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IMPACT OF MACROECONOMIC SURPRISES ON THE BRAZILIAN YIELD CURVE AND EXPECTED INFLATION

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Abstract

Announcements of macroeconomic data can contain unanticipated shocks that impact on the term structure of interest rates, a highly relevant topic for market agents and monetary authorities. The present study investigates how unexpected variations in Brazilian and U.S. macroeconomic indicators affect the term structure of interest rates and expected inflation in Brazil. Using daily data from March 2005 to July 2011, we employ a vector error-correction model in order to take into account the long-term equilibrium among different maturities of the yield curve and the inflation expectations curve. In general, we find empirical evidence that macroeconomic announcement surprises, domestic (Brazilian) and external (U.S. American), which lead the market to believe that there might be a higher risk of inflation or an overheated economy, raise the nominal yield curves and, in some cases, affect the real yield curve and the expected inflation. Surprisingly, in relation to the efficient-market hypothesis, we also find that some macroeconomic surprises have a lagged effect on the yield curve, indicating over- and undershooting as well as delayed responses.

Key words: Nominal and real yield curve; expected inflation; macroeconomic surprises; unanticipated shocks.

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1 – Introduction

According to the efficient-market hypothesis proposed by Fama (1970), asset prices are instantly influenced by the arrival of new information. Several studies have attempted to quantify and evaluate the impact of macroeconomic surprises on different financial instruments, such as the future yield curve, exchange rate and stock market; see for instance Kuttner (2001), Fatum and Scholnick (2008) and Bernanke and Kuttner (2005). However, most of those studies have focused on the U.S. market and its response to unexpected FOMC¹ decisions and to the disclosure of unanticipated macroeconomic information.

Unlike the previously published studies on the subject, our analysis also investigates the impact of unanticipated news on the real yield curve and market inflation expectations. One of the advantages of the methodology adopted is that it enables us to compare the impact of surprises in the nominal and real yield curves as well as the inflation expectations. Thus, our contribution is not limited to being an innovative study of the impact of macroeconomic surprises in the Brazilian economy. We also contribute to the literature by investigating how unexpected news effects disentangle the nominal rates, real rates and expected inflation. Additionally, we investigate whether the market is in fact efficient in this regard by testing whether announcement surprises have lagged effects on nominal and real rates as well as expected inflation.

In one of the first studies on the subject, Kuttner (2001) estimated the impact of Federal Reserve monetary policies on future interest rates, decomposing the monetary authorities' decisions into an expected component (the market expectations extracted from the future yield curve) and an unexpected component (the difference between announced and expected decisions). As predicted, the response of the yield curve to surprises was high and significant; however, the expected component was small and lacked statistical significance.

¹ The FOMC is the monetary policy committee of the Federal Reserve (the Fed) and is responsible for conducting the U.S. monetary policy and deciding on the monetary policy interest rate (Fed Funds rate).

The reactions of the exchange rate and stock market to unexpected information have also been studied. Fatum and Scholnick (2008) estimated the change in the exchange rate in response to changes in the interest rate made by the FOMC and concluded that the unexpected component of the decision is associated with a variation in the value of the dollar on the same day. Unexpected tightening leads to American dollar appreciation, whereas unexpected loosening leads to dollar depreciation. Bernanke and Kuttner (2005), in turn, estimated the influence of FOMC decisions on the U.S. stock market and found that surprises in decisions made by the committee are followed by a consistent response from the U.S. stock market. On average, an unexpected 25-basis-point decrease in the Federal Funds Rate Target is associated with a 1% increase in broad stock indexes.

Other studies have proposed that U.S. macroeconomic surprises produce global shocks. Craine and Martin (2008) described evidence that unexpected movements in both domestic monetary policy and U.S. monetary policy affect the Australian yield curve, while surprises in Australian announcements do not affect the U.S. curve. Ehrmann, Fratzscher and Rigobon (2011) showed that surprises in European macroeconomic data have no significant effect on U.S. American markets; however, Ehrmann and Fratzscher (2011) found evidence of an influence of surprises in U.S. American macroeconomic announcements on European financial markets. Extending the range of those analyses, a panel study by Hausman and Wongswan (2011) provided evidence that surprises in U.S. monetary policy directly affect the financial markets of 49 countries studied.

Balduzzi, Elton and Green (2001) and Taylor (2010) estimated the effects of unanticipated information in the announcements of major U.S. macroeconomic data on the variation in the U.S. yield curve. The median value expected by a panel of several economists was used as the expected data value. The articles concluded that in addition to the FOMC decisions, several indicators affect the variability of the yield curve, with non-farm payrolls and civilian unemployment as the other indicators with the most significant effects.

Also focusing on the study of the effect of surprises in macroeconomic indicators, Ramchander, Simpson and Chaudhry (2003) tested five instruments (treasury bills, certificates of deposit, bankers' acceptances, dealer-placed commercial papers and directly placed commercial papers) within three months of the maturity date. Unlike the previously mentioned studies, a vector error-correction model was used to estimate the impact of surprises on each instrument. Three results were found: (1) the effect of surprises was confirmed in all the instruments; (2) an increase in instrument volatility was observed on the days of surprises in macroeconomic announcements; and (3) movements common to all instruments occurred on the days of surprises, such that the volatilities of the instruments could not be considered significantly different from each other. Ramchander, Simpson and Chaudhry (2005) complemented their previous study using different maturities and a greater number of macroeconomic indicators. The yield curve was significantly affected by surprises in seventeen of the twenty-three announcement types studied.

While the studies presented until now have considered the effects of U.S. data, some studies in the literature have addressed the effects of surprises in other countries. For example, Soderlind (2010) studied the effect of surprises in Swiss monetary policy on the Swiss yield curve and concluded that an unexpected increase in the base rate causes an increase of the same magnitude in the short-term rates (shorter maturity), whereas the longer-term rates show a less intense drop, thereby decreasing the risk premium. In a more recent study, Wang and Mayes (2012) used event study methods to investigate the response of stock prices to monetary policy announcements for New Zealand, Australia, the United Kingdom and the euro area. In particular, the authors found asymmetric responses across the countries, mainly when making comparisons across business cycles and during the global financial crisis, defined as August 2007 to February 2010. Part of the explanation relied on the fact that Australia and New Zealand did not reach the zero bound of monetary policy, in comparison with the UK, which did reach the zero bound. Using high-frequency data, Coleman and Karagedikli (2012) investigated the impact of monetary policy announcements, CPI and GDP news on the New Zealand exchange rate and two- and five-year

swap rate differentials to the U.S. They found evidence that spot exchange rates appreciate and interest rates increase as a result of positive surprises in monetary policy, CPI and GDP. Another interesting fact is their finding that the spot exchange rate has a larger response than the swap interest rates.

Larrain (2007) examined this question in emerging economies and found a positive and significant correlation between the surprise component of decisions made by Chile's Central Bank and variations in the Chilean interest rates. Finally, Reid (2009) measured the response of South African expected inflation to unanticipated shocks in local macroeconomic indicators, and their results indicate that South African expected inflation responds less to unexpected variations in current inflation than was previously observed, suggesting a consistent improvement in Central Bank credibility over the last few years.

Tabak (2004) studied the Brazilian market but did not study the effects of surprises. Instead, Tabak estimated the variability of future interest rates relative to variations in the Selic² rate, regardless of the expected and unexpected components. Therefore, because a significant portion of the variation is anticipated by the market, there is no significant response from the future yield curve to changes in the basic Selic interest rate. Still, for the Brazilian case, Robitaille and Roush (2006) found a positive correlation between the Brazilian C-Bond³ rate and surprises in American monetary policy and a negative correlation between the Brazilian stock market and the same American surprises. Nevertheless, this study did not analyze the effect of surprises in Brazilian macroeconomic indicators on the instruments.

In short, to the best of our knowledge, the literature to date has established three principal results: (1) there is no significant response from any of the studied financial instruments to variations in macroeconomic data anticipated by the market; (2) macroeconomic surprises are consistent with significant movements of the yield curve, exchange rates and stock markets; and (3) U.S. economic shocks cause reactions in the markets of several other countries and may be considered global shocks.

² Selic rate: the weighted and adjusted average rate of financing operations for one day backed by federal public securities. This is a Brazilian reference interest rate determined by the Monetary Policy Committee (COPOM) of the Central Bank.

³ C-Bond: capitalization bond, a Brazilian external debt bond, currently the most liquid one with the highest turnover. These bonds will mature in 2014 and have paid half-yearly installments since 2004.

However, no studies have demonstrated the effect of surprises in domestic and U.S. macroeconomic indicators on the Brazilian yield curve. Moreover, a vast majority of studies have used the nominal yield curve without checking whether the responses occur because of variations in the expected inflation or variations in the real yield.

In summary, we highlight four main contributions of this study to the literature. First, we studied the impact of macroeconomic surprises on the Brazilian economy, an emerging market that was the seventh-largest economy in the world in 2010 according to data from the IMF and the World Bank. Second, we considered not only the impact of domestic surprises on the domestic yield curve but also the impact of unanticipated information from the U.S. economy. Third, our methodology accounted for the possible long-term cointegration relationship among the vertices of the yield curve when estimating the VECM to distinguish the impact of macroeconomic surprises. Finally, this study introduced the innovation of separately analyzing the impact on nominal rates in terms of the real yield and inflation expectations for different maturities.

The rest of the study is organized as follows. The next part of the study focuses on the analysis of the behavior of Brazilian curves for the nominal yield, real yield and market expected inflation in response to surprises in the macroeconomic indicators. This section also describes the data and the econometric model used. The third section discusses the results and the fourth section concludes.

2 – Methodology and data description

2.1 – Methodology

Interest rates of the same securities with different maturities usually move together and are considered substitutes for one another. Therefore, interdependence exists among the several vertices that provide a great deal of information and consequently cannot be disregarded. For this reason, the statistical process is conducted within a framework that preserves the strong effect of substitution and the

equilibrium among the several vertices of the yield curve. Specifically, the cointegration methodology is applied to analyze the long-term equilibrium among the variables.

The cointegration methodology was implemented through three vector error-correction models (hereinafter VECM) for the nominal interest rates, the real interest rates and the implicit expected inflation. As we established above, unanticipated shocks in the macroeconomic indicators were inserted into the VECMs as a vector of exogenous variables. This methodology enabled flexible and functional modeling of the behavior of interest rates, thus enabling the differentiation of short-term and long-term relationships while estimating the impact of each macroeconomic announcement on the yield curve.

To estimate the VECs, we first tested whether there were unit roots in each of the vertices of the nominal yield, real yield and expected inflation curves through the augmented Dickey–Fuller test. The cointegration tests were then conducted after testing for unit roots in the series integrated in the same order, i.e., after requiring that the series included in our VECMs were all stationary. We also made use of the Hannan–Quinn criterion to select the number of lags to be considered in the model. This method is performed by estimating a VAR model and applying a test to choose the number of lags.

The Johansen (1988) procedure was used to identify the existence of cointegration relationships among the different vertices. This test uses the maximum likelihood method and aims to determine the number of cointegration vectors required for the system.

Having confirmed that a long-term balanced relationship exists, we then proceeded to estimate a VECM to obtain the impact of macroeconomic surprises, which are included as exogenous variables. Specifically, the VECM is represented by the following system of equations:

$$\begin{aligned}
 \Delta Y_{1,t} &= \alpha_1 + \sum_{j=1}^n \sum_{i=1}^p \beta_{1,ji} \Delta Y_{j,t-i} + \sum_{k=1}^r \sum_{j=1}^n \omega_{k,j} Y_{j,t-1} + \sum_{l=1}^m \varphi_{1,l} S_{l,t} + \varepsilon_{1,t} \\
 \Delta Y_{2,t} &= \alpha_2 + \sum_{j=1}^n \sum_{i=1}^p \beta_{2,ji} \Delta Y_{j,t-i} + \sum_{k=1}^r \sum_{j=1}^n \omega_{k,j} Y_{j,t-1} + \sum_{l=1}^m \varphi_{2,l} S_{l,t} + \varepsilon_{2,t} \\
 &\vdots \\
 \Delta Y_{n,t} &= \alpha_n + \sum_{j=1}^n \sum_{i=1}^p \beta_{n,ji} \Delta Y_{j,t-i} + \sum_{k=1}^r \sum_{j=1}^n \omega_{k,j} Y_{j,t-1} + \sum_{l=1}^m \varphi_{n,l} S_{l,t} + \varepsilon_{n,t}
 \end{aligned} \tag{1}$$

where Δ is the first-difference operator, $Y_{j,t}$ is the rate of interest (nominal or real) or expected inflation for maturity i on date t , n is the number of maturity vertices, p is the number of lags obtained by the Hannan–Quinn test, r is the number of cointegration relationships obtained by the Johansen test, m is the number of macroeconomic announcements and S_l is the surprise announcement component for each macroeconomic indicator l . The estimated coefficients are α_j , $\beta_{q,ji}$, $\omega_{k,j}$ and $\varphi_{q,l}$ for $q,j=1,2,\dots,n$; $i=1,\dots,p$; $k=1,\dots,r$; and $l=1,\dots,m$. Finally, $\varepsilon_{j,t}$, $j=1,2,\dots,n$ are the residuals.

More specifically, our main interest was in the coefficients $\varphi_{q,l}$, which measure the impact of each macroeconomic surprise l on the maturity q of the yield curve (nominal and real) and inflation expectations. Consequently, this model enabled us to estimate the effect of each announcement on each of the specific vertices considering the long-run equilibrium relationships between each maturity of the yield curve (nominal and real) and inflation expectations.

2.2 – Data description

Our data set includes daily observations from the period between March 2005 and July 2011, a total of 1580 observations. We considered interest rates from 1-, 3-, 6-, 12-, 18-, 24-, 30- and 36-month contracts from BM&FBovespa⁴ Pré x DI and IPCA x DI swaps to unanticipated shocks to the main Brazilian economic indicators.

As explanatory variables, we included nine macroeconomic announcements for the Brazilian Economy and seven U.S. indicators. Namely, for Brazil, these indicators include the monthly National Consumer Price Index – broad (*Índice de Preços ao Consumidor—IPCA*), the monthly Market General Price Index (*Índice Geral de Preços do mercado—IGPM*), the GDP, the trade balance, the monthly unemployment rate, the monthly retail sales index and the industrial production, the source for all of them being the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística—*

⁴ Pré x DI swap: a swap that is active in fixed rate and passive in CDI (Interbank Deposit Certificate – post fixed rate) registered at the Brazilian Mercantile and Futures Exchange (BM&F Bovespa). IPCA x DI swap: a swap that is active in the variation in inflation index IPCA and passive in CDI registered at the Brazilian Mercantile and Futures Exchange (BM&F Bovespa).

IBGE). We also considered the basic interest rate (Selic) announced by the Monetary Policy Committee of the Brazilian Central Bank (COPOM) and the number of job creations released by the General Register of Employed and Unemployed (Caged) from the Ministry of Labor and Employment. In addition, we examined whether the unexpected components of American inflation indicators (CPI – Consumer Price Index), industrial activity (ISM⁵), new home sales, retail sales, volume of orders and deliveries for durable goods, number of jobs created and Fed Funds rate decisions by the FOMC (Federal Open Market Committee of the Federal Reserve) impact on Brazilian yield curves. All U.S. announced data were collected from the Bloomberg databases.

We obtained the inflation expectations directly from the nominal and real interest rates. According to the Fisher equation, the nominal interest rate may be written as:

$$1 + i_{j,t} = (1 + r_{j,t}) \times (1 + \pi_t^e) \quad (2),$$

where j denotes the maturity, t denotes the date of observation, i is the nominal interest rate, r is the real interest rate and π^e is the expected inflation. The above-defined IPCA x DI swap curve supplies the real interest rates, and the Pre x DI swap curve provides the nominal interest rates. Therefore, the expected inflation may be obtained by equation (2) rewritten as follows:

$$1 + \pi_{j,t}^e = \frac{1 + i_{j,t}}{1 + r_{j,t}} \quad (3)$$

Notice that in equation (3) we are implicitly incorporating into the expected inflation, π^e , the inflationary risk premium; see Kozicki and Sellon (2005).

⁵ The ISM is the Manufacturing Institute for Supply Management Report on Business and it is based on data compiled from monthly replies to questions asked of purchasing and supply executives in over 400 industrial companies. A higher value of the ISM indicates better economic conditions and a higher activity level.

The surprise in each announcement is defined as the difference between the disclosed data and the survey's median:⁶

$$S_l = \frac{I_l^a - I_l^e}{\sigma_l} \quad (4)$$

where S_l is the surprise component, I_l^a and I_l^e are, respectively, the disclosed and expected values for the macroeconomic indicator l and σ_l is the standard deviation of the same indicator l . More specifically, I_l^e is the median value of expectations collected from the Bloomberg survey with a sample of market analysts. Tables 1 and 2 present descriptive statistics for Brazilian and U.S. macroeconomic announcement surprises computed according to equation (4). Figures 1 and 2 illustrate the relative size and frequency across time of the surprises.

[INSERT TABLE 1 AROUND HERE]

Because most of the macroeconomic data considered were disclosed on a monthly or quarterly basis and the survey database contains data on a daily basis, we assigned the disclosed macroeconomic indicator value (more precisely, its surprise component) to the first trading session during which the information was available and assign a zero value to all the other working days. Sixteen vectors were created in this way for use as regressors in our VECM specification, equation (1).

[INSERT TABLE 2 AROUND HERE]

Of the announcements studied here, the Brazilian job creation data started only on February 28, 2009; therefore, we set the Brazilian series of surprises for job creation before this date equal to zero.

[INSERT FIGURES 1 AND 2 AROUND HERE]

⁶ Except for the COPOM and FOMC meetings, at which the Bloomberg survey average was used. As the committee movements are usually multiples of 25 basis points, the expectations of economists are also multiples of 25 basis points. Because of this characteristic, the average provides more information about the division of expectations than the median, as the latter will also be a multiple of 25 basis points.

3 – Results

3.1 – Unit root test and cointegration

We began the data analysis by checking the temporal characteristics of each series. Table 3 shows the results of the ADF unit root test. The empirical evidence suggests that all the rates are integrated of order one – $I(1)$. This justifies our estimation of the VEC in differences, equation (1).

[INSERT TABLE 3 AROUND HERE]

Table 4 presents the results of the Johansen cointegration tests. A test was conducted for each group of rates, nominal yield, real yield and expected inflation. In all of the three groups we found evidence of more than one cointegration relationship among all the vertices considered. Those results confirmed our preliminary hypothesis that rates at different maturities maintain a long-run equilibrium relationship, so we established the VECM as the appropriate model to be estimated.

[INSERT TABLE 4 AROUND HERE]

3.2 – Impacts of macroeconomic surprises on the curves for nominal yield, expected inflation and real yield

Three vector error corrections (VEC) were estimated, one for each group of analyzed term structures (nominal yields, real yields and expected inflations) to verify how the surprises impact on each of those components when inserted into the system as exogenous variables. Therefore, it is possible to understand the market dynamics, i.e., whether the shocks generate variations in the inflation expectations, nominal yield or real yield.

To make the coefficients comparable, the surprises were normalized as defined in equation (4). The coefficients may be interpreted as the effect of a surprise with a magnitude of one standard deviation of the indicator on the vertices of the yield curve.

Table 5 shows the VEC results for the 3-, 12- and 36-month vertices.⁷ We considered those vertices as representing respectively short-, medium- and long-term effects.⁸ Analyzing the domestic macroeconomic surprises revealed that the unexpected component of COPOM decisions regarding the monetary policy Selic interest rate has a statistically significant impact on short-term nominal interest rates. This effect is larger for the shorter vertices and decreases as the term increases until the coefficient is negative and not significant in the long term (36 months). One possible explanation for this result is that the market understands that an unexpected increase in the short-term monetary policy rate changes the expectations towards tougher monetary policy in the future, leading to an increase in the short- (3-month) and mid-term (12-month) nominal yields. However, it is interesting to see that neither inflation expectations nor real yields are affected.

[INSERT TABLE 5 AROUND HERE]

Unanticipated news about the Brazilian GDP had a statistically significant impact only for the medium term (12 months). The GDP surprise impact is positive for the expected inflation and negative for the real yield, while generating practically no effect on the nominal yield. One possible interpretation of this result is that the market considers that the Central Bank will not increase the nominal yield in response to an unexpected upsurge in the economy; consequently, an increase in inflation is expected but compensated for by a lower real interest rate.

Surprises in inflation had a positive and significant effect on the nominal interest curve, with the IPCA exerting an effect on all of the curves, whereas the IGPM affected the expected inflation and long-term real yield but not the nominal interest. Because the IPCA is the official inflation index for the inflation target system adopted by the Brazilian Central Bank, this indicator is expected to affect monetary policy decisions, and consequently the yield curve is expected to react more intensely to

⁷ Tables A.1, A.2 and A.3 in the appendix present the results for all of the tested vertices. The results show that our results do not change by summarizing the results only for the 3-, 12- and 26-month vertices. Figures A.1, A.2 and A.3 in the appendix show the residues of the three estimated VECs.

⁸ For a developed economy, medium term refers to 2–10 years and long term is considered to be more than 10 years; however, for an emerging economy like Brazil, the liquidity of fixed-income instruments with more than 3 years is very limited, which is why we adopted these more appropriate concepts of medium- and long-term horizons.

surprises in the IPCA than in the IGPM. One interpretation of the positive IPCA coefficient is that the market believes that an inflation surprise would lead to a cycle of increases in the short-term monetary policy rate by the Central Bank, which would reflect the increase in the nominal interest rates in all the vertices. The fact that the inflation expectations' responses to a positive IPCA shock is significantly positive only for the next three months may be interpreted as a sign of the Central Bank's market credibility. The response of the monetary policymaker would be enough to offset the increases in inflation expectations on the 12- and 36-month vertices. Likewise, surprises in the IGP-M inflation index increase the expected inflation and lower the real yield curves in the long term.

Positive surprises in the trade balance indicator, implying higher exports and lower imports, seemed to indicate lower domestic economic activity and consequently decreased the nominal interest rates in the short term. Unexpected higher retail sales increased the nominal yields in the 12-month maturity and increased the inflation expectations in the longer term. Unexpectedly, surprises in the unemployment rate and job creation did not cause any statistically significant coefficient.

Surprises in Brazilian industrial production increased the nominal interest rates in all three maturities; they also increased the real yields at the 12-month maturity and inflation expectations in the longer 36-month maturity. This result indicates that the industrial production indicator is one of the indicators that is most closely monitored by investors and that surprises in this indicator may change projections for the Brazilian economy and lead to a shift in interest rates to correct for excess demand or supply.

Another interesting result is that the IPCA and Brazilian industrial production show significant coefficients of the same order of magnitude in the three periods: short term, medium term and long term. Therefore, surprises in the IPCA or in industrial production lead to almost parallel shifts in all the nominal yield curves.

Similar to our result reported for the domestic industrial production indicator, unanticipated positive U.S. shocks on the ISM economic conditions index had a positive and significant impact on short- and medium-term maturities for the nominal yields and in all the maturities for the real yields. Likewise, positive news relating to the Job Creation Index caused an increase in the Brazilian nominal (12- and 36-month) yields and real 36-month yields and no noticeable effect on the future expected inflation. This result may indicate that an upsurge in the U.S. economy, above the market estimates, increases the Brazilian economy's expected activity and consequently increases the nominal and real Brazilian rates.

We also found that U.S. Central Bank decisions on the monetary policy interest rate have a significant impact on other economies. In particular, an unanticipated increase in the Fed Funds increases the Brazilian nominal and inflation expectations at the longer 36-month maturity. We may interpret this result as an indication that the concerns of an overheated U.S. economy imply higher activity and higher nominal rates for the Brazilian economy in the long run. Further, this finding is in line with that of Hausman and Wongswan (2011), who found that the explanatory power of surprises in U.S. monetary policy for the interest rate were greater in the long term than in the short term in 20 other foreign countries.

In summary, the results shown in table 5 imply that monetary policy decisions, inflation indexes and activity-level indicators have a statistically significant impact on nominal interest rates, real rates or inflation expectations. All the results point in a common direction: positive surprises, indicating unanticipated higher inflation or a more accelerated economy than expected, will increase rates and inflation expectations. However, across the indicators we see great heterogeneity. First, domestic surprises regarding the monetary policy interest rate and the official inflation index increase the nominal rates. Second, still on the domestic front, a higher activity level, mainly measured by the industrial production index, increases both the nominal rates and the inflation expectations. Third, considering positive U.S. unanticipated news, we emphasize the great impact of the ISM activity level and job

creation, increasing the Brazilian nominal and real rates and the impact of the Fed Funds rate, in which positive surprises increase the nominal rates and inflation expectations for the longer 36-month maturity only.

3.3 – Impacts of lagged surprises

The last step of our empirical analysis was to estimate the impact of surprises on the yield curve one day after the surprise. This exercise intended to determine whether the initial market responses to surprises are totally absorbed on the day of the announcement or not. If the coefficients of the lagged surprises are statistically significant, there are three possible results: i) overshooting, when the estimated coefficient has the opposite sign of the previous day's coefficient; ii) undershooting, which is the opposite case to i) with the lagged impact reinforcing the sign of the contemporaneous impact; and iii) delayed responses, which would be the case in which the previous coefficient was found not to be significant.

For this purpose, we added the lagged surprises term $\sum_{l=1}^m \gamma_{j,l} S_{j,t-1}$ to each equation $j=1, \dots, n$ in our VECM represented in equation (1). Remembering our notation, $S_{l,t-1}$ is the surprise component for each indicator l lagged by one day, yesterday's surprise, and $\gamma_{j,l}$ is the coefficient that measures the lagged impact of surprise l on the maturity j of the yield (real and nominal) and inflation curves.

The coefficients of the three VECMs were re-estimated with the additional term for lagged surprises. The values of the contemporaneous coefficients changed slightly without affecting the previously obtained results and are not reported here. Table 6 shows the estimated coefficients for the variation of vertices in response to surprises of one standard deviation for each of the macroeconomic announcements on the day after the announcement.

[INSERT TABLE 6 AROUND HERE]

Looking at the results shown in table 6, it is clear that not all the surprises were absorbed in the same day as the announcement. First, there is some evidence of overshooting corrections for the domestic

IPCA official inflation index (short-term inflation expectations), for the Brazilian retail sales (long-term inflation expectations) and for the U.S. job creation indicator (long-term 36-month nominal yield).

Second, we only observed underreaction responses to the FOMC decision, with a further increase in the day following the announcement of the 36-month Brazilian nominal yield in response to an unexpected increase in the U.S. monetary policy rate.

Finally, we found evidence of many delayed responses, meaning that the market responds only on the day following the announcement for some indicators. For the domestic surprises, we found a positive short-term real yields increase in response to an unexpected surge in the official inflation index, IPCA. We also found evidence of a positive delayed reaction in the 3-month nominal yields and inflation expectations to surprises in the GDP. The short-term real yield also responds in a delayed way to an unpredicted increase in industrial production. An unanticipated increase in Brazilian unemployment only decreases the long-term (36-month) inflation expectations on the next day. For U.S. surprises, we also found delayed responses of the 12-month nominal yield curves and 36-month real yields to unexpected increases in the Fed Funds rate. In addition, the 36-month nominal yield curves react positively to surprises regarding the activity-level indicators ISM and durable goods orders.

4 – Conclusions

This study presents empirical evidence of the impact of surprises in macroeconomic data announcements on the Brazilian nominal and real yield curves and market inflation expectations in the years from 2005 to 2011. We used a VEC to estimate the results while preserving the strong substitution effect and the long-term cointegration relationships among the several vertices.

Besides considering the nominal yields, we also estimated the effect of surprises in announcements on expected inflation and on the real yield curve and, to the best of our knowledge, added to the literature a more complete quantification of the effects on short-, medium- and long-term inflation expectations.

In general, we concluded that unanticipated news indicating inflationary pressures or higher than expected economic activity increases the nominal and real yields and inflation expectations. However, as discussed in the last section, those impacts are not homogeneous across the indicators.

Our results also indicate that the U.S. economy affects Brazilian yields, mainly through the U.S. indicators of Fed Funds rate decisions, industrial activity level and job creation numbers. We confirmed the results of Hausman and Wongsuan (2011) for Brazil. The long-term interest rates vary in response to surprises from the FOMC, whereas the short-term rates show practically no reaction to the same surprises.

Finally, we found that there was a higher number of significant coefficients for the contemporary surprises than for the lagged surprises, leading us to believe that the most important and significant part of the variations caused by surprises occurs on the day of the announcement. However, the market responses to surprises are not all absorbed on the same day, leaving some room for adjustments on the following trading day.

Possible extensions to the study are as follows: (1) verifying the effect of surprises on the volatility of interest rates; (2) studying the response of the stock market and the Brazilian exchange rate to macroeconomic surprises; (3) using high-frequency data to measure the latency of the market response to surprises in announcements and possible “overshooting” throughout the announcement day.

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Table 1 – Descriptive statistics of surprises in Brazilian announcements

	COPOM	GDP	IPCA	IGPM	Trade Balance	Unemploy ment	Job Creation	Retail Sales	Industrial Production
Observations	41	25	66	77	76	67	19	89	70
Average	-0.02	0.08	0.00	-0.01	104.40	-0.04	11,908	0.30	-0.29
Median	-0.01	0.14	0.01	0.01	78.50	-0.10	12,547	0.09	0.09
Maximum	0.21	1.10	0.20	0.26	1.25 1.90	0.80	96,700	4.08	2.40
Minimum	-0.29	-1.90	-0.15	-0.39	-893.00	-0.80	-115,192	-3.68	-6.27
Standard Deviation	0.12	0.69	0.06	0.11	488.72	0.34	53,351	1.31	1.49
Asymmetry	-0.45	-0.69	0.18	-0.42	0.22	0.12	-0.61	0.23	-1.39
Kurtosis	2.73	3.93	4.04	4.03	2.56	2.53	3.02	3.58	5.84

Note: This table presents the descriptive statistics for the series of surprises in the announcements of each of the Brazilian macroeconomic indicators. On days without an announcement, no observations were considered.

Table 2 – Descriptive statistics of surprises in American announcements

	CPI	ISM	New Homes Sold	Retail Sales	Orders of Durable Goods	Jobs	FOMC
Observations	62	69	76	70	73	73	21
Average	- 0.00	- 0.29	-2 1.58	- 0.01	- 0.03	-32.58	- 0.02
Median	- 0.10	- 0.30	-17.00	0.10	- 0.10	-22.00	0.00
Maximum	0.50	4.50	169.00	1.70	9.50	213.00	0.07
Minimum	- 0.50	-5.40	-189.00	- 1.70	-1 0.70	-467.00	- 0.23
Standard Deviation	0.17	2.10	62.94	0.72	3.16	118.23	0.08
Asymmetry	0.35	0.10	0.18	- 0.04	- 0.14	- 0.84	- 1.43
Kurtosis	4.07	2.46	4.18	2.96	4.27	4.87	4.10

Note: This table presents the descriptive statistics for the series of surprises in the announcements of each of the American macroeconomic indicators. On days without an announcement, no observations were considered.

Table 3 – ADF unit root test

Maturity (Months)	Level			First Difference		
	Nominal Yield	Expected Inflation	Real Yield	Nominal Yield	Expected Inflation	Real Yield
1	-2.17	0.68	-1.14	-40.28*	-51.45*	-50.97*
3	-2.12	1.60	-0.84	-40.12*	-51.24*	-50.1*
6	-2.14	1.48	-1.26	-39.90*	-46.26*	-46.28*
12	-2.02	1.34	-1.54	-42.17*	-45.13*	-43.29*
18	-1.95	1.03	-1.59	-42.24*	-45.56*	-44.44*
24	-1.90	0.85	-1.51	-41.43*	-47.04*	-45.31*
30	-1.88	0.62	-1.53	-40.26*	-44.82*	-43.65*
36	-1.93	-0.06	-0.91	-40.99*	-45.78*	-43.83*

Note: This table shows the results of the augmented Dickey–Fuller (ADF) unit root test for the level and first difference for each of the vertices of the curves for the nominal yield, expected inflation and real yield. The null hypothesis of the test is that there is a unit root in the series. The * indicates rejection of the null hypothesis with statistical significance of 1%.

Table 4 – Johansen cointegration test

Nominal Yield			
Number of Cointegration Equations	Statistics	Critical Value	P-value
None *	809.19	169.60	0.00
Maximum 1*	669.79	134.68	0.00
Maximum 2*	372.58	103.85	0.00
Maximum 3*	215.45	76.97	0.00
Maximum 4*	130.77	54.08	0.00
Maximum 5*	53.68	35.19	0.00
Maximum 6	18.46	20.26	0.00
Maximum 7	4.73	9.16	0.31

Expected Inflation				Real Yield			
Number of cointegration equations	Statistics	Critical Value	P-value	Number of Cointegration Equations	Statistics	Critical Value	P-value
None *	424.21	187.47	0.00	None *	416.01	187.47	0.00
Maximum 1*	263.47	150.56	0.00	Maximum 1*	260.64	150.56	0.00
Maximum 2*	160.55	117.71	0.00	Maximum 2*	182.99	117.71	0.00
Maximum 3*	104.07	88.80	0.00	Maximum 3*	120.82	88.80	0.00
Maximum 4	54.48	63.88	0.01	Maximum 4*	71.80	63.88	0.00
Maximum 5	31.69	42.92	0.35	Maximum 5	42.23	42.92	0.02
Maximum 6	16.69	25.87	0.56	Maximum 6	19.17	25.87	0.13
Maximum 7	6.74	12.52	0.40	Maximum 7	6.22	12.52	0.45

Note: This table shows the results of the Johansen cointegration tests for nominal interest rates, expected inflation and real interest rates. The null hypothesis of the test is that the number of cointegration equations is less than or equal to the tested maximum number. The * indicates the rejection of the null hypothesis at a statistical significance of 5%.

Table 5 – Estimated coefficients for normalized surprises

	3 months			12 months			36 months			
	Nominal Yield	Inflation Expect.	Real Yield	Nominal Yield	Inflation Expect.	Real Yield	Nominal Yield	Inflation Expect.	Real Yield	
BRAZIL	Selic rate	8.95 (7.49)***	-4.44 (-0.46)	9.28 (0.89)	6.85 (4.14)***	1.57 (0.52)	4.38 (1.30)	-0.81 (-0.38)	-1.77 (-0.86)	0.27 (0.13)
	IPCA	2.32 (2.45)**	16.94 (2.21)**	-8.92 (-1.08)	3.72 (2.83)***	2.49 (1.03)	2.41 (0.90)	3.45 (2.03)**	1.09 (0.67)	2.89 (1.74)*
	IGPM	0.62 (0.71)	2.08 (0.29)	-0.67 (-0.09)	0.95 (0.78)	1.17 (0.53)	-0.27 (-0.11)	0.87 (0.55)	5.05 (3.38)**	-3.51 (-2.31)**
	GDP	-0.48 (-0.31)	10.24 (0.81)	-9.53 (-0.71)	0.37 (0.17)	11.28 (2.85)**	-11.04 (-2.55)**	-0.15 (-0.05)	2.28 (0.85)	-0.78 (-0.29)
	Industrial Production	5.22 (5.79)***	0.06 (0.01)	2.58 (0.33)	4.94 (3.95)***	-0.81 (-0.35)	4.61 (1.83)*	5.22 (3.22)***	4.63 (3.00)**	0.46 (0.29)
	Retail Sales	0.08 (0.10)	3.23 (0.50)	-3.11 (-0.45)	1.89 (1.71)*	2.91 (1.43)	-1.63 (-0.73)	2.15 (1.50)	2.91 (2.13)**	-0.87 (-0.63)
	Unemployment	-0.30 (-0.32)	-5.49 (-0.72)	3.74 (0.46)	-1.62 (-1.25)	-0.72 (-0.30)	-1.26 (-0.48)	-0.51 (-0.30)	-2.54 (-1.58)	0.85 (0.52)
	Job Creation	0.44 (0.25)	-10.84 (-0.76)	7.17 (0.47)	0.48 (0.20)	0.43 (0.10)	-0.61 (-0.12)	-1.08 (-0.34)	3.78 (1.26)	-5.00 (-1.63)
	Trade Balance	-3.54 (-4.1)***	-3.46 (-0.50)	10.38 (1.39)	-1.31 (-1.10)	-0.90 (-0.41)	0.45 (0.19)	-1.59 (-1.03)	0.79 (0.54)	-1.50 (-1.00)
	Fed Funds Rate	1.26 (0.75)	3.45 (0.25)	-0.67 (-0.05)	2.60 (1.11)	-5.38 (-1.25)	7.05 (1.49)	7.24 (2.39)**	6.41 (2.22)**	0.18 (0.06)
	CPI	-0.02 (-0.02)	-0.79 (-0.10)	2.28 (0.26)	-0.84 (-0.60)	-2.86 (-1.12)	2.70 (0.96)	-3.32 (-1.83)*	-1.42 (-0.83)	-1.09 (-0.62)
	ISM	5.87 (6.36)***	2.30 (0.31)	36.27 (4.52)***	5.27 (4.13)***	0.63 (0.27)	14.25 (5.52)***	0.73 (0.44)	-2.16 (-1.37)	7.04 (4.39)***
USA	New Home Sales	-0.48 (-0.57)	0.30 (0.04)	0.59 (0.08)	-0.43 (-0.37)	-2.37 (-1.10)	1.75 (0.74)	-0.30 (-0.20)	-0.27 (-0.19)	-0.66 (-0.45)
	Retail Sales	0.89 (0.96)	-5.90 (-0.79)	3.40 (0.42)	1.47 (1.14)	2.13 (0.90)	-0.39 (-0.15)	0.98 (0.59)	-0.47 (-0.30)	0.99 (0.62)
	Durable Goods Orders	-0.55 (-0.61)	-0.61 (-0.08)	-0.65 (-0.08)	-1.66 (-1.33)	-0.23 (-0.10)	-1.13 (-0.45)	-1.20 (-0.74)	2.49 (1.61)	-3.85 (-2.45)**
	Job Creation	0.89 (1.02)	0.64 (0.09)	1.00 (0.13)	2.59 (2.15)**	1.02 (0.46)	1.10 (0.45)	3.41 (2.18)**	-1.10 (-0.74)	3.82 (2.52)**

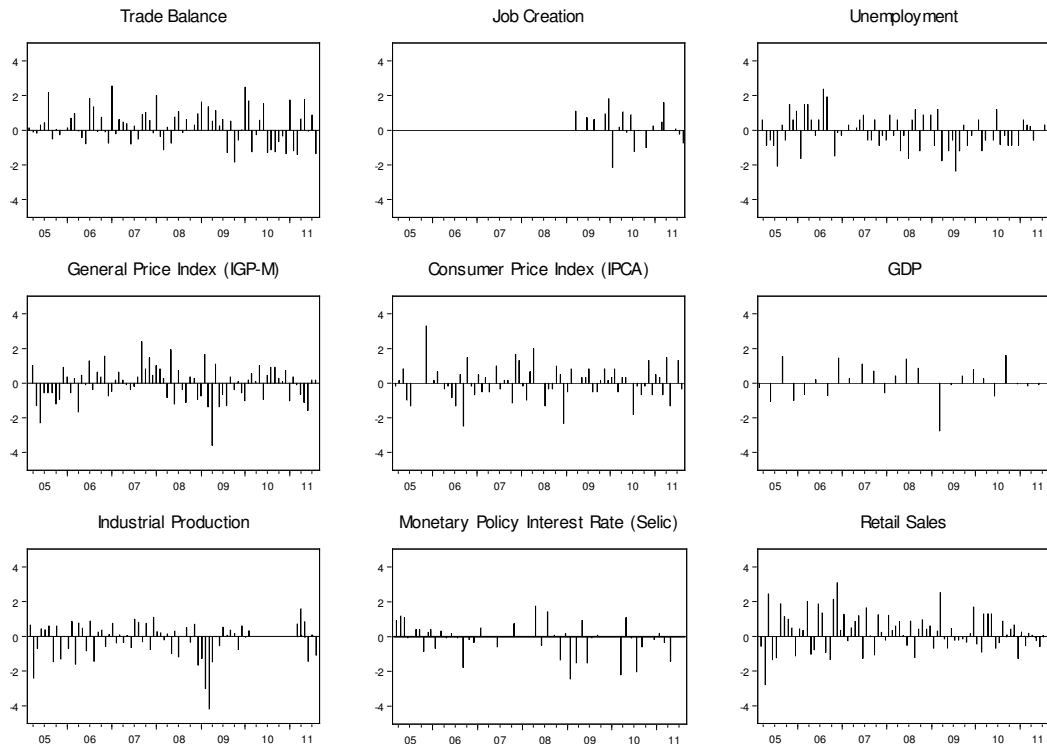
Note: This table shows the estimated VEC coefficients for the variation of short-, average- and long-term vertices of the nominal yield, expected inflation and real yield curves in response to surprises of one standard deviation for each of the macroeconomic announcements. The t statistic of each coefficient is in brackets. *, ** and *** indicate statistical significance of 10%, 5% and 1%, respectively. All of the coefficients were multiplied by 100 for better visualization.

Table 6 – Estimated coefficients for surprises lagged by one day

	3 months			12 months			36 months			
	Nominal Yield	Inflation Expect.	Real Yield	Nominal Yield	Inflation Expect.	Real Yield	Nominal Yield	Inflation Expect.	Real Yield	
BRAZIL	Selic Rate	0.30 (0.25)	-5.24 (-0.54)	1.36 (0.13)	-1.30 (-0.77)	-0.15 (-0.05)	-1.16 (-0.34)	0.28 (0.13)	1.12 (0.55)	-0.72 (-0.34)
	IPCA	0.77 (0.81)	-17.80 (-2.31)**	17.86 (2.15)**	1.43 (1.08)	-0.93 (-0.38)	2.58 (0.96)	2.54 (1.49)	1.26 (0.77)	1.14 (0.69)
	IGPM	-0.84 (-0.96)	4.36 (0.61)	-4.35 (-0.57)	-0.25 (-0.20)	-1.41 (-0.63)	1.62 (0.66)	-0.71 (-0.45)	-0.26 (-0.17)	-0.09 (-0.06)
	GDP	2.96 (1.91)*	22.05 (1.75)*	-5.99 (-0.44)	3.28 (1.53)	4.58 (1.15)	-1.93 (-0.44)	2.74 (0.99)	4.52 (1.70)*	-1.54 (-0.57)
	Industrial Production	0.88 (0.96)	-7.09 (-0.96)	14.47 (1.83)*	1.42 (1.12)	2.08 (0.90)	-1.00 (-0.39)	0.45 (0.28)	-0.45 (-0.29)	1.88 (1.19)
	Retail Sales	-0.37 (-0.47)	-0.15 (-0.02)	-1.43 (-0.20)	-0.92 (-0.83)	-2.84 (-1.39)	2.55 (1.13)	-1.40 (-0.98)	-2.31 (-1.68)*	1.27 (0.91)
	Unemployment	-0.11 (-0.12)	5.26 (0.69)	-3.57 (-0.44)	0.04 (0.03)	-0.11 (-0.04)	0.29 (0.11)	-0.39 (-0.23)	-2.68 (-1.67)*	2.42 (1.48)
	Job Creation	-0.47 (-0.26)	-12.53 (-0.87)	12.41 (0.80)	-2.71 (-1.10)	1.49 (0.33)	-1.86 (-0.37)	-0.55 (-0.17)	0.83 (0.27)	-0.14 (-0.05)
	Trade Balance	-0.94 (-1.08)	-1.49 (-0.21)	2.99 (0.40)	-1.37 (-1.14)	-2.32 (-1.05)	1.20 (0.49)	-1.11 (-0.71)	-0.13 (-0.09)	-0.83 (-0.55)
	Fed Funds Rate	-0.24 (-0.14)	2.90 (0.21)	1.19 (0.08)	4.15 (1.77)*	2.02 (0.47)	1.93 (0.41)	6.06 (2.00)**	2.41 (0.83)	4.88 (1.65)*
	CPI	0.24 (0.24)	-4.09 (-0.50)	6.00 (0.68)	-0.86 (-0.61)	0.53 (0.21)	-0.23 (-0.08)	-2.28 (-1.26)	-2.13 (-1.24)	0.23 (0.13)
	ISM	1.20 (1.29)	-0.20 (-0.03)	10.04 (1.23)	1.75 (1.36)	1.12 (0.48)	2.36 (0.90)	3.24 (1.94)*	2.37 (1.50)	1.33 (0.82)
USA	New Home Sales	0.33 (0.39)	-0.26 (-0.04)	-0.29 (-0.04)	-0.63 (-0.54)	0.36 (0.17)	-0.03 (-0.01)	-1.39 (-0.91)	-0.17 (-0.12)	-0.65 (-0.44)
	Retail Sales	0.81 (0.87)	4.04 (0.53)	-4.91 (-0.60)	1.06 (0.82)	-0.52 (-0.22)	1.37 (0.52)	0.59 (0.35)	-1.24 (-0.77)	1.36 (0.83)
	Durable Goods Orders	2.18 (2.41)**	-0.71 (-0.10)	1.41 (0.18)	2.81 (2.24)**	2.70 (1.17)	-1.32 (-0.52)	4.44 (2.74)***	1.08 (0.70)	2.01 (1.27)
	Job Creation	0.75 (0.86)	9.31 (1.32)	-8.45 (-1.11)	-0.50 (-0.42)	0.51 (0.23)	-1.06 (-0.43)	-4.42 (-2.84)***	-1.39 (-0.93)	-2.40 (-1.58)

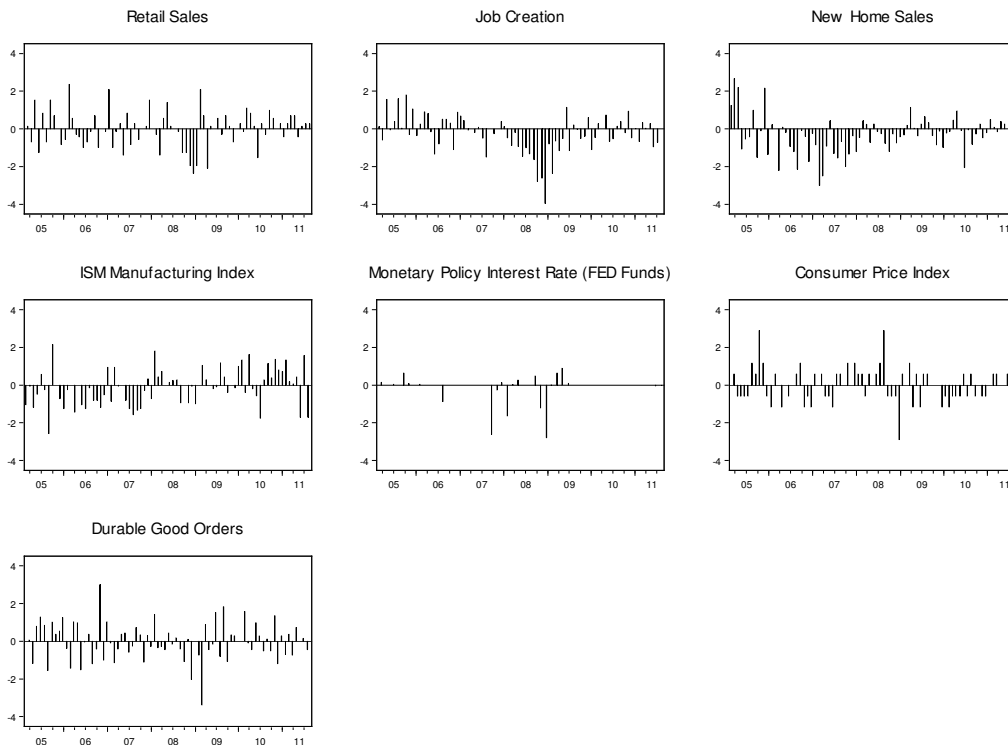
Note: This table shows the estimated coefficients of VECs for the variation of short-, medium- and long-term vertices of the nominal yield, expected inflation and real yield curves in response to surprises of one standard deviation of each of the macroeconomic announcements on the day after the announcement. The t statistic of each coefficient is in brackets. *, ** and *** indicate statistical significance of 10%, 5% and 1%, respectively. All of the coefficients were multiplied by 100 for better visualization.

Figure 1 – Normalized surprises in Brazilian indicators



Note: This figure shows a series of surprises in terms of the numbers of standard deviations for each of the Brazilian economic indicators studied. The y-axis of each graph indicates the number of standard deviations of the surprise, and the x-axis indicates on which trading day the surprise occurred, with the data encompassing 1580 trading days from March 1, 2005 to July 29, 2011. The series of surprises from job creation announcements starts on February 28, 2009 because Bloomberg survey data were not available before this date.

Figure 2 – Normalized surprises in American indicators



Note: This figure shows the series of surprises in the numbers of standard deviations for each of the American economic indicators studied. The y-axis of the graph indicates the number of surprise standard deviations, and the x-axis indicates on which trading day the surprise occurred, from the first trading day of March 1, 2005 to the 1580th trading day of July 29, 2011.

APPENDIX

Table A.1 – Estimated coefficients for the nominal yield curve

Indicator	Pre 1 month	Pre 3 months	Pre 6 months	Pre 12 months	Pre 18 months	Pre 24 months	Pre 30 months	Pre 36 months		
BRAZIL	COPOM	8,70 (7.43)***	8,95 (7.49)***	8,30 (6.52)***	6,85 (4.14)***	4,05 (2.14)**	2,50 (1.25)	0,16 (0.07)	- 0,81 (- 0.38)	
	GDP	1,11 (0.73)	- 0,48 (- 0.31)	0,61 (0.37)	0,37 (0.17)	0,55 (0.22)	0,44 (0.17)	0,59 (0.22)	- 0,15 (- 0.05)	
	IPCA	0,79 (0.85)	2,32 (2.45)**	2,51 (2.49)**	3,72 (2.83)***	3,40 (2.27)**	3,13 (1.96)**	3,54 (2.12)**	3,45 (2.03)**	
	IGPM	0,17 (0.20)	0,62 (0.71)	0,88 (0.95)	0,95 (0.78)	0,88 (0.63)	1,21 (0.83)	1,24 (0.81)	0,87 (0.55)	
	Trade Balance	-4,58 (-5.43)***	-3,54 (-4.11)***	- 1,78 (- 1.94)*	- 1,31 (- 1.10)	- 1,38 (- 1.01)	- 1,39 (- 0.96)	- 1,85 (- 1.22)	- 1,59 (- 1.03)	
	Unemployment	- 0,29 (- 0.32)	- 0,30 (- 0.32)	- 0,59 (- 0.59)	- 1,62 (- 1.25)	- 1,48 (- 0.99)	- 1,20 (- 0.76)	- 1,55 (- 0.94)	- 0,51 (- 0.30)	
	Job Creation	- 0,39 (- 0.23)	0,44 (0.25)	0,70 (0.38)	0,48 (0.20)	- 1,04 (- 0.37)	- 0,85 (- 0.29)	- 1,51 (- 0.49)	- 1,08 (- 0.34)	
	Retail Sales	0,05 (0.06)	0,08 (0.10)	1,10 (1.30)	1,89 (1.71)*	1,92 (1.52)	1,78 (1.33)	2,06 (1.47)	2,15 (1.50)	
	Industrial Production	5,67 (6.42)***	5,22 (5.79)***	5,16 (5.37)***	4,94 (3.95)***	5,26 (3.68)***	5,58 (3.68)***	5,58 (3.51)***	5,22 (3.22)***	
	CPI	- 0,45 (- 0.45)	- 0,02 (- 0.02)	- 0,93 (- 0.87)	- 0,84 (- 0.60)	- 1,64 (- 1.02)	-2,73 (- 1.61)	-3,19 (- 1.79)*	-3,32 (- 1.83)*	
	ISM	4,26 (4.71)***	5,87 (6.36)***	6,30 (6.41)***	5,27 (4.13)***	4,41 (3.02)***	3,18 (2.05)**	1,76 (1.08)	0,73 (0.44)	
	New Home Sales	- 0,35 (- 0.43)	- 0,48 (- 0.57)	- 0,60 (- 0.66)	- 0,43 (- 0.37)	- 0,52 (- 0.39)	- 0,39 (- 0.27)	0,45 (0.30)	- 0,30 (- 0.20)	
	USA	Retail Sales	0,33 (0.37)	0,89 (0.96)	0,94 (0.95)	1,47 (1.14)	1,48 (1.00)	1,35 (0.87)	0,46 (0.28)	0,98 (0.59)
		Durable Goods Orders	- 0,28 (- 0.32)	- 0,55 (- 0.61)	- 0,70 (- 0.73)	- 1,66 (- 1.33)	- 1,71 (- 1.20)	- 1,44 (- 0.95)	- 1,66 (- 1.05)	- 1,20 (- 0.74)
		Job Creation	0,18 (0.21)	0,89 (1.02)	1,53 (1.66)*	2,59 (2.15)**	3,52 (2.55)**	3,89 (2.66)***	4,09 (2.67)***	3,41 (2.18)**
FOMC		0,59 (0.36)	1,26 (0.75)	1,84 (1.03)	2,60 (1.11)	5,22 (1.96)*	7,17 (2.53)**	7,81 (2.64)***	7,24 (2.39)**	

Note: This table shows the estimated VEC coefficients for the variation of each one of the vertices of the nominal yield curves in response to normalized surprises for each of the macroeconomic announcements. The t statistic of each coefficient is between brackets. *, ** and *** indicate statistical significance of 10%, 5% and 1%, respectively. All of the coefficients were multiplied by 100 for better visualization.

Table A.2 – Estimated coefficients for expected inflation

	IPCA 1 month	IPCA 3 months	IPCA 6 months	IPCA 12 months	IPCA 18 months	IPCA 24 months	IPCA 30 months	IPCA 36 months	
BRAZIL	COPOM	0.08 (0.00)	-4.44 (-0.46)	-3.88 (-0.74)	1.57 (0.52)	-2.19 (-0.92)	-3.56 (-1.56)	-2.35 (-1.14)	-1.77 (-0.86)
	GDP	7.087 (2.07)**	1.024 (0.81)	1.000 (1.46)	1.128 (2.85)***	7.48 (2.42)**	5.21 (1.75)*	3.23 (1.20)	2.28 (0.85)
	IPCA	5.119 (2.45)**	16.94 (2.21)**	-1.75 (-0.42)	2.49 (1.03)	1.40 (0.74)	0.36 (0.20)	0.78 (0.48)	1.09 (0.67)
	IGPM	-4.54 (-0.24)	2.08 (0.29)	0.93 (0.24)	1.17 (0.53)	3.41 (1.97)**	4.06 (2.44)**	4.45 (2.96)***	5.05 (3.38)***
	Trade Balance	-46.75 (-2.46)**	-3.46 (-0.50)	0.35 (0.09)	-0.90 (-0.41)	-0.26 (-0.15)	0.16 (0.10)	-0.17 (-0.12)	0.79 (0.54)
	Unemployment	-2.004 (-0.97)	-5.49 (-0.72)	-5.54 (-1.34)	-0.72 (-0.30)	-1.71 (-0.92)	-2.11 (-1.18)	-3.07 (-1.90)*	-2.54 (-1.58)
	Job Creation	-2.160 (-0.56)	-1.084 (-0.76)	-1.36 (-0.18)	0.43 (0.10)	3.51 (1.01)	4.86 (1.45)	3.44 (1.14)	3.78 (1.26)
	Retail Sales	-8.72 (-0.50)	3.23 (0.50)	-1.86 (-0.53)	2.91 (1.43)	1.90 (1.20)	1.81 (1.19)	2.89 (2.11)**	2.91 (2.13)**
	Industrial Production	-8.10 (-0.41)	0.06 (0.01)	2.06 (0.52)	-0.81 (-0.35)	1.17 (0.66)	2.08 (1.21)	3.92 (2.52)**	4.63 (3.00)***
	USA	CPI	-17.98 (-0.81)	-0.79 (-0.10)	-1.73 (-0.39)	-2.86 (-1.12)	-1.12 (-0.56)	-0.85 (-0.44)	-1.13 (-0.65)
ISM		-13.94 (-0.68)	2.30 (0.31)	0.34 (0.08)	0.63 (0.27)	0.69 (0.38)	0.32 (0.18)	-1.31 (-0.82)	-2.16 (-1.37)
New Home Sales		1.57 (0.08)	0.30 (0.04)	-1.18 (-0.32)	-2.37 (-1.10)	-1.54 (-0.92)	-1.14 (-0.71)	-0.66 (-0.45)	-0.27 (-0.19)
Retail Sales		-17.30 (-0.85)	-5.90 (-0.79)	9.18 (2.26)**	2.13 (0.90)	0.55 (0.30)	-0.14 (-0.08)	-1.04 (-0.65)	-0.47 (-0.30)
Durable Goods Orders		-2.75 (-0.14)	-0.61 (-0.08)	-0.59 (-0.15)	-0.23 (-0.10)	0.12 (0.07)	1.13 (0.66)	2.42 (1.56)	2.49 (1.61)
Job Creation		-4.80 (-0.25)	0.64 (0.09)	-4.11 (-1.07)	1.02 (0.46)	-0.41 (-0.24)	-0.52 (-0.32)	-0.32 (-0.21)	-1.10 (-0.74)
FOMC		1.47 (0.04)	3.45 (0.25)	0.67 (0.09)	-5.38 (-1.25)	0.14 (0.04)	2.45 (0.76)	5.53 (1.90)*	6.41 (2.22)**

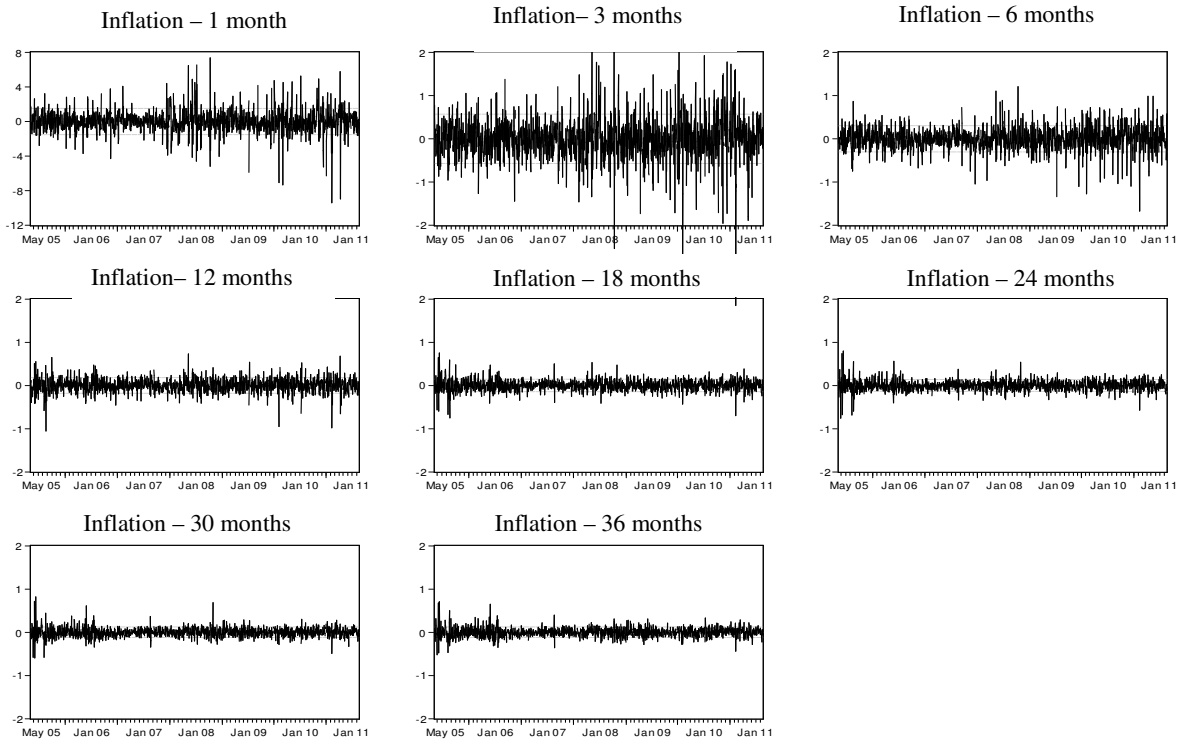
Note: This table shows the estimated VEC coefficients for the variation of each of the vertices of the expected inflation curve in response to normalized surprises in each of the macroeconomic announcements. The t statistic of each coefficient is in brackets. *, ** and *** indicate statistical significance of 10%, 5% and 1%, respectively. All of the coefficients were multiplied by 100 for better visualization.

Table A.3 – Estimated coefficients for the real yield curve

Indicator	Real yield 1 month	Real yield 3 months	Real yield 6 months	Real yield 12 months	Real yield 18 months	Real yield 24 months	Real yield 30 months	Real yield 36 months	
BRAZIL	COPOM	3.56 (0.14)	9.28 (0.89)	11.53 (1.99)**	4.38 (1.30)	5.71 (2.23)**	4.97 (2.09)**	1.75 (0.82)	0.27 (0.13)
	GDP	-63.11 (-1.88)*	-9.53 (-0.71)	-9.79 (-1.31)	-11.04 (-2.55)**	-6.76 (-2.05)**	-4.11 (-1.34)	-1.69 (-0.61)	-0.78 (-0.29)
	IPCA	-32.77 (-1.59)	-8.92 (-1.08)	5.66 (1.23)	2.41 (0.90)	2.85 (1.41)	3.30 (1.75)*	3.17 (1.88)*	2.89 (1.74)*
	IGPM	2.57 (0.14)	-0.67 (-0.09)	-0.30 (-0.07)	-0.27 (-0.11)	-2.79 (-1.50)	-3.07 (-1.77)*	-3.02 (-1.96)*	-3.51 (-2.31)**
	Trade Balance	51.93 (2.79)***	10.38 (1.39)	1.54 (0.37)	0.45 (0.19)	-0.32 (-0.17)	-1.46 (-0.85)	-1.76 (-1.15)	-1.50 (-1.00)
	Unemployment	15.20 (0.74)	3.74 (0.46)	4.25 (0.93)	-1.26 (-0.48)	0.01 (0.01)	0.40 (0.21)	1.25 (0.74)	0.85 (0.52)
	Job Creation	-5.59 (-0.15)	7.17 (0.47)	-2.42 (-0.28)	-0.61 (-0.12)	-4.50 (-1.20)	-5.98 (-1.71)*	-5.36 (-1.72)*	-5.00 (-1.63)
	Retail Sales	-1.33 (-0.08)	-3.11 (-0.45)	1.28 (0.33)	-1.63 (-0.73)	0.23 (0.14)	0.38 (0.24)	-0.71 (-0.50)	-0.87 (-0.63)
	Industrial Production	9.25 (0.47)	2.58 (0.33)	3.59 (0.82)	4.61 (1.83)*	4.01 (2.09)**	3.24 (1.81)*	1.15 (0.72)	0.46 (0.29)
	USA	CPI	20.30 (0.93)	2.28 (0.26)	1.46 (0.30)	2.70 (0.96)	0.51 (0.24)	-0.54 (-0.27)	-1.24 (-0.70)
ISM		66.59 (3.34)***	36.27 (4.52)***	23.84 (5.34)***	14.25 (5.52)***	10.07 (5.13)***	8.48 (4.63)***	8.07 (4.94)***	7.04 (4.39)***
New Home Sales		-1.16 (-0.06)	0.59 (0.08)	1.00 (0.24)	1.75 (0.74)	0.96 (0.54)	0.61 (0.36)	0.04 (0.02)	-0.66 (-0.45)
Retail Sales		17.32 (0.87)	3.40 (0.42)	-9.36 (-2.10)**	-0.39 (-0.15)	1.15 (0.58)	1.66 (0.91)	1.22 (0.74)	0.99 (0.62)
Durable Goods Orders		-1.79 (-0.09)	-0.65 (-0.08)	-0.29 (-0.07)	-1.13 (-0.45)	-1.70 (-0.88)	-2.45 (-1.37)	-3.85 (-2.41)**	-3.85 (-2.45)**
Job Creation		3.55 (0.19)	1.00 (0.13)	6.51 (1.55)	1.10 (0.45)	3.19 (1.72)*	3.89 (2.25)**	3.99 (2.59)***	3.82 (2.52)**
FOMC		19.85 (0.54)	-0.67 (-0.05)	5.32 (0.65)	7.05 (1.49)	3.68 (1.02)	2.78 (0.83)	1.12 (0.37)	0.18 (0.06)

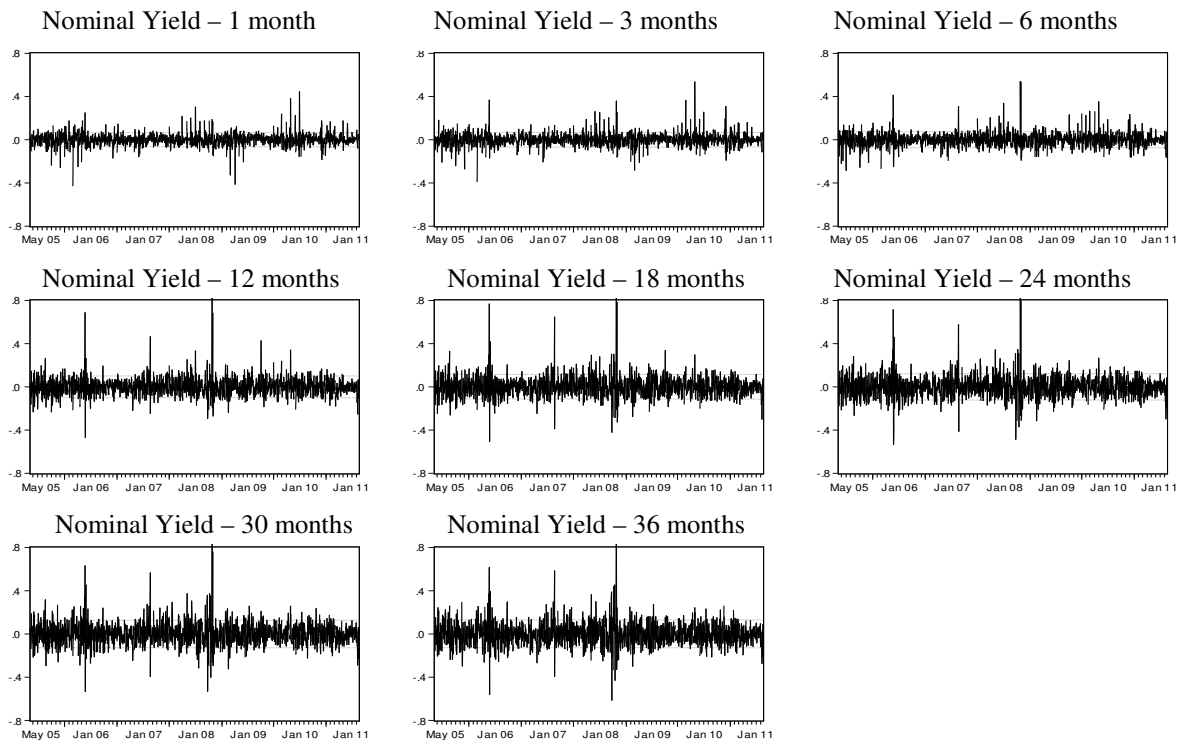
Note: This table shows the estimated VEC coefficients for the variation of each of the vertices of the real yield curve in response to normalized surprises of each of the macroeconomic announcements. The t statistic of each coefficient is in brackets. *, ** and *** indicate statistical significance of 10%, 5% and 1%, respectively. All of the coefficients were multiplied by 100 for better visualization.

Figure A.1 – Residuals of the expected inflation VECs



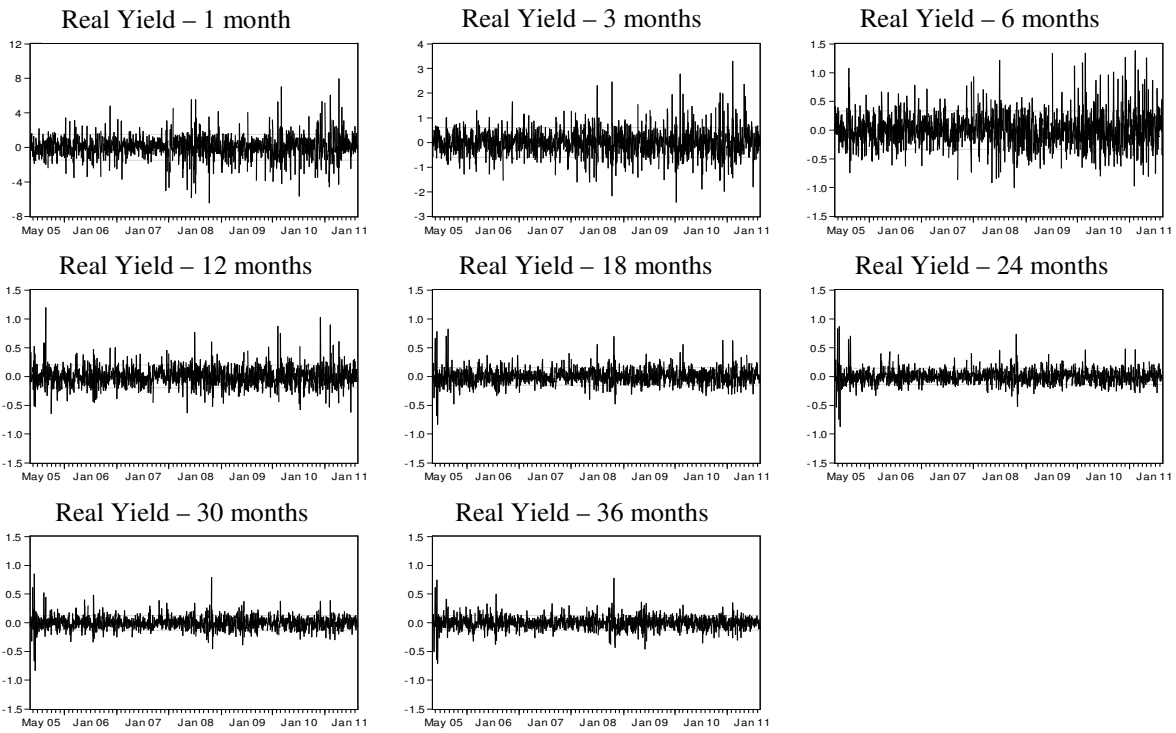
Note: This figure shows a series of residuals for each series of expected inflation data for the VEC of the expected inflation curve.

Figure A.2 – Residuals of the nominal interest rate VECs.



Note: This figure shows the series of residuals for each series of nominal yield data for the VEC of the nominal yield curve.

Figure A.3 – Residuals of the real interest rate VECs



Note: This figure shows the series of residuals for each series of real yield data for the VEC of the real yield curve.