest rates, with a spread explained by a term premium. Then, two variations of these models were also created: for the IS model the trend and cycle factors were decomposed from the NIR, while in the CST the behavior of the output gap was assumed as both endogenous and exogenous. Finally, a model for uncovered interest rate parity (UIRP) was estimated. Appendix 1 contains a detailed description of the data, models and estimates.

The estimates pointed to an NIR of 1.9% in real terms, increasing to 2.25% in 2015

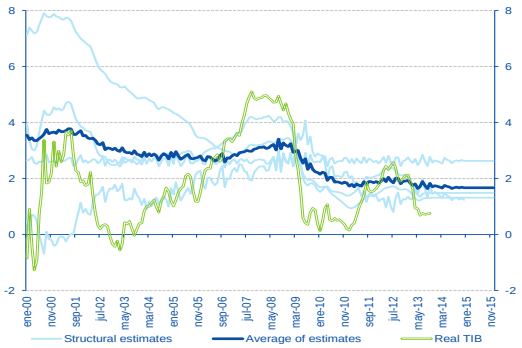
The results are displayed in chart 2, which shows the NIR using these methodologies, their monthly average from 2000 to 2015 and the real interbank reference rate (TIB)[1]. As we can see, the NIR has steadily fallen from average real levels of 3.5% in 2000 to 2.65% in 2009, and 1.9% in 2012-2013. The high levels of the NIR in 2000 and 2001 were generated by the 1999 crisis, when, given the definition of the NIR, the NIR had to increase to close the output gap. Following this period, the NIR slowed, consistent with output converging on its potential level.

The recent reduction in the neutral rate can be explained by a structural reduction in risk premiums, which were high above all in 2009 with the reduction in the local EMBI and the

1 The real ex-post TIB was calculated using non-food inflation.

subsequent level of sovereign debt investment. Likewise, the lower level in 2013 can be explained by low international rates (FED and QE3). We will discuss these determinants of the NIR in greater detail below.

Chart 2
Estimates of NIR, average of estimates and TIB.



Source: Bank of the Republic and BBVA Research

Table 1 shows estimates of the real NIR using the most recent data and its May 2012 average (2.16%). The May average is in line with the findings of Magud et. al. (2012)[2], as shown in the table. For September 2013, the average is 1.9% in a range from 1.31% to 2.90%, compared to a real inflation-deflated interest rate of 1%; deflated by non-food inflation of 0.75%; and deflated by inflation expectations of -0.1%. Therefore, the interest rate gap suggests an expansionary stance for September. The table also shows NIR projections to December 2015, the average of which is 2.25%, with a range from 1.25% to 4.56%. The uncovered interest rate parity model is not included in the average in the charts, as this would introduce variability into the average NIR, and such an estimate would not be consistent with economic theory[3], considering that the NIR varies gradually with the economic cycle. Chart 3 shows the dispersal of the estimates, their average and the real TIB. We can see that the interest rate gap indicates a neutral position at the end of 2015, resulting from convergence of the policy rate towards the NIR.

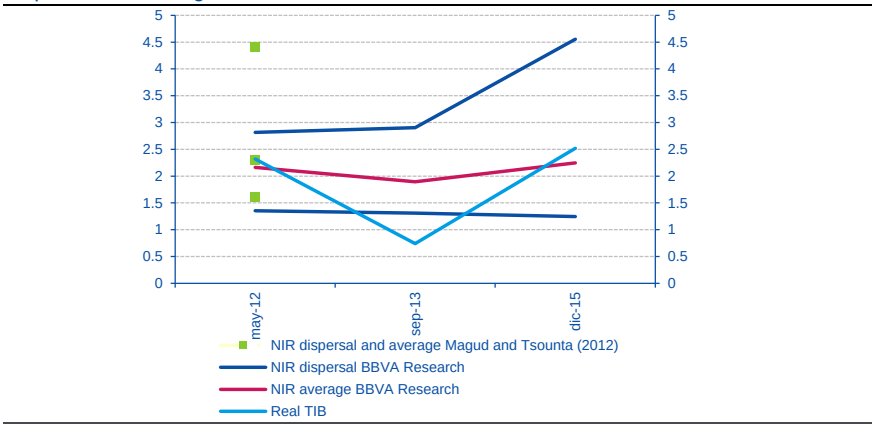
Table 1
Real NIR estimates

Date	Magud and Tsounta (2012)	IS model	IS model*	CST model	CST model*	UIRP	Total average
May-12	2.3%	2.81%	1.35%	1.68%	2.34%	2.62%	2.16%
Sep-13	-	2.44%	1.33%	1.31%	1.49%	2.90%	1.90%
Dec-15	-	2.63%	1.25%	1.32%	1.49%	4.56%	2.25%

Source: Magud N. & E. Tsounta, 2012," To cut or not to cut: that is the (Central Bank´s) question" and BBVA Research.
* Variations of the model

2 The value shown in the table is the average of the estimates of Magud et. al. (2012).
3 Refer, for example, to T. Bernhardsen & Gerdrup K. *"The neutral interest rate".* Norges Bank.

Chart 3
Dispersal and average real TIB and NIR

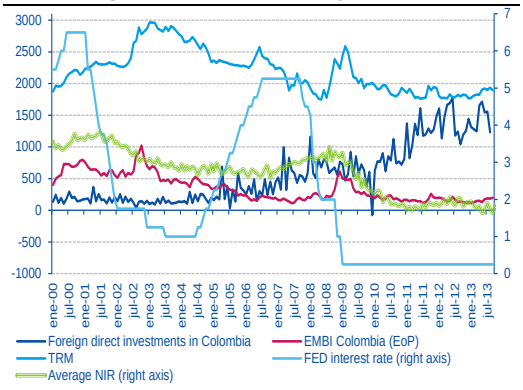


Source: Magud N. & E. Tsounta, (2012) and BBVA Research

International interest rates and output gap: the two main determinants of the NIR

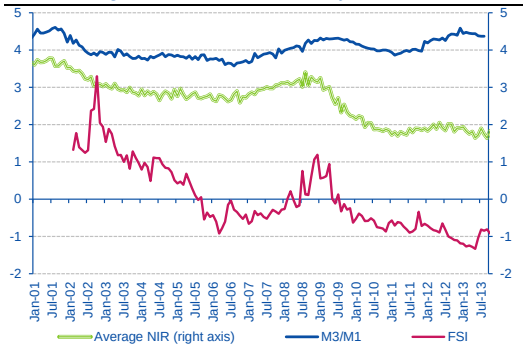
Charts 4 and 5 show the relationship between the NIR and the variables mentioned in the previous section. The reductions in international interest rates (represented by the FED reference rate) in 2000 and 2008 explain much of the rapid decrease in the domestic NIR in these periods, accompanied by an appreciation of the Colombian peso following increased foreign direct investments (FDI) and increased demand for domestic financial assets. In addition, the domestic risk premium, measured by the EMBI Colombia and the financial stress index (FSI)[4]; put downward pressure on the NIR throughout the period.

Chart 4
Determining factors in NIR variability over time



Source: Banco de la República, Bloomberg, JP Morgan and BBVA Research

Chart 5
Determining factors in NIR variability over time



Source: Banco de la República, DANE and BBVA Research

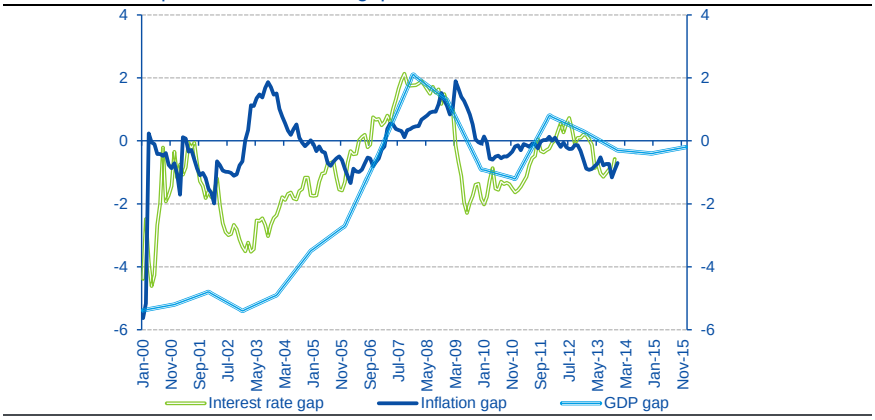
The efficiency of monetary expansion is also related to the performance of the NIR, as this affects the output gap. Chart 5 shows the banking multiplier (M3/M1), which was on a

4 The FSI is calculated using the principal components method, using the variables: exchange rate depreciation; exchange rate volatility measurements (USDCOP); the general stock market index; the EMBI spread; and the 10-year ex-ante interest rate. Source: BBVA Research.

downward trend from mid-2002, leading to lower credit growth until early 2006. We can also observe that the fall in the multiplier between 2009 and 2010 coincides with a more rapid fall in the NIR; however, over recent years there has been a slight change in the trend, which would suggest that the NIR will increase over coming years.

If we compare the interest rate gap with the inflation gap (the difference of non-food inflation and the BanRep target, see chart 6), we can observe that BanRep took a deflationary position (or a change of trend towards deflation) when inflation was above its target. We can also see a slight negative relationship between the NIR gap and the future inflation gap. When the interest rate gap is expansionary, the output gap stabilizes in subsequent periods (growth of output equal to its potential). Therefore, the pace of stabilization in the output gap depends on how negative the interest rate gap is. On the other hand, when the interest rate gap suggests a deflationary position, output consequently grows below or at potential.

Chart 6
The inflation, output and interest rate gaps



Source: Banco de la República, DANE and BBVA Research

We expect a neutral policy rate at the end of 2015

Forecasts for international interest rates and the output gap are two of the most important factors in determining the future behavior of the NIR. Their behavior gives us a general guide to how this variable will perform.

According to our expectations, the FED will hold its reference rate at 0.25% until mid-2015, determining at the same time stability in the NIR due to interest rate parity. Furthermore, we expect an output gap throughout 2014 and 2015, stabilizing in mid-2016, increasing the NIR. Considering the increase in the NIR and our projections for the policy rate, we consider that the interest rate gap will have a neutral monetary stance at the end of 2015, with a real NIR of 2.25%. With the FED increasing rates in 2015, we expect the NIR to increase (through UIRP), creating a possible expansionary interest rate gap, and leading to output increasing above potential at the end of 2016.

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Appendix 1

We will now discuss the two semi-structural models used and their variants. These models were estimated using a Kalman filter. Finally, we will set out the UIRP model. The first of the semi-structural models replicates that used by Magud et. al. (2012).

IS model

$$(y_t - y_t^*) = \alpha_1^y (y_{t-1} - y_{t-1}^*) + \alpha_1^r (r_{t-1} - r_{t-1}^*) + e_t^y \quad [1]$$
$$\pi_t = \beta_1^\pi \pi_{t-1} + \beta_1^y (y_{t-1} - y_{t-1}^*) + e_t^\pi \quad [2]$$
$$y_{t=} y_t^* + e_t^{yc} \quad [3]$$
$$\boldsymbol{r_t = r_t^* + r_t^c + e_t^{rc}} \quad [4]$$
$$r_t^* = r_{t-1}^* + e_t^{rc} \quad [5]$$
$$y_t^* = y_{t-1}^* + g_{t-1} \quad [6]$$
$$g_{t=} g_{t-1} + e_t^g \quad [7]$$
$$\boldsymbol{r_t^c = \beta_c r_{t-1}^c + e_t^{cc}} \quad [8]$$

Equation [1] shows an IS curve, expressing the relationship between the output gap $(y_t - y_t^*)$ and its past and the interest rate gap, the difference between the real interest rate and the NIR $(r_t - r_t^*)$. Equation [2] is a Phillips curve, relating the inflation gap, inflation differential and target (π_t), to its past and the output gap. Equation [3] breaks down the trend component of output (modeled by state equation [6]) to find potential output. Equation [4] breaks down the real interest rate into its trend component (long term, modeled by equation [5]) and the cyclical rate (short term, modeled by equation [8]). Finally, equation [7] expresses the potential output growth rate (g_t). Two variants of this model were prepared, breaking down the cycle and without breaking down the cycle (eliminating r_t^c from the model in the highlighted equations). The second semi-structural model consists of the following equations:

Common stochastic trend model (CST)

$$(y_t - y_t^*) = \alpha_1^y (y_{t-1} - y_{t-1}^*) + \alpha_1^r (r_{t-1} + r_{t-1}^*) + e_t^y \quad [9]$$
$$\pi_t = \beta_1^\pi \pi_{t-1} + \beta_1^y (y_{t-1} - y_{t-1}^*) + e_t^\pi \quad [10]$$
$$\boldsymbol{y_{t=} y_t^* + e_t^{yc}} \quad [11]$$
$$r_t = r_t^* + r_t^c + e_t^{rc} \quad [12]$$
$$r_t^l = \alpha_t + r_t^* + r_t^c + e_t^l \quad [13]$$
$$\boldsymbol{y_t^* = y_{t-1}^* + e_t^{yc}} \quad [14]$$
$$r_t^* = r_{t-1}^* + e_t^r \quad [15]$$
$$\alpha_t = \alpha_1^p + \alpha_2^p \alpha_{t-1} \quad [16]$$
$$r_t^c = \beta_c r_{t-1}^c + e_t^c \quad [17]$$

In the CST model, unlike the IS model, we add equations [13] and [16] and modify equation [14], adding the variables r_t^l, the real long-term interest rate, and α_t, a term premium variable over time, to the model. Equation [13] expresses the relationship between a long-term interest rate that is equal to the short-term interest rate (r_t) plus a premium variable over time (modeled with equation [16] as an autoregressive process with a constant). Equation [14], unlike the previous model, does not include growth in potential output, in order to obtain a minimal state-space representation. We created two variants of this model, estimating potential output and adding potential output as an observed variable[5], estimating the model with and without the highlighted equations.

Uncovered interest rate parity model (UIRP)

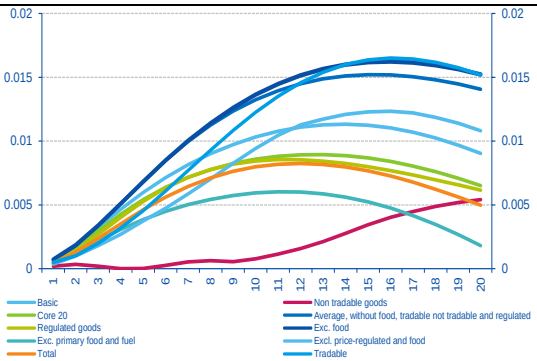
$$r_t^* = r_t^i + (e_t^e - e) + \gamma_t \qquad [18]$$

In equation [18], r_t^* is the domestic natural interest rate, r_t^i is the international interest rate, e is the exchange rate, e_t^e is the expected exchange rate and γ_t is a risk premium. The exchange rate is defined as the number of units of the domestic currency that must be paid for one unit of foreign currency.

Data

The data used in the estimation of output was taken from the monthly economic activity index published by BanRep (IMACO[6]); the real TIB was used for the interest rate[7]; for the long-term interest rate we used the 360-day CDT rate[8]; for the risk premium we used Colombia's EMBI spread; for the projected exchange rate we used forecasts; and for the inflation gap we chose the difference between non-food inflation and the BanRep target[9]. We chose non-food inflation since BanRep's monetary policy responds more closely to non-food inflation than other definitions of inflation (chart 7).

Chart 7
Response of the interbank rate to a stimulus under different inflation definitions.



Source: BBVA Research.

[5] Source: BBVA Research calculations
[6] Source: Banco de la República. For details of how this is constructed, see Kamil H. Pulido J.D. & J.L. Torres, 2010, "*El "IMACO": un índice mensual líder de la actividad económica en Colombia".* Banco de la República.
[7] Source: Asobancaria and BBVA Research. Deflated by non-food inflation.
[8] Source: Banco de la República. Deflated by non-food inflation.
[9] Source: Mejia D.M.2001.*"La meta de inflación de largo plazo y la velocidad de desinflación"* Reports by the issuer, research and economic investigation by BBVA Research

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