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Joaquim Pinto Andrade
Manoel Carlos de Castro Pires

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IMPLICATIONS OF PUBLIC DEBT INDEXATION FOR MONETARY POLICY TRANSMISSION

Joaquim Pinto De Andrade
Brasília University (UnB)

Manoel Carlos De Castro Pires*
Brazilian Institute of Applied Economic Research (IPEA)

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The goal of this paper is to provide a better understanding of monetary policy effectiveness in the case of indexed bonds. When public debt management deals with bonds indexed to the interest rate set by the monetary policy, there is no wealth effect and, as a consequence, monetary policy has a weak transmission channel reducing its effectiveness. This can help to explain why monetary policy in Brazil has been so tight and interest rates so high during the Real Plan.

JEL classification codes: E32, E43
Key words: wealth effect, monetary policy, indexation, public debt management

I. Introduction

Since the implementation of Brazil's Real Plan in 1994 and the beginning of a period of stable inflation, the monetary policy of the Brazilian Central Bank has been qualified as very tight. Not only are interest rates very high, so is their response to inflation shocks (Minella, Freitas, Goldfajn and Muinhos 2003). This result casts doubt on monetary policy's effectiveness to stabilize the inflation rate in Brazil.

Some economists argue that public debt management in Brazil may be responsible for this weakness and, as a consequence, for the tightness of the monetary policy. Actually, they argue that the existence of public debt indexed

* Pires (corresponding author): Brazilian Institute of Applied Economic Research (IPEA), SQN 216, Bloco E 102, Brasília, Brazil, 75875050. Tel. 55 61 33155402. E-mail: manoel.pires@ipea.gov.br. Andrade: Brasília University (UnB), Campus Darcy Ribeiro, Departamento de Economia, Asa Norte, Brasília, Brazil, 70910900. Tel. 55 61 32723548. E-mail: jandrade@unb.br

to short run Selic interest rate does not permit that the wealth effect channel of monetary policy fully operates.[1]

This paper makes an attempt to quantify the monetary policy transmission through the wealth effect. The wealth effect is related to how wealth variations induced by monetary policy affects aggregate demand. The seminal contribution came from Pigou (1943) who argued that deflation would increase wealth leading to the expansion of aggregate demand. Modigliani (1943 and 1963) and Ando and Modigliani (1963) extensively studied how the wealth effect could stabilize labor, goods and monetary markets delivering its contemporaneous interpretation of the wealth effect.

In the applied field, the macro econometric models in the 1960's and 1970's predicted significant impacts caused by the wealth channel. Ludvigson, Steindel and Lettau (2002) conducted an experiment to investigate the role of the wealth effect in the Data Resources, Incorporated (DRI) model, the Washington University Macroeconomic Model (WUMM) and the Federal Reserve Bank (FRB) model and reported large impacts.

Although those macro econometric models pointed out some important effects of the wealth channel, there is a trend in the recent models to abandon it. This trend may be explained by the recent research on monetary policy transmission that has concluded it has a secondary role compared to direct interest rate effects (Boivin, Kiley and Mishkin 2010).

Fair (2004) also provides evidence of small wealth effects, concluding, however, that the large capital gains during 1995-2000 were responsible for the great performance of the U. S economy. In other words, despite the small estimated coefficients, the wealth effect may have large macroeconomics consequences. Because of this controversy, the interest in this theme has been renewed in order to understand the changes that might have occurred during the recent period.[2]

Other than that, public debt management offers an efficient way for consumption smoothing over time. On the positive side, public debt can help overcome imperfections in financial market intermediation (Woodford 1990). Public debt provides liquid assets in private wealth, thereby increasing the flexibility of the

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[1] The wealth effect channel measures how asset variations induced by monetary policy affects consumption. For a model with a wealth effect, see Bénassy (2007) who constructs an IS-LM model in a non-Ricardian world.

[2] Boivin and Giannoni (2006), for example, provide strong support to the idea that the conduction of monetary policy has been responsible for the lower volatility after the 1980's.

private sector in responding to variations in income and spending opportunities. Furthermore, much of the literature has investigated whether changes in the structure of debt has macroeconomics implications. For instance, there has been a number of studies which consider whether debt management will have effects on asset prices.[3]

The main goal of this paper is to study how indexed bonds affect the transmission of monetary policy. For this study, Brazil seems to be a rich laboratory because public debt management led to an increasing indexation of bonds to short term interest rate – Selic. In the next section, this debate and the main implications of public debt management for monetary policy are presented. In the third section, a counterfactual experiment, following Boivin and Giannoni (2002) is performed to assess the role of public debt indexation in the monetary transmission process. A structural VAR is estimated to provide wealth and public debt management effects on consumption. Counterfactual exercises are implemented in order to assess the whole role of indexation on monetary policy transmission. The results indicate that indexed bonds to Selic interest rate weakened the effectiveness of monetary policy in Brazil.

II. Implications of the Brazilian public debt management and the wealth effect

The dynamics of wealth provided by public debt is defined by the following identity:

$$B_t = B_{t-1} + NB_t + CGB_t \,, \tag{1}$$

where B_t represents public bonds, NB_t is net public bonds issuance and CGB_t is the value of capital gains on the public debt bonds.

The first two terms in equation (1) consider, respectively, the stock of public debt that has already been issued, reflecting past macroeconomic conditions, and the new issuance reflecting the newest ones. An important feature regarding equation (1) is the way interest rate affects the price of the bond which will be accounted as a capital gain. Public debt management in Brazil has offered bonds indexed by the Selic rate which is the main monetary policy instrument (*LFT*) and prefixed bonds (*LTN*) building a linkage between public debt management and the wealth effect.

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[3] These include Modigliani and Sutch (1967) and Agell and Persson (1992).

In order to explain the phenomenon, consider that there are perpetuities linked to the short term interest rate. The price ($P_{i,t}$) of this bond (B) is the present value of the income flow that results from the short interest rate *(i)* paid by the bond. In this particular case the price of the bond does not depend on the interest rate:

$$P_{i,t} = \sum_{t=0}^{\infty} \frac{iB}{(1+i)^{t+1}} = B \tag{2}$$

Alternatively consider a prefixed bond ($P_{r,t}$) that pays a fixed interest rate (r). In this case, the price of these perpetuities depends negatively on the interest rate:

$$P_{r,t} = \sum_{t=0}^{\infty} \frac{rB}{(1+i)^{t+1}} = \frac{rB}{i} \tag{3}$$

This phenomenon is recognized by many Brazilian economists as a factor that creates monetary policy ineffectiveness (Bevilaqua, Mesquita and Minela 2007). However, some economists argue that this transmission channel might have little empirical relevance.

Some of the reasons for this interpretation are the following: (i) the high income inequality, (ii) the low private wealth in relation to GDP in Brazil, (iii) the low liquidity of household markets and; (iv) Ricardian equivalence may have turned stronger for Brazil recently because the tax burden rose when public debt accelerated (Barro 1974). In brief, the empirical relevance of Selic indexed bonds to monetary policy transmission should be evaluated econometrically.

Furthermore, public debt composition is a result of demand and supply forces. On the demand side, the holdings of the Brazilian public debt are shared mainly between pension funds and banks. Nowadays, just a small share belongs to households and foreigners. The bond maturity demanded by pension funds and foreigners is lengthy but, on average, the whole maturity is short.

On the supply side, the National Treasury has the objective of minimizing long term borrowing costs. This may be possible when positive government cash flow manages to provide degrees of freedom for the National Treasury in the determination of public debt composition (National Treasury of Brazil 2008). Despite the National Treasury's effort in the recent past, this composition is still based on the Selic indexed bonds (Table 1).

Table 1. Brazilian public debt composition

	Exchange rate	Inflation	Selic	Prefixed	Others
1996	9.4	1.8	18.6	61.0	9.2
1997	15.4	0.3	34.8	40.9	8.6
1998	21.0	0.4	69.1	3.5	6.0
1999	24.2	2.4	61.1	9.2	3.1
2000	22.5	6.0	52.7	14.9	3.9
2001	29.5	7.2	54.4	8.1	0.8
2002	20.3	11.4	55.2	2.0	11.1
2003	10.0	12.6	57.0	11.6	8.8
2004	4.9	14.1	54.0	19.0	8.0
2005	2.6	15.2	50.6	27.2	4.4
2006	0.0	21.4	42.6	24.8	11.26

Source: Brazilian Central Bank Bulletin, various issues.

Moreover, it is important to notice that the whole dynamic of the wealth effect should be analyzed. In this sense, the main goal is to understand:

$$\frac{\partial B_t}{\partial i_t} = \frac{\partial B_{t-1}}{\partial i_t} + \frac{\partial NB_t}{\partial i_t} + \frac{\partial CGB_t}{\partial i_t} \tag{4}$$

and how this affects consumption.

In this way, it is important to understand whether the wealth effect causes changes in the debt composition. For instance, for each possible debt composition, monetary policy may affect economic activity in a different way, which means that the above equation (4) might be bond-dependent. This aspect has been entirely neglected by most economists.

However, in the particular case of public debt, it's important to stress that the data are built on a historical value base, making it impossible to assess the specific role of the capital gain factor. Thus, given the distinct interest rate effects on each kind of bond, it's possible to evaluate whether debt management and the remaining dynamic of wealth might change the monetary policy transmission and how they would affect consumption.

III. Structural VAR and econometric evidence

The traditional empirical approach to study basic relationships in macroeconomic data is the Vector Autoregressive (VAR) technique. This traditionalism is basically

due to two reasons. The first one is that medium or large scale macro econometric models impose too many restrictions (Sims 1980). The second one refers to policy simulation that can be erroneous if the models did not incorporate agent expectations (Lucas, 1980).

The methodology was designed by Boivin and Giannoni (2002). They analyzed monetary policy transmission by counterfactual exercises in a structural VAR approach. A counterfactual exercise in this approach requires an additional restriction on a specific policy channel.

The dataset is quarterly and covers the period 1996:1 to 2007:2. The variables are the inflation rate measured as log variation of consumer price index (π), salaries measured as the workers' income of São Paulo city (s), consumption from Brazilian National Accounts (c), Selic nominal interest rate (i), Selic indexed bonds (LFT), prefixed bonds (LTN) and the sum of these two bonds (d_t).

Some variables didn´t present evidence of stationarity by the ADF and KPSS tests. These variables are consumption, salaries, prefixed bonds and total debt. In the empirical set up, these series are modeled in first differences. The others, inflation and Selic rate, presented evidence of stationarity according to those tests. In the particular case of Selic indexed bonds, the tests presented mixed evidence. We will show just the results for the non stationary case because they are very similar to the stationary one (Table 2).

The structural VAR model to be considered consists of:

$$A_0 X_t = \delta + A_1 X_{t-1} + ... + A_p X_{t-p} + u_t \ , \tag{5}$$

where $X_{1,t} = \{\pi_t, s_t, c_t, d_t, i_t\} X_{2,t} = \{\pi_t, s_t, c_t, LTN_t, i_t\}$ and $X_{3,t} = \{\pi_t, s_t, c_t, LFT_t, i_t\}$.

Table 2. Unit root tests and integration order

	ADF	KPSS	Decision
c_t	I(1)	I(1)	I(1)
st	I(1)	I(1)	I(1)
LFT_t	I(0)	I(1)	I(1)
LTN_t	I(1)	I(1)	I(1)
π_t	I(0)	I(0)	I(0)
i_t	I(0)	I(0)	I(0)
d_t	I(1)	I(1)	I(1)

The VAR identification is similar to the one used by Ludvigson, Steindel and Lettau (2002) which restrains consumption from being affected contemporaneously by wealth.

$$A_0 = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ A_{21} & 1 & 0 & 0 & 0 \\ A_{31} & A_{32} & 1 & A_{34} & A_{35} \\ A_{41} & A_{42} & A_{43} & 1 & A_{45} \\ A_{51} & A_{52} & A_{53} & A_{54} & 1 \end{bmatrix} \tag{6}$$

The identification proposed in (6) assumes that interest rate responds contemporaneously to macroeconomic data but it affects variables only with a lag ($A_{35}=0$). It also assumes that wealth, which is a stock, is not affected by consumption, which is a flow ($A_{43}=0$). The relationship between monetary policy and wealth is simultaneous but the monetary authority does not have a target for it and only reacts when wealth affects other macroeconomic variables ($A_{54}=0$).

The counterfactual exercise consists in the additional restriction that the contemporaneous and lagged impact of wealth in the consumption function is zero ($A_{34}=0$ and $A_{i,34}=0$ for $i=1,...p$, are the lag coefficients of the VAR). For all models, the lags were defined by the BIC criteria.

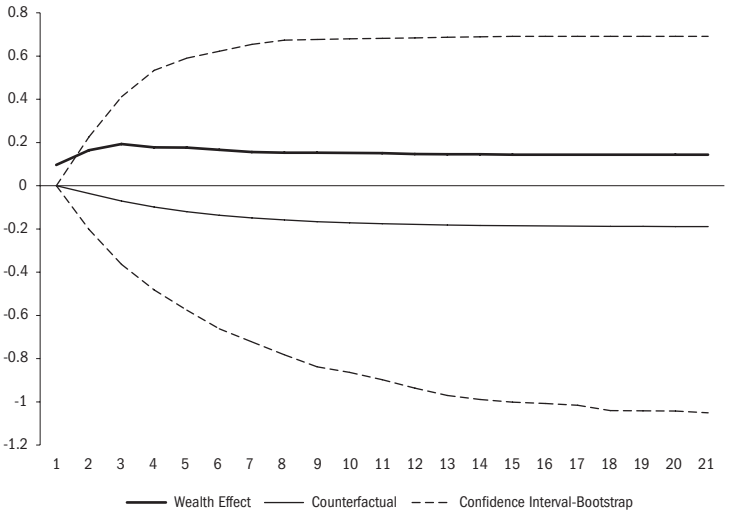
The first exercise evaluates the effect of public debt in the monetary transmission mechanism. The empirical evidence presented in Figure 1 shows that the public debt does not change in a statistically significant way as monetary policy affects consumption. The differences are significant only for the first quarter. Does this evidence mean that public debt does not make any difference for monetary policy?

The answer is provided in Figure 2. In this experiment, public debt has been decomposed between indexed bond and prefixed bonds. The results indicate that the differences between the model with prefixed bonds and the counterfactual exercise are statistically significant. The estimates of the counterfactual exercise show that consumption falls significantly for 4 quarters in response to an interest rate shock when the debt is composed by prefixed bonds only. On the other hand, the model in which wealth is only composed by Selic indexed bonds does not show statistically significant differences with its counterfactual.

It is interesting to analyze whether the results from both models is subject to structural breaks. The Brazilian economy suffered some shocks and as a result public debt composition has changed as well as the different goals of the National Treasury during the period.

Figure 1. Consumption response of monetary policy shocks and the wealth effect

Consumption response to interest rate shocks



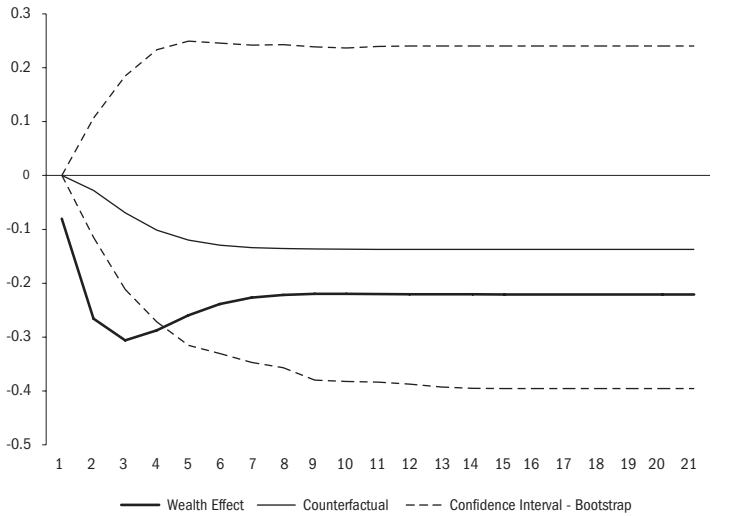
* The BIC criteria defined one lag.

In order to deal with structural breaks, we applied the Chow test to the full system of equations in the VAR. The Chow test tests against the alternative that all coefficients, including the residual covariance matrix, may vary (Candelon and Lütkepohl 2001). Figure 3 shows the p-value generated by the test in both models and rejects the alternative hypothesis. Because the actual small samples distributions under the null may be quite different from the asymptotic χ^2 or F distributions, we show the bootstrap results based on 10.000 replications.

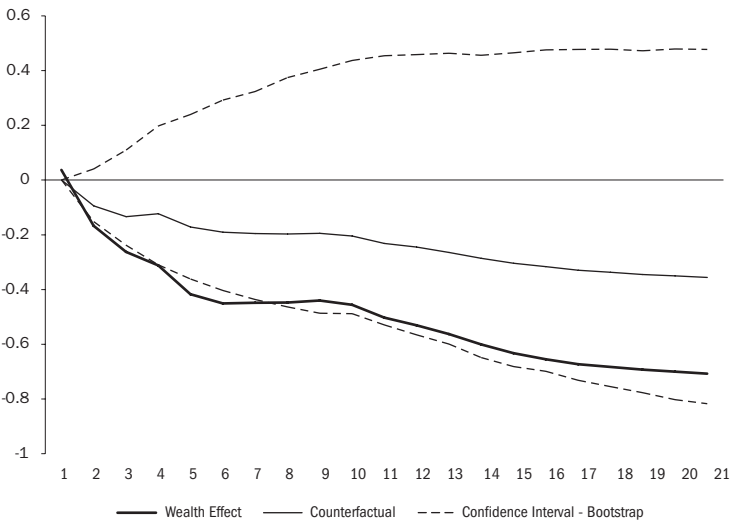
We have conducted another exercise to verify if the results in the model with prefixed bonds are robust. Following up on the Ludvigson, Steindel and Lettau (2002) experiment, we have included the commodities price index in the analysis. Figure 4 shows the response of consumption to interest rate shocks in the model with commodities and its counterfactual, and compares it with the prediction of the previous model. The results also predict a significant wealth effect.

Figure 2. Consumption response of monetary policy shocks and debt indexation

A. Consumption response to interest rate shocks – Model with prefixed bonds



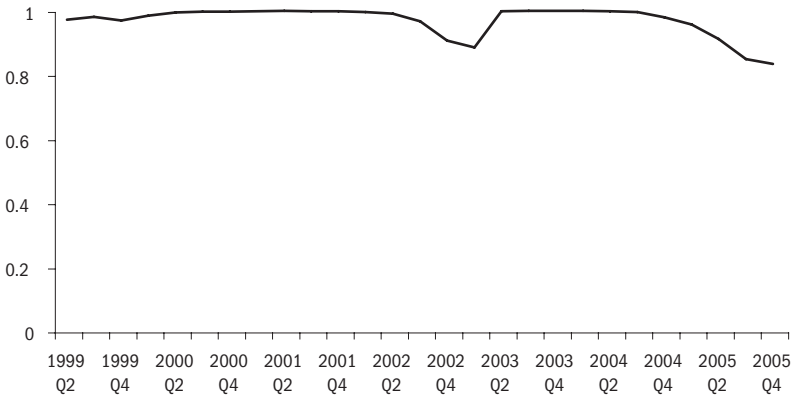
B. Consumption response to interest rate shocks – Model wih Selic bonds



* The BIC criteria defined one lag for the prefixed bonds model and four lags for the Selic indexed model.

Figure 3. P-value of Chow test of structural break

Model with prefixed bonds



Model with Selic indexed bonds

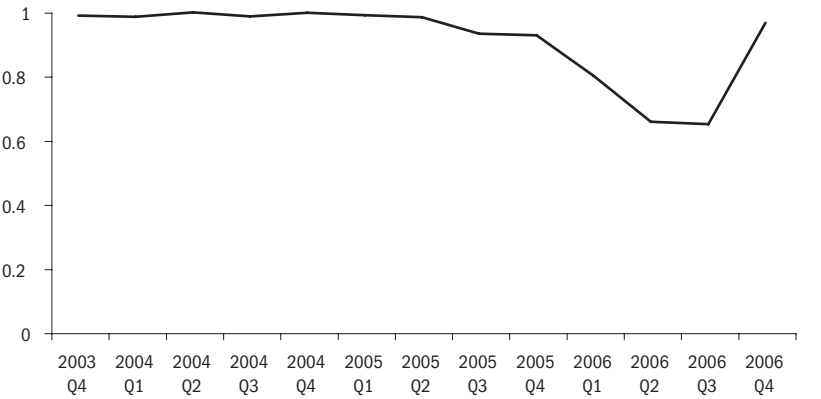
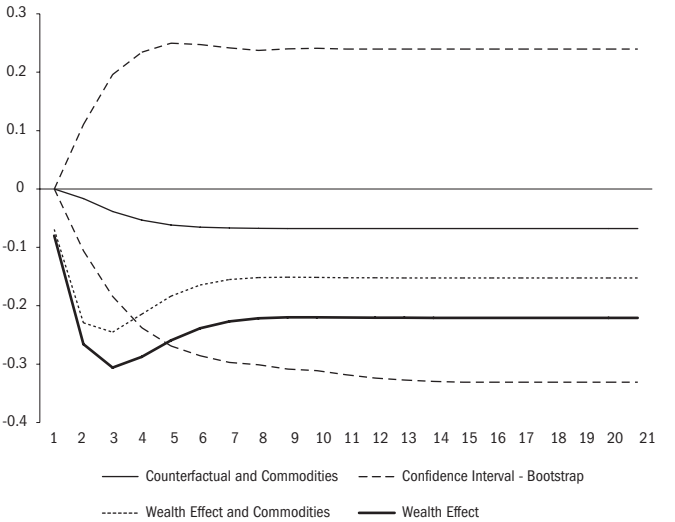


Figure 4, Consumption response of monetary policy shocks and commodities prices
Consumption response to interest rate shocks – Model with prefixed bonds and commodities



* The BIC criteria defined one laf for this model.

IV. Conclusions

The purpose of this paper is to provide a better understanding of the channels through which monetary policy in Brazil influences real variables. The high level of the short term interest rate in Brazil and a strong monetary policy reaction function have been taken as puzzling facts since the adoption of the Real Plan which brought inflation down. In order to provide an explanation (or one explanation more) we quantified the Brazilian Central Bank policy impact on consumption through the wealth effect.

Our results indicate that the wealth effect may be a relevant channel of monetary policy transmission in Brazil. Nevertheless, the econometric experiments indicate that the share of indexed bonds makes the wealth effect non-significant. In other words, the high share of indexed bonds compromises the wealth effect on consumption, consequently the monetary transmission mechanism through wealth and as a result reduces the power of monetary policy. Summarizing, the data suggest that there is a negative wealth effect on consumption induced by a rise in the interest rate. However it is offset by the presence of bonds indexed to the interest rate.

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