INSPER
PROGRAMA DE ENSINO

BRUNO SPELLANZON

THE FISCAL POLICY IN BRAZIL: A TVAR APPROACH

São Paulo
2016

BRUNO SPELLANZON

THE FISCAL POLICY IN BRAZIL: A TVAR APPROACH

Work Project presented to the Double Degree Masters in Economics Program from Insper and NOVA School of Business and Economics as a part of the prerequisites for the entitlement as Master in Economics.

Area of expertise: Macroeconomics.
Advisor Insper: Marcelo Rodrigues dos Santos
Co-Advisor Nova SBE: Paulo M. M. Rodrigues

São Paulo
2016

Spellanzon, Bruno

The fiscal policy in Brazil: a TVAR approach / Bruno Spellanzon; Advisor: Marcelo Marcelo Rodrigues dos Santos; Co-Advisor: Paulo M. M. Rodrigues – São Paulo: Insper, 2016.

Work Project (Masters – Masters in Economics. Area of expertise: Macroeconomics) – Insper Instituto de Ensino e Pesquisa and NOVA School of Business and Economics.

1. Fiscal Policy, 2. Credit Market, 3. TVAR Model, 4. GIRF, 5. Fiscal Multipliers

BRUNO SPELLANZON

THE FISCAL POLICY IN BRAZIL: A TVAR APPROACH

Work Project presented to the Double Degree Masters in Economics Program from Insper and NOVA School of Business and Economics as a part of the prerequisites for the entitlement as Master in Economics.

APPROVED IN:

COMMITTEE

Prof. Dr. Marcelo Rodrigues dos Santos **Signature:__________________________**
Institution: INSPER

Prof. Dr. Paulo M. M. Rodrigues **Signature:__________________________**
Institution: NOVA SBE

Prof. Dr. xxxx **Signature:__________________________**
Institution: INSPER

Prof. Dr. xxxx **Signature:__________________________**
Institution: NOVA SBE

ABSTRACT

Following Ferraresi *et al.* (2015), this work studies the relationship between fiscal policy and gdp growth and different fiscal multipliers given different credit market conditions in developing countries. This study focus on the brazilian economy and estimates a Threshold VAR utilizing brazilian quarterly data from 1996-2014. Although higher fiscal multipliers are found when the brazilian credit market is tight and lower ones when the market is normal, there is no statistical significance in these results. Additionally, a robustness check is made by changing the threshold variable from credit outstanding of houlseholds to credit outstanding of the industry. The results found also imply the idea of different responses depending on the credit market regime of Brazil. Therefore, the results go in line with international literature for developed countries, but also confirm the hypothesis that countries with less efficient financial markets have stronger fiscal multiplier results.

Keywords: Fiscal Policy, Credit Market, TVAR Model, GIRF, Fiscal Multipliers

INDEX

1. INTRODUCTION 6
2. LITERATURE 7
3. METHODOLOGY 7
3.1 TVAR MODELS 7
3.2 GIRFS AND THE FISCAL MULTIPLIER 9
3.3 ORDERING 10
4. DATA 10
4.1 THRESHOLD VARIABLE 11
4.2 OTHER VARIABLES 11
5. ESTIMATION AND RESULTS 11
6. ROBUSTNESS ANALYSIS 14
7. CONCLUSION 14
BIBLIOGRAPHY 16
APPENDIX 19

1. INTRODUCTION

This work's objective is twofold. First, to contribute to the Brazilian empirical literature, by understanding how the fiscal multiplier is affected by different conditions of its local credit market. Second, a comparison between the results found here and the ones found for the G7 economies (Ferraresi *et al.*, 2015, Baum *et al.*, 2012 and Afonso *et al.*, 2011) is made under the hypothesis that less efficient financial markets, as in the case of Brazil and other developing economies, will present stronger fiscal multipliers when financial frictions are higher.

The relevance of this study is due to the fact that until recently, empirical literature about fiscal policy and fiscal multipliers were given much less attention than studies on monetary policy. However, recent years have seen an increase in studies focused on fiscal multipliers and their effects on the state of the economy due to the new assumption that business cycles fluctuations could be stabilized through effective fiscal policies (Fátas and Mihov 2001).

Additionally, accordingly to Ng and Wright (2003), over the last 30 years, financial market shocks were responsible for all recessions that hit the American economy. Consequently, empirical studies on this subject have been made focusing on nonlinear relationships (see e.g. Bernanke *et al.*, 1999, and Brunnermeier and Sannikov, 2014).

Furthermore, extending the studies to other G7 economies Baum and Koester (2011), Baum *et al.* (2012) and Afonso *et al.* (2011) have shown that these shocks also affect developed economies in non-linear ways and in the same way as they do in the American economy, that is, once financial markets are constrained, fiscal policies can be more efficient than in normal times.

That said, this work employs a threshold vector autoregressive (TVAR) model to understand how credit market conditions can impact the fiscal multiplier of the Brazilian economy. Generalized impulse response functions (GIRFs) are computed and, in order to have a more quantitative assessment of these responses, fiscal multipliers are calculated.

The results found in this work follow recent international literature on fiscal policy (Ferraresi *et al.*, 2015, Afonso *et al.*, 2011, Baum *et al.*, 2012) and; therefore, although no statistical significance was found, confirm the initial hypothesis of a nonlinear response from output growth in relation to shocks in the fiscal policy variable. That is, when the credit market is "tight", the impact of fiscal policy is higher in the output growth, and the impact is lower when the credit market is in a better state. Further still, the results found here also support the hypothesis that countries with less developed financial markets have stronger responses than developed ones.

2. LITERATURE

Although a significant number of studies for developed countries have been made to analyse the size of the fiscal multiplier, the outcome has not been as straightforward as with monetary policies (Afonso *et al.*, 2011). The results vary significantly due to slight changes in model specifications, sample sizes and periods, and also how each variable of the model is defined. However, with monetary policies running out of options, understanding how fiscal policies may influence the economy becomes essential for policy makers to increase their choice set against potential crises.

Researchers have produced new studies trying to understand the relationship between government expenditures and GDP growth; however, nonlinear relations (Ferraresi *et al.*, 2014, Afonso *et al.*, 2011 and Baum and Koester (2011)) are increasing in importance, specifically when financial markets are taken into consideration.

In Brazil, studies are still focused on the relationship between monetary policies and economic growth. Additionally, these studies employ linear models (e.g: Luporini 2008, Cavalcanti and Silva 2010); therefore, no TVARs have been used when studying the Brazilian economy.

In relation to other developing countries, few studies with nonlinear models have been done and they are basically focused on exchange rates and inflation issues (Guo 2013, and Aleem 2010)

Thus, this study differentiates itself from others in two aspects. The first, is the use of nonlinear models to study the Brazilian economy; and the second, is the relationship between fiscal policy variables and the growth of the economy, instead of focusing on monetary policies.

3. METHODOLOGY

3.1 TVAR MODELS

VAR models have been shown to be useful tools for understanding the relationship between variables and also for forecasting. However, once the relationship among variables is not linear, these models show some pitfalls and lose their strength. Therefore, to make up for this deficiency TVAR models have been developed over the last few decades.

The idea behind the TVAR model is quite straightforward. There is a pre-defined endogenous or even exogenous variable (Baum *et al.*, 2012; Hansen 1996 and Tsay 1998) that works as a transition variable. Once this variable crosses the threshold value, the parameters of the equations change; that is, depending on the value of the threshold variable, a different VAR model with different parameters is used. Thus, although the TVAR model itself is not linear, there still exists linearity within each regime.

A general way of representing the TVAR is the following:

$$Y_t = [A^1 Y_t + B^1(L)Y_{t-1}] * I_{(Z_{t-d} \leq \omega)} + [A^2 Y_t + B^2(L)Y_{t-1}] * I_{(Z_{t-d} > \omega)} + U_t$$

where, in the case of this study, Y_t is a six dimension vector containing all the analyzed variables, and $I_{(z)}$ is the indicator function which is equal to one when the threshold variable (Z) is above a given value (ω) and zero otherwise. A^i and $B^i(L)$, $i=1,2$, are parameter matrices, L is the usual lag operator and d is the lag order.

TVAR models bring some significant advantages. First, the model can be estimated through OLS (Ferraresi *et al.*, 2015). Additionally, according to Afonso *et al.* (2011), another advantage is that given that the threshold is endogenous to the model the regime switches are defined by the model itself, which implies that shocks to the other variables are able to influence regime changes. In the case of this work, it is expected that fiscal policies will be more or less efficient depending on the financial market situation.

Before estimating a TVAR model, a linearity test must be performed. In this paper, the method selected is an extension of Hansen's univariate linearity test (Hansen 1999), for multivariate nonlinear models proposed by Lo and Zivot (2001), Galvão (2003), and also explained in Greene (2008). The method estimates the threshold value through conditional least-square, and compares the covariance matrix of each model through a Likelihood Ratio (LR) test:

$$LR_{ij} = 2(\ln\left(det\ \hat{\Sigma}_i\right) - \ln(\det\ \hat{\Sigma}_j))$$

where the variance-covariance matrix of each model is represented by $\hat{\Sigma}_i$, i is the number of regimes and i-1 the number of thresholds.

Once linearity is rejected a TVAR model is estimated through OLS conditional on the threshold value, the number of regimes and order (Ferraresi *et al.*, 2015); however, as in

Ferraresi *et al.* (2015), given the limited number of observations, only two regimes will be considered: a "regular" and a "contractionary".

Next, generalized impulse response functions must be calculated to find the impact of the fiscal policy on the growth of GDP for each regime.

3.2 GIRFS AND THE FISCAL MULTIPLIER

Impulse response functions (IRF) are well established tools to understand how a shock to one variable will reflect on the other variables of the system. They can be easily calculated when the model under scrutiny is linear; however, in a non-linear model such as the TVAR, these responses must follow a different and more complex approach. Additionally, calculations of the fiscal multipliers can be over or understated when wrongly employing linear impulse response functions (Baum *et al.* 2012).

This work follows the methodology presented by Koop *et al.*, (1996)[1]; that is, a Generalized Impulse Response Function (GIRF) approach.

The representation of a GIRF is as follows:

$$GIRF = E[Y_{t+m}|\Omega_{t-1}, \varepsilon_t, \varepsilon_{t+1} = \cdots = \varepsilon_{t+m} = 0] - E[Y_{t+m}|\Omega_{t-1}, \varepsilon_t = \varepsilon_{t+1} = \cdots = \varepsilon_{t+m} = 0]$$

where Ω_{t-1} is the initial information available up to time t-1, and ε_t is a specific shock in one of the endogenous variables.

Differently from IRFs, GIRFs are history dependent, that is, the effect of a shock in a variable depends on its history due to the nonlinearity of the moving-average. Therefore, in nonlinear models, the "reaction of an endogenous variable to a shock depends on the past history, the state of the economy, and the size of the shock under study at time 0, and the size and the sign of all the shocks hitting the economy within the period of interest" Ferraresi *et al.* (2015).

Therefore, to generate the GIRFs, simulations for each starting point of the sample period must be performed taking into consideration the nature of the shock and an initial condition (Balke 2000). The estimated conditional expectation of the GIRFs is reached by repeating this procedure 300 times and averaging out the results.

---

[1] The step by step of the calculation is presented in the appendix B.

Once the GIRFs are estimated, fiscal multipliers are calculated to give a better quantitative evaluation of the shocks. Following Ferraresi *et al.'s* (2015) suggestion, the multipliers, for each period, are calculated dividing the GDP response by the average of the government expenditure in the whole data gathered previously. The calculation is described as follows:

$$FM_n = \frac{\Delta Y_{t+n}}{\Delta G_t}$$

where ΔY_{t+n} represents the accumulated variation of gdp growth in relation to an initial shock in the fiscal policy variable, and ΔG_t is the initial shock in the fiscal policy variable.

3.3 ORDERING

The Choleski decomposition of the respective variance-covariance matrix of each regime in the TVAR model can follow a standard linear framework. As argued in Blanchard and Perotti (2002) and Fatás and Mihov (2001), the variable representing fiscal policy is predetermined in relation to the others in the VAR models. The assumption is that government spending, in the short run, might be unable to react to macroeconomic changes in time. Also, as mentioned in Ferraresi *et al.* (2015), this allows separating automatic stabilizers from discretionary fiscal policies, which is paramount to make sure the output growth is responding to discretionary fiscal policies and not just to automatic adjustments such as unemployment benefits. That said, the first variable in the VAR model will be a fiscal policy proxy.

For the rest of the variables this work follows the suggestion made by Balke (2000), that is, second, GDP growth, which implies no immediate responses to monetary or inflation shocks; third, inflation (IPCA); fourth, a monetary policy proxy, and fifth, the threshold variable. Further explanation of the details related to data gathering is provided in the next section.

4. DATA

The present work uses Brazilian quarterly data collected from IBGE, Banco Central do Brasil, and Ipeadata. Given the hyperinflation period prior to 1995 the data is collected between 1996 and 2014.

Government total spending (government expenditure plus gross capital formation) and GDP growth were both seasonally adjusted, and all variables were made stationary using natural logarithms.

4.1 THRESHOLD VARIABLE

The threshold variable used is the credit outstanding for households due to two facts. First, according to Liu and Rosenberg (2013) the increase in private non-financial debt has been "both cause and effect of the great recession". Second, household debt has increased in significance in the total size of the Brazilian credit market. This type of lending has been increasing fast and gaining more representativeness in the total credit outstanding of the economy, reaching around 30% of all credit. Therefore, it is fair to assume that the private debt is a useful proxy of the local credit market.

4.2 OTHER VARIABLES

For the fiscal policy variable, real government consumption, which includes expenditures with goods, services, and welfare, and the gross fixed capital formation, which represents all the investments in infra-structure made by the government during the period, was considered.

In line with current literature (Ferraresi *et al.* 2015 and Afonso *et al.* 2011), the output variable to be considered is GDP growth. The GDP deflator chosen was the Broad IPCA, which is considered the official brazilian consumer price index, given that the focus of this paper is to understand the fiscal multiplier in the economy as a whole. Also, as a monetary policy proxy this work considers the Brazilian interbank deposit certificate (CDI), which has been used by Oliveira and Ramos (2011) as benchmark.

5. ESTIMATION AND RESULTS

Prior to testing for stationarity, an Augmented Dicker-Fuller (ADF) is performed to check for stationarity and if further adjustments must be performed in the model. As we can see from the table below, stationarity is present in all variables, even inflation following Marques and Figueiredo (2009):

Table 1 - Augmented Dicker-Fuller test for non-stationarity

Threshold Variable	Prob	Lag	MaxLag	Obs
Credit HH	0.0188	0	11	74
Fiscal Policy	0.0001	0	11	74
GDP Growth	0.0000	0	11	74
Inflation	0.0000	0	11	74
Monetary Policy	0.0000	1	11	73

Source: Created by author

Therefore, with stationarity guaranteed, the first step for estimating the model is testing for linearity. The threshold variable was tested with one lag following Ferraresi *et al.'s* (2015) suggestion given the small sample size. From the table below, we can see that the null hypothesis of linearity is rejected.

Table 2 - Linearity test (Likelihood Ratio Test) of threshold variables

Threshold Variable	Lags	Threshold Value	LR Test	p-value
Credit HH	1	0.02344	91.90	0.0000

Source: Created by author

Also, as suggested by Ferraresi *et al.* (2015) to check if the threshold variable follows closely the business cycles, correlation analysis between the threshold variable and GDP growth were performed and the results show that no significant correlations exists.

Table 3 – Correlation between GDP growth and threshold variables

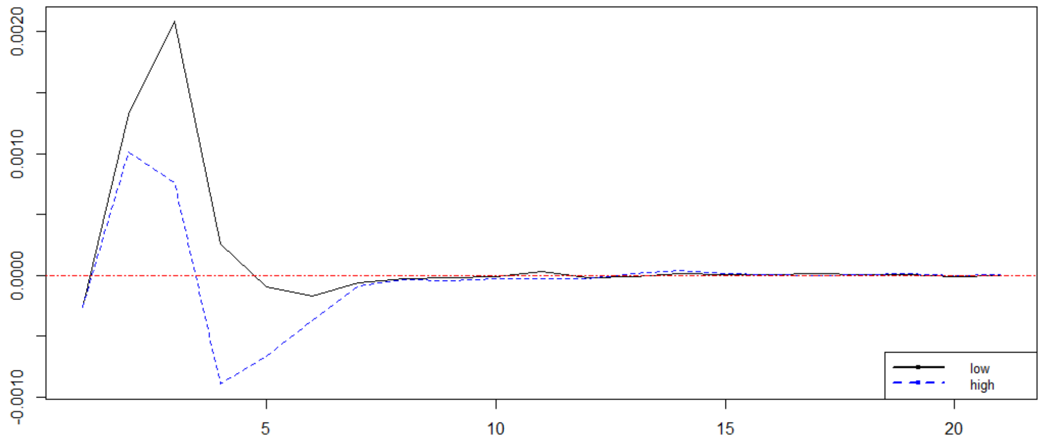
	GDP Growth	Credit HH
GDP Growth	1.00	0.26
Credit HH	0.26	1.00

Source: Created by author

Once non-linearity and small correlations are confirmed, the next step is to estimate the TVAR[2]. The model was estimated with one lag and with a minimum percentage (20%) of observations in each regime. The GIRFs using the outstanding credit for households can be seen below:

[2] See appendix A for equations.

Figure 1 - Generalized Impulse Functions of GDP growth to a 1% shock in the Fiscal Policy variable. Threshold variable is the credit outstanding for households with one lag



Source: Created by author

The graph shows a significant difference in response of the GDP growth to a shock in the fiscal policy variable given the two different credit markets. That is, when the credit market is expanding (dashed line) the GDP growth response is weaker in comparison to the response found with "contractionary" credit market conditions. These results go in line with the ones found in recent literature for developed countries.

Furthermore, to have a more quantitative assessment, the fiscal multipliers are calculated and the results can be seen in the table below:

Table 4 – Fiscal multiplier results for both "Contractionary" and "Normal" credit markets

	2nd Quarter	4th Quarter	Max
Contractionary	4.12*	13.70*	13.70*
Normal	2.64*	2.06*	5.58*

* Not significant at 10%

Source: Created by author

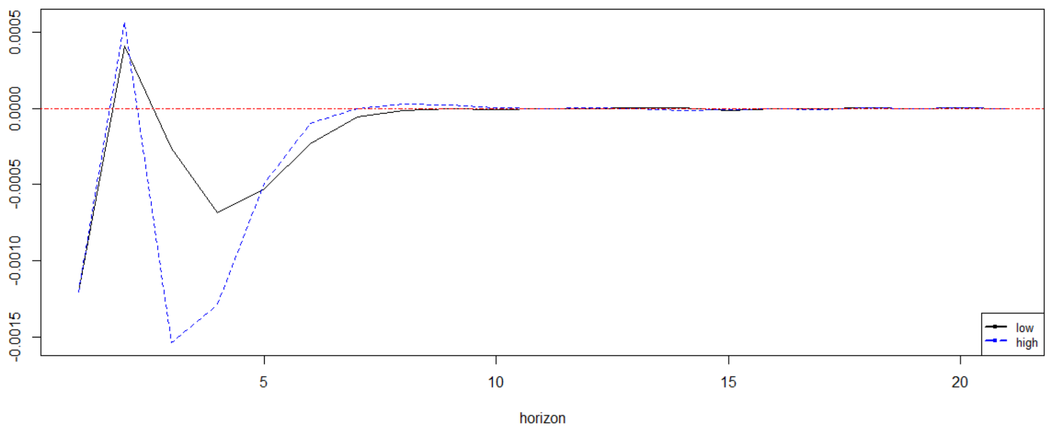
Given the limitations of the sample size, the null hypothesis cannot be rejected with 10% significance level. However, as we can see from the table above, relevant differences can be seen between regimes. The first difference is the length of the gdp responses to shocks in the fiscal policy. In the "normal" period, the gdp response starts to fade away right after the third quarter, while in the "contractionary" regime the maximum is reached only in the fourth, at 13.70.

The second difference is the size of the responses. When we compare the results of this work with the results found for the developed world (Ferraresi *et al.*, 2015, Afonso *et al.*, 2011, and Baum and Koester 2011), the numbers found here corroborate the hypothesis that less efficient financial markets should have stronger gdp responses to fiscal policy shocks.

6. ROBUSTNESS ANALYSIS

To further improve the analysis a robustness check is done by exchanging the threshold variable from personal credit to industry credit. A new TVAR model and GIRF are estimated and the graph below shows the impulse responses in each credit regime.

Figure 2 - Generalized Impulse Functions of GDP growth to a 1% shock in the Fiscal Policy variable. Threshold variable is the credit outstanding for firms with one lag



Source: Created by author

The results, although not statistically significant, suggest that similar responses are found when personal credit is used as the threshold variable.

7. CONCLUSION

This work tries to contribute to recent literature on nonlinear fiscal policies effects in the gdp growth in developing economies. By considering different credit market regimes in Brazil, it is hypothesized that, just as in developed economies (Ferraresi *et al.*, 2015, Afonso *et al.*, 2011 and Baum and Koester 2011), developing countries also face different fiscal multipliers given their respective credit market conditions. Further still, it is hypothesized that developing economies have less efficient financial markets which, which in turn, would imply stronger responses from fiscal multipliers.

After non-linearity of the threshold variable and stationarity of all other variables is confirmed, the estimation of a threshold VAR (Tsay, 1998) using Brazilian quarterly data is estimated followed by generalized impulse response functions (GIRFs) and fiscal multipliers calculations.

It is found that, although the results are not statistically significant, there are different responses in the gdp growth to fiscal policy shocks depending on the situation of the credit market regimes. The responses follow different directions even when the threshold variable is switched from credit outstanding for households to the industry credit outstanding. Therefore, it is possible to conjecture that, once more data for developing countries such as Brazil is available, nonlinear results will follow the ones found in developed economies; however, given the hypothesis of less efficient financial markets in developing economies, stronger responses will probably appear in these economies.

BIBLIOGRAPHY

AFONSO, António; BAXA, Jaromir; SLAVIK Michal. Fiscal Developments and Financial Stress: A Threshold VAR Analysis. **ECB WORKING PAPER SERIES 1319.** March, 2011. Available at: <http://pascal.iseg.utl.pt/~depeco/wp/wp112011.pdf>. Accessed in: 2 aug. 2016.

ALEEM, Abdul. Transmission mechanism of monetary policy in India. **Journal of Asian Economics,** v. 21, n. 2, p. 186-197, apr. 2010. Avaiable at: <http://www.sciencedirect.com/science/article/pii/S1049007809000967>. Accessed in: 12 jul. 2016.

BALKE, Nathan S. Credit and Economic Activity: Credit Regimes and Nonlinear Propagation of Shocks. **The Review of Economics and Statistics,** v. 82, n. 2, p. 344–349, may 2000. Available at: <http://www.mitpressjournals.org/doi/pdf/10.1162/rest.2000.82.2.344>. Accessed in 3 aug. 2016.

BAUM, Anja; KOESTER, Gerrit B. The Impact of Fiscal Policy on Economic Activity over the Business Cycle –Evidence from a Threshold VAR Analysis. In: **BUNDESBANK DISCUSSION PAPER 03/2011.** January, 2011. Available at: <https://www.econstor.eu/bitstream/10419/44961/1/65618079X.pdf>. Accessed in 4 aug. 2016.

BAUM, Anja; POPLAWSKI-RIBEIRO, Marcos; WEBER, Anke. Fiscal Multipliers and the State of the Economy. In: **IMF WORKING PAPER 12/286.** December, 2012. Available at: <http://www.imf.org/external/pubs/ft/wp/2012/wp12286.pdf>. Accessed in: 30 jul. 2016.

BERNANKE, Ben S.; GERTLER, Mark L.; GILCHRIST, Simon. The financial accelerator in a quantitative business cycle framework. In: TAYLOR, J. B.; WOODFORD, M. **Handbook of Macroeconomics,** Amsterdam: Elsevier, 1999. v. 1, p. 1341–1393.

BLANCHARD, Olivier; PEROTTI, Robert. An Empirical Characterization Of The Dynamic Effects Of Changes In Government Spending And Taxes On Output. **The Quarterly Journal of Economics**, v. 117, n. 4, p. 1329–1368, nov. 2002. Available at: <https://ideas.repec.org/p/nbr/nberwo/7269.html>. Accessed in 18 jul. 2016.

BRUNNERMEIER, Markus K.; SANNIKOV, Yuliy. A macroeconomic model with a financial sector. **American Economic Review,** v. 104, n. 2, p. 379–421, feb. 2014. Available at: <https://ideas.repec.org/a/aea/aecrev/v104y2014i2p379-421.html>. Accessed in: 18 jul. 2016.

CAVALCANTI, Marco A. F. H.; SILVA, Napoleão L. C. Dívida Pública, Política Fiscal e Nível de Atividade: uma Abordagem VAR para o Brasil no Período 1995-2008. **Economia Aplicada,** v. 14, n. 4, p. 391-418, oct. 2010. Available at: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1413-80502010000400007>. Accessed in: 12 jul. 2016.

FATÁS, Antonio; MIHOV, Ilian. The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence. **CEPR DISCUSSION PAPERS 2760**. April, 2001. Available at: <http://faculty.insead.edu/fatas/fiscal.pdf>. Accessed in 29 jul. 2016.

FERRARESI, Tommaso; ROVENTINI, Andrea; FAGIOLO, Giorgio. Fiscal Policies and Credit Regimes: A TVAR Approach. **Journal of Applied Econometrics,** v. 30, n. 7, p. 1047-1072, nov. 2015. Available at: <https://ideas.repec.org/p/ssa/lemwps/2013-03.html>. Accessed in: 15 apr. 2016.

GALVÃO, Ana B. C. Multivariate threshold models: TVARs and TVECMs. **Brazilian Review of Econometrics,** v. 23, n. 1, p. 143–171, jan. 2003. Available at: <http://bibliotecadigital.fgv.br/ojs/index.php/bre/article/view/2734>. Accessed in: 27 jun. 2016.

GREENE, William H. **Econometric Analysis**. 5th ed, Saddle River, NJ: Prentice Hall. 2011. 827p.

GUO, F. What Causes China's High Inflation? A Threshold Structural Vector Autoregression Analysis. **China & World Economy,** v. 21, n. 6, p. 100-120, nov. 2013. Available in: <http://onlinelibrary.wiley.com/doi/10.1111/j.1749-124X.2013.12048.x/abstract>. Accessed at: 25 jul. 2016.

HANSEN, Bruce E. Inference when a nuisance parameter is not identified under the null hypothesis. **Econometrica,** v. 64, n. 2, p. 413-430, mar. 1996. Available in: <https://www.jstor.org/stable/2171789>. Accessed at: 10 jun. 2016.

HANSEN, Bruce E. Testing for linearity. **Journal of Economic Surveys,** v. 13, n. 5, p. 551-576, feb. 1996. Available at: <http://www.ssc.wisc.edu/~bhansen/papers/jes_99.pdf>. Accessed in 10 jun. 2016.

KOOP, Gary; PESARAN, Hashem; POTTER, Simon M. Impulse Response Analysis in Nonlinear Multivariate Models. **Journal of Econometrics,** v. 74, n. 1, p. 119–147, feb. 1996. Available at: <https://www.researchgate.net/publication/4858930_Impulse_Response_Analysis_in_Non-L]inear_Multivariate_Models>. Accessed in: 25 jun. 2016.

LO, Ming C.; ZIVOT, Eric. Threshold cointegration and nonlinear adjustment to the law of one price. **Macroeconomic Dynamics,** v. 5, n. 4, p. 533–576, sep. 2001. Available at: < https://ideas.repec.org/a/cup/macdyn/v5y2001i04p533-576_02.html>. Accessed in: 10 jun. 2016.

LIU, Yan; ROSENBERG, Christoph B. Dealing with private debt distress in the wake of the European financial crisis: A review of the economics and legal toolbox. **IMF Working Papers,** v.44, n. 1, p. 1-20, feb. 2013. Available at: <https://www.imf.org/external/pubs/ft/wp/2013/wp1344.pdf>. Accessed in: 15 jun. 2016.

LUPORINI, Viviane. The monetary transmission mechanism in Brazil: evidence from a VAR analysis. **Estudos Econômicos,** v. 38, n. 1, p. 7-30, jan. 2008. Available at: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0101-41612008000100001>. Accessed in: 22 jun. 2016.

MARQUES, André M.; FIGUEIREDO, Erik Alencar de. Inflação inercial como um processo de longa memória: análise a partir de um modelo arfima-figarch. **Estudos Econômicos**, v. 39, n. 2, p. 437-458, apr. 2009. Available at: <http://www.scielo.br/pdf/ee/v39n2/v39n2a08.pdf>. Accessed in: 28 oct. 2016.

NG, Serena; WRIGHT, Jonathan H. Facts and challenges from the Great Recession for the forecasting and macroeconomic modeling. **Journal of Economic Literature,** v. 51, n. 4, p. 1120–1154, dec. 2013. Available at: <https://ideas.repec.org/a/aea/jeclit/v51y2013i4p1120-54.html>. Accessed in: 19 jun. 2016.

OLIVEIRA, Fernando N.; RAMOS, Leonardo. Choques não antecipados de política monetária e a estrutura a termo das taxas de juros do Brasil. **Pesquisa e Planejamento Econômico,** v. 41, n. 3, p. 433-470, dez. 2011. Available at: <http://ppe.ipea.gov.br/index.php/ppe/article/viewFile/1255/1104>. Accessed in: 19 jun. 2016.

TSAY, Ruey S. Testing and modeling multivariate threshold models. **Journal of the American Statistical Association,** v. 93, n. 443, p. 1188–1202, sep. 1998. Available at: <https://rmgsc.cr.usgs.gov/outgoing/threshold_articles/Tsay1998.pdf>. Accessed in: 17 jul. 2016.

APPENDIX

APPENDIX A

[[1]] Contractionary

	Intercept	fp_credit_gdp -1	gdp_sa -1	inflation -1	mon_policy -1	credit_hh -1
fp_credit_gdp	1.3276(1.4896)	-0.7518(0.5094)	-0.5360(1.0122)	-0.7188(0.5188)	-0.0999(0.0482)*	-0.2818(0.9627)
gdp_sa	0.6289(0.4971)	0.0227(0.1700)	-0.3272(0.3378)	0.0308(0.1731)	-0.0375(0.0161)*	-0.0878(0.3213)
inflation	1.7795(0.3244)***	0.7108(0.1109)***	1.5282(0.2204)***	0.7705(0.1130)***	0.0196(0.0105).	-1.0943(0.2096)***
mon_policy	-1.9825(4.9894)	-2.2387(1.7060)	4.7370(3.3904)	-2.4127(1.7375)	0.6223(0.1615)***	5.3501(3.2245)
credit_hh	3.3555(1.1966)**	-0.2112(0.4092)	-0.3272(0.8131)	-0.0489(0.4167)	-0.1056(0.0387)**	-0.7816(0.7733)

[[2]] Normal

	Intercept	fp_credit_gdp -1	gdp_sa -1	inflation -1	mon_policy -1	credit_hh -1
fp_credit_gdp	-1.8452(1.4769)	0.0556(0.2313)	0.1333(0.4024)	0.4417(0.7101)	0.0395(0.0414)	0.6361(0.2533)*
gdp_sa	0.3215(0.4929)	-0.0795(0.0772)	0.1153(0.1343)	0.1573(0.2370)	-0.0638(0.0138)***	0.0508(0.0845)
inflation	1.3577(0.3216)***	0.0248(0.0504)	-0.1162(0.0876)	0.1167(0.1546)	0.0020(0.0090)	-0.0088(0.0552)
mon_policy	-11.4181(4.9468)*	-0.2607(0.7747)	2.0880(1.3477)	0.8365(2.3785)	0.2494(0.1385).	1.1486(0.8484)
credit_hh	0.9305(1.1864)	0.4169(0.1858)*	0.8396(0.3232)*	0.3350(0.5704)	-0.0205(0.0332)	0.3942(0.2035).

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Threshold value: 2.344041

Percentage of Observations in each regime: 25.7% 74.3%

APPENDIX B – GENERALIZED IMPULSE RESPONSE FUNCTIONS (based on Ferraresi *et al.*, 2015)

1. Select a random history Ω^{r}_{t-1}.
2. Bootstrap residuals of the TVAR, and, considering the different variance-covariance matrices of each regime, select a sequence of shocks.
3. Simulate the evolution of the model given the estimated TVAR coefficients, Ω^{r}_{t-1} and the residuals.
4. Repeat adding new shocks at time 0.
5. Repeat step 2 to 4, 300 times, and compute the average.
6. Subtract the average from the path with no shock.
7. Keep repeating steps 1 to 6, but with a different history Ω^{r}_{t-1}.