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Macroeconomic policy transmission and international interdependence: A SVAR application to Brazil and US[☆]

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Abstract

Economic policy transmission between trade partners has been analyzed over different contexts in the literature. Depending on real or nominal frictions, the results indicate possible beggar-thy-neighbor effects for policies, given international trade, and need for coordinating policies. The baseline model is Corsetti and Pesenti (2001) of macroeconomic interdependence. The theoretical proposition suggests that a no anticipated economic policy of exchange rate depreciation creates a beggar-thyself effect. Yet, many economies have engaged in this policy to enhance exports and improve welfare. Here, fiscal policy transmissions over Brazilian economic aggregates are investigated, considering Brazil as home and US as foreign country. The problem is specified in a Structural VAR (Vector Autoregression) model, taking Granger causality tests and Impulse Response analysis as econometric applications. The results indicate that expansionary fiscal policy in US has a beggar-thy-neighbor effect for the Brazilian economy in the long-run. The policy transmission mechanism relies on the terms of trade. In addition, real money balances are affected by foreign fiscal policy, affecting the efficiency of domestic monetary policy.

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Resumo

Os efeitos de longo prazo da política fiscal sobre os agregados da economia brasileira são analisados dentro do contexto das inter-relações macroeconômicas de países parceiros comerciais, Brasil e EUA. A investigação empírica utiliza a análise Impulso Resposta, Causalidade de Granger com modelos de Vetores Auto-regressivos Estruturais (SVAR). Assim, desenvolvemos uma aplicação do modelo de Corsetti & Pesenti (2001) de interdependência macroeconômica. Os resultados indicam que a política fiscal expansionista permanente nos EUA causa efeitos de empobrecimento da vizinhança no Brasil no longo prazo. O canal de

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transmissão da política é confirmado como os termos de troca. Além disso, os encaixes reais são também afetados de forma negativa pela política estrangeira, interferindo na eficiência da política monetária nacional.

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Palavras-chave: Efeitos repercussão; Política fiscal; Empobrecimento da vizinhança; Modelos SVAR

1. Introduction

The international macroeconomic interdependence of national policies under fixed exchange rate regime started getting attention in 60s (Cooper, 1969; Roper, 1971). The reason for such a concern was related to the fast growing demand for US dollars as an exchange mean among the economies. Such growing role for US dollars also brought questions related to policy transmissions and repercussions of economic policies being made in US and elsewhere.

How much of a macroeconomic policy practice abroad can be internalized by fixed, or pegged, exchange rate systems? What are the transmission channels of these policies? How broad is the extension, or spillover effects, of national macroeconomic policies to the world economies? These issues became open questions to be answered by economic researchers.

These open questions became the central issue in the 70s and the 80s researches. This research intensification was greatly corroborated by events occurred at that time. Events like the break of Bretton Woods system, world input price shocks, recessions, and the adoption of flexible exchange rates regime among others corroborated to intensify the economic research on international macroeconomic interdependence of the economies (Dornbusch, 1976; Helpman, 1976; Frenkel and Razin, 1985; Cooper, 1986; Frankel, 1988; Devereux and Wilson, 1989).

Besides the need for coordination of economic policies among nations engaged in world trade, the above events brought also more urgent matters to the economies. In especial the need for domestic price stability policies that required among other things choosing an exchange rate regime (Henderson, 1977; Dornbusch, 1982; Andresen and Everaert, 1987; Aoki, 1987). The emergence of different exchange regimes among the economies required also new studies on economic policies interdependence.

Hence, the theories of international economic policy interdependence and its applications evolved greatly in the 90s due to new microeconomic foundation development. The new propositions embraced wage arrangements and price competition prevailing in the market that was different from the models of 70s and 80s. Under the new microeconomic foundation the theories revealed outcomes of international macroeconomic policy interdependence not present in the previous literature (Obtsfeld and Rogoff, 1995; Wren-Lewis, 1997; Betts and Devereux, 2000; Diboğlu, 2000).

For instance, Obtsfeld and Rogoff (1995) showed that monetary policy may not be a *beggar-thy-neighbor* instrument under flexible exchange rate, using a model of monopolistic competition and sticky prices. Hence, there would be no incentive to engage in a competitive depreciation. As a result, there would be little space for international coordination, and it could even reduce world welfare.

Among the proposals, the contribution of Corsetti and Pesenti (2001) stands out for improving the previous literature, especially regarding the effects of national policies on trade partners. One of the main results of the model was that an unanticipated exchange rate depreciation can be *beggar-thyself* rather than *beggar-thy-neighbor*. This result stands in contrast to the frequently practiced economic policy by nations to implement exports as way of improving national welfare. It was also in contrast to the result of Obtsfeld and Rogoff (1995) seminal paper “Exchange Rate Dynamics Redux”.

In this context, we developed an empirical analysis of the Corsetti and Pesenti (2001) model of macroeconomic interdependence as a way of learning the welfare implications for Brazil, the domestic economy, from a fiscal policy made in US, the foreign economy. The main objective is to test the effects of US fiscal policy on Brazilian consumption, real balances, terms of trade, and domestic prices.

The empirical tests are based on the solutions of the Corsetti and Pesenti (2001) model. The model solutions generate two sets of equations. The first one represents the short-term relations that highlight the effects of monetary policy on economic aggregates: output (Y), consumption (C), nominal interest rate (R), terms of trade (TT) and the nominal exchange rate (E). These effects are transitory and with no direct consequences for the formulation of economic policy in the long run for the domestic country, here Brazil. The second set of equations represents long run relations arising

from fiscal policy made by foreign economy, here US. In the long run, the fiscal position of the world (domestic and foreign economies combined) is a determinant of real money balances and affects the behavior of main aggregate variables such as: long run output (\bar{Y}), long run consumption (\bar{C}), long run real balances (\bar{m}), the terms of trade (TT), here real exchange rate, and domestic prices (P_h).³ Therefore, this paper is mainly concerned with the long run welfare effects on the Brazilian economy coming from the fiscal policy practiced by US.

The empirical methodology to be used is SVAR (Structural Vector Autoregressive). This methodology is more appropriate for estimating the long run effects proposed in the theoretical model. Also this methodology allows us to evaluate the transitory shocks, or shocks occurring only once, and the permanent shocks, those accumulated over time. Moreover, our empirical proposition permits us to assess the interaction between fiscal and monetary policy. This interaction will be done by estimating the model equation that relates real money balance and fiscal policy.

The paper is organized as follows. Section II presents a discussion of the New Open Economy Macroeconomics (NOEM) in the context of empirical analyzes. Then, we describe the data set used, the empirical methodology, and the main results of selected literature. Section III discusses the results for the Brazilian economy. [Appendix A](#) presents some variables and main equations of the [Corsetti and Pesenti \(2001\)](#) model. [Appendix B](#) describes in details the SVAR model.

2. Macroeconomic interdependence and specific rigidity

As the real and nominal rigidities were incorporated with rigorous formulations, analyzes of the effects of economic policy shocks gained greater robustness.

[Helpman \(1976\)](#) shows the consequences of fiscal policies under flexible exchange rate regime to employment and relative prices considering nontradable and tradable goods sectors. Within a system of wage restrictions and sticky prices in terms of foreign currency for the home country, expansionary fiscal policy would not affect output and employment if the additional expenses occurred in tradable goods, yet would create a trade account deficit. On the other side, if government spending happens to be on nontrade goods, then it increases the output of nontrade goods sector and reduces the sector of tradable. Also, it expands trade account deficits. The employment will rise if the nontradable goods sector be labor-intensive, but will fall if otherwise.

In [Devereux and Wilson \(1989\)](#), the international interdependence was discussed over the coordination of fiscal and monetary policies. With expansionary fiscal policy practiced simultaneously by trading partner countries it could achieve higher employment without imbalances in the current account. Ignoring the potential benefits to the partner, both countries would follow excessively restrictive fiscal policies. Given the non-cooperative game, it would imply lower income and employment in both trading partners, featuring a typical beggar-thy-neighbor policy.

Furthermore, an expansionary monetary policy could bring to domestic economy adverse consequences, depending on whether the wage rigidity occurred in the domestic or foreign country, and which economy was leading the strategic policy game.

Thus, the lack of coordination involves spillover effects, resulting in excessively restrictive fiscal policies. With mutual coordination of economic policies, however, both countries would have better results for welfare. [Devereux and Wilson \(1989\)](#) also analyze the existence of unfavorable adversities to cooperation arising from the quality of information among partners.

The analyses of international transmission of macroeconomic policy enhanced with [Obtsfeld and Rogoff \(1995\)](#), *Exchange Rate Dynamics Redux*.⁴ Under an intertemporal approach with nominal price rigidities in the short run and explicit microeconomic foundations to the aggregate supply, in which output market is imperfectly competitive, producing differentiated goods, world consumption and world government spending takes the form of a weighted sum of domestic and foreign spending.

[Obtsfeld and Rogoff \(1995, p. 629\)](#) emphasize that the purchasing power parity applies to consumer prices because countries consume the same basket of goods, but does not hold for the output deflators, then the terms of trade are flexible.

³ As indicated in [Appendix A](#).

⁴ A detailed description of [Obtsfeld and Rogoff's \(1995\)](#) model and its implications to macroeconomic theory and policy is provided in [Lane \(2001\)](#).

Also, the domestic and foreign nominal prices of producers (nominal producer prices) are predetermined in the short run. Then, export prices are fixed in domestic currency of each producer market. However, producer prices in the foreign currency may vary if the exchange rate fluctuates (Obtsfeld and Rogoff, 1995, p. 637).

Under the short run domestic price rigidity the Obtsfeld and Rogoff (1995) model predicts that a permanent fiscal policy shock causes increase on demand for goods in both countries and it only increases taxes for domestic residents. Leisure and consumption would fall in the domestic economy, as well as the nominal interest rate. This price rigidity even if it lasts only in the short term may affect other variables in the economy if the government expenditure expansion remains for the future. Moreover, the model predicts lower real interest rate and currency depreciation of domestic economy for a permanent fiscal policy. Such policy under price rigidity is not *beggar-thy-neighbor*, but it is *beggar-thy-self* since it lowers private consumption relative to the trading partner.

Now we look for the effect of equivalent monetary policy effect still considering short run price rigidity. It causes global aggregate demand increase in both countries. The permanent increase in the money supply or an expansionary monetary policy would be *prosper-thyself* and *prosper-thy-neighbor*, dispensing policy coordination, according to the authors of the model.

Considering that at some point time both policies may bring domestic price changes or inflation in our view there is no incentive for the practice of such policies of permanent increase in fiscal or monetary variables. These policies might harm the domestic economy as well as the foreign by imposing demand pressure to last over a long period. Therefore, it might require recessive policies at some point in time that would spread to the foreign economies harming their welfare. Hence, there is no incentive for permanent economic policies of increase in fiscal or monetary variables in Obtsfeld and Rogoff (1995) model.

However, the model by Corsetti and Pesenti (2001) changes the above results. According to Corsetti and Pesenti (2001) the new open macroeconomics (NOEM) analyzes the interrelationships between internal and external sources of economic distortions. Economic distortions can be associated with the degree of openness of an economy to trade, through the power of a country to affect its terms of trade by manipulating the supply of their products. So, their model proposed a new theoretical analysis over the monetary and fiscal transmissions among interdependent economies. In this sense the model brought out a better understanding of the interdependence of economic policies.

The Corsetti and Pesenti (2001) micro-foundation was the main difference and it was built upon three basic assumptions. First, firms act competitively, implying alignment of goods prices at home and abroad; second, there are real frictions in the labor market, so real wage is predetermined; third the goods market operates under monopolistic competition. In addition to these assumptions the equilibrium positions of short and long run assets of both economies are zero.⁵ Therefore, adjustments to shocks fall over the variations of the terms of trade, without changing the position of the net domestic assets. The implications of this micro-foundation arrangement for economic policies and welfare will be described in the coming section.

2.1. Implication of Corsetti and Pesenti (2001) to economic policy

The analysis of Corsetti and Pesenti (2001) emphasizes the effects of economic policy shocks on the product of a country, depending on their degree of openness and its size in the world market. In the case of a closed economy, the increase in welfare due to a small monetary shock occurs when the highest level of domestic consumption, achieved through politics, dominates the “disutility” resulting from additional work effort. Given a large shock, the marginal benefit of a monetary expansion is positive for *all* shocks, whose size does not violate the participation constraint (Corsetti and Pesenti, 2001, p. 437).

In contrast, when the economy is opened and small, an expansionary monetary policy would increase the world monetary supply [$M_W = M^Y (M^*)^{1-\gamma}$]. This would reduce real interest rate causing outflows of capital from the economy implementing the shock, depreciating domestic exchange rate. As a result, aggregate demand increases. On the other hand, the increase in the exchange rate drives the economy toward a lower purchasing power of domestic money. The negative terms of trade externality may more than offset the positive aggregate demand externality described above. In the long run, the authors argued that this monetary shock would be neutral because home prices would move together

⁵ Ghironi (2001) expands this analysis by changing this hypothesis.

with money supply, making consumption and output to return to their initial levels along with real money balances and exchange rate.⁶

In accordance with the model, if the economy is large, the effects of *large* expansionary monetary policy are even worse than those described for the small economy case when policy-makers use it in an attempt of close the gap between actual and potential output. In both cases of small and large opened economies, expansionary policies could be *beggar-thyself*. Moreover, “only if the monetary expansions were jointly implemented, [...] the exchange rate effect would disappear, and each country would benefit from bringing output to its potential level” (Corsetti and Pesenti, 2001, p. 438). This result is opposite to Obstfeld and Rogoff’s (1995) one.

Expansionary fiscal policies in home country could affect trade partners in a negative way. Fiscal shocks are unexpected changes in the long run government spending to output ratios ($g = Y/Y-G$). The long-run levels of government spending are determined endogenously and held only over domestic goods. Additionally, permanent fiscal shocks imply setting the level of short-run spending to its long-run level. “The crucial element is that domestic government spending is exclusive in domestic goods...” (Corsetti and Pesenti, 2001, p. 440).

According to the model, an unexpected fiscal expansion has no short-run effect on domestic demand and employment at unchanged terms of trade. This is so because changes in government spending do not directly affect the marginal utility of private consumption and because the equilibrium exchange rate depends only on relative money supply ($M_R = M/M^*$). The authors argue that if the hypothesis of money demand as function of both private and public consumption is included, then the model’s results could hold as follows: whenever there was an expansionary fiscal policy, there should be an accommodating monetary policy in such a way that there would be no change in exchange rate. In this case, an expansionary fiscal policy would not cause the exchange rate to appreciate. Then, a temporary fiscal policy would not affect economy more than one period.

However, the effects of a permanent fiscal policy shock are not neutral and are highly related to the elasticity of intertemporal substitution ($1/\rho$).⁷ The authors explain that:

“When the shock is permanent, however, the increase in demand for Home goods requires an upward adjustment of Home wages in the long run. Thus, in the new steady state the relative price of Home goods rises, and the Home currency appreciates in real terms. Because of the real wage adjustment, long-run Home output increases by less than public spending, and world consumption falls while prices increase in both countries. The economy reaches an equilibrium corresponding to lower consumption and higher output levels relative to the initial steady-state allocation” (Corsetti and Pesenti, 2001, p. 440).

In the case of a increase in government spending abroad (g^*), it would increase world government spending [$g_W = g^\gamma (g^*)^{1-\gamma}$] with reflects over national economy in the long run. Since the condition that government spending lays only on national goods holds to both economies. Initially, it would increase the demand for foreign goods that could be attended if real wages in foreign country rises, so foreign output increase is possible. It would increase foreign price and deteriorate home terms of trade and reduce domestic real wages. Private consumption would fall in foreign country because the increase in foreign output would be smaller than its spending increment. It also would decrease in home country because the national deteriorated terms of trade. Moreover, if the expansion abroad increases home inflation, it would also decrease real money balances, adding up to the negative impact of consumption. The effect over home production would depend on ρ . According to Corsetti and Pesenti (2001, p. 440),

“Since the Foreign fiscal shock reduces the availability of Foreign goods to world consumers (Y^*-G^* falls), world demand for Home goods increases if the two national goods are substitutes ($\rho > 1$), and falls otherwise.”

Hence, Corsetti and Pesenti (2001, p. 441) shows that in many situations the fiscal policy shock spillovers are *beggar-thy-neighbor*.

Considering the theoretical results discrepancies found to the effects of economic policy between Obstfeld and Rogoff (2002) and Corsetti and Pesenti (2001), we investigate the implications of fiscal policies on the main economic

⁶ Corsetti and Pesenti (2001, p. 435).

⁷ If $\rho < 1$, then home and foreign goods are complements. However, if $\rho > 1$, home and foreign goods are substitutes.

aggregates of [Corsetti and Pesenti \(2001\)](#) for the Brazilian economy, taking the American economy (US) as foreign country.⁸

3. Empirical analysis of international macroeconomics transmission

The previous section showed how complex is the [Corsetti and Pesenti \(2001\)](#) model. The proposed interactions require a long run analysis in order to understand the results of macroeconomic interdependence of the economies. Hence, we propose to use the SVAR applications as way to learn about the long run economic relationship between Brazil, the domestic economy, and US, the foreign economy. Details of the SVAR model are presented in [Appendix B](#).

It is important to emphasize that we do not abdicate of the short run analyses. We will perform impulse response analysis through unique and cumulative shocks. Therefore, the short run analysis can be drawn from the long run one by considering a small period instead of the complete period of the impulse response analysis. The coming section explains the data to be used is estimating the econometric model in more details.

The problem of estimating time series has received special attention from econometricians in recent decades. The methodology of analysis of economic relations in the short and long run completely changed. New concepts and techniques were introduced to conduct empirical research.

In what follows, we present the main points of the time series analysis with structural VAR and over the issue of economic interdependence and pricing.

3.1. Data base

According to the Brazilian Treasury Secretary (Ministério da Fazenda do Brasil), from 1980 through 2000, the US economy represented 25% of Brazilian trade balance flow, reducing in the last decade to about 16%. For this reason we consider US as the foreign economy in this study. The period of analysis ranges from 1980:I to 2009:II, because of data availability and volume of trade. The data source comes from IFS and IPEA.⁹

Recall the period of analysis cover many events occurring in the Brazilian economy, 1980–2009. Brazilian economic shock of 1994, Real Stabilization Plan (*Plano Real de Estabilização da Economia*), was especially important to the series of real exchange rate to the behavior of the nominal exchange rate and the home wholesale price. Another important event was the effect of the *Plano Verão I* (Summer Plan I), 1989, for the reduction of inflation in the Brazilian economy over household consumption expenditure. There were also possible effects from the shock of Cruzado Plans I and II (*Plano Cruzado I and II*), for containment of inflation, over the real money balances series. In addition, many shocks over home price index may be included. Since all these shocks had as main objective to reduce inflation or its acceleration, these had direct effect over home goods price. The economic shock of 1990 was called *Plano Collor I*. Its major implication was to confiscate population savings deposits, reducing dramatically the volume of money available in the economy, M1 concept. The inflation rate at this point of history in Brazil was 2739.8% a.a., taking CPI as the basis of measurement. Moreover, the adoption of inflation targets since July, 1999 may affect estimation in the real balances and home prices equations. Thus, dummy variables were applied to account for these events in the Brazilian economy, depending of the equation estimated.

The macroeconomic variables applied in this paper are the following: Gross Domestic Product ($PIB = Y$); Household Consumption (C); Real Money Balances (M/P); Nominal Exchange Rate (ξ); Terms of Trade ($\xi P_F^*/P_H = \mathcal{J}$); Prices (P_H); Nominal Money (M); Government Spending to Output Ratio (g); World Government Spending Position (BR and US).

3.2. Econometric applications to international economic policy transmissions

In this section our aim is to review briefly the applied literature on macroeconomic interdependence, based on [Corsetti and Pesenti \(2001\)](#) analysis, which presented different results from [Obtsfeld and Rogoff \(1995\)](#), coming from rigidities on the labor market and monopolistic competition in the goods market.

⁸ An expanded version of this analysis is in [Dias and Dias \(2010\)](#).

⁹ IFS-International Financial Statistics of IMF; and IPEA-Research Institute of Applied Economics.

The applied papers in this field follow the initial empirical estimates proposed by [Blanchard and Quah \(1989\)](#). In their paper, the authors decomposed the shocks into two categories – transitory and permanent. The transitory shocks represent the short-run impact arriving from the exogenous variables in the model while permanent shocks represent the long-run impact from the same variables. They proposed to analyze these short- and long-run effects through an SVAR – a Structural Vector Autoregressive Model.¹⁰

The advantage of the SVAR models is allowing the identification of the restrictions imposed in the estimates, accordingly to proposed theory. Then, the theory can easily be tested empirically. Completely theory tests fully, the SVAR models are combined with exogeneity or causality tests. Therefore, the results can be interpreted as an economic policy shock from one country to the other in our case.

Following is a brief review of the literature that depicts the application of SVAR models that tested the interdependence of economic policies between countries. The aim is demonstrating the versatility of application of SVAR models.

3.3. *Applicability of SVAR models for the transmission of economic policy*

Initially, the NOEM – New Open Economy Macroeconomics – literature used SVAR models to test pricing hypotheses. The price hypotheses tested in these models were PCP – *Producer Currency Price*, if prices should be determined equally in both markets (domestic and abroad), or PTM – *Pricing to Market* behavior and LCP – *Local Currency Pricing*, when prices are differentiated across markets (domestic and abroad). Under PCP, prices are determined according the currency of the producer, being a price prevailing to both markets. However, if prices are fixed in the producer's currency, an exchange rate movement could affect its competitively abroad, just as in the case of traditional Mundell-Fleming model.

When testing the effects of monetary shocks on terms of trade, [Clarida and Galí \(1994\)](#) and [Eichenbaum and Evans \(1995\)](#) found that the underlying price hypothesis was PTM. [Betts and Devereux \(1996\)](#) extended the previous empirical models considering the trade balance surplus. They reached the conclusion that PTM better explains product and terms of trade movements when compared with models under Purchasing Power Parity and using the PCP hypothesis.

As shown by [Devereux et al. \(2003\)](#), in the case of LCP, producers set prices in their own currency, and importing intermediaries set consumer prices in local currencies of the consumers. Then, a nominal appreciation improves the terms of trade, consistent with observations by [Obstfeld and Rogoff \(2000\)](#).

Comparing the two strategies of price setting, with PCP, the exchange rate is affected by both money and velocity shocks. Under PCP, as in [Obstfeld and Rogoff \(2002\)](#), an unexpected home monetary expansion increases domestic consumption directly, but part of this increase is offset by exchange rate depreciation, while it leads to foreign exchange rate appreciation, a reduction of the price level and an expansion of foreign real balances, increasing consumption abroad ([Devereux and Engel, 2003](#), p. 774).

Further development in theory testing was achieved by [Dhrymes and Dimitrios \[A1\] \(1997\)](#). They specify SVAR models that are more compatible with prevalent economic theory hypotheses. For instance, they tested whether the model is better specified when the variables are entered as *forward looking* or *backward looking*. Their main results were that: (i) the international interest rate and the real exchange rate are determinants of the real output; (ii) there is domestic and foreign money exogeneity; and (iii) there is no money illusion.

Recently, the SVAR models were used to test wage rigidity implications to international transmission. For instance, [Bergin \[A4\] \(2003, 2004\)](#) also included the hypotheses of flexible price and wage rigidity testing whether prices were PCP or PTM. The hypothesis of wage rigidity was rejected in all the empirical tests. The PTM did explain most of the movements in the output; however, it did not perform well in explaining exchange rate movements. This result on the exchange rate was obtained by using a standard structural model for benchmarking. Thus, this last result discords with the results found in [Clarida and Galí \(1994\)](#) and [Eichenbaum and Evans \(1995\)](#).

In addition, SVAR were applied in NOEM testing the effects of monetary policies on the balance of payments. A test of long-run or permanent productivity shocks on the balance of payments was performed by [Cavallari \(2001\)](#).

¹⁰ See [Sims \(1980\)](#). Using SVAR models to test theoretical hypothesis was highly applied to Real Business Cycles. These literatures permit understanding theoretical and empirical relations through SVAR. Recently, [Chari et al. \(2005\)](#), [Fernandez-Villaverde et al. \(2007\)](#), [Dupaigne et al. \(2007\)](#) are helpful to SVAR applications to economic models.

Productivity movements were defined as the first difference of the ratio of domestic to world output. Then, using the first difference of the ratio of the domestic to world output, the balance of payments to output, and the domestic to international interest rates, [Cavallari \(2001\)](#) found that monetary shocks cause no contemporaneous effect on real activity. However, the author did not include the exchange rate, which is considered crucial for understanding the mechanisms of international transmission of monetary policy.

[Lee and Chinn \(2002\)](#) extended the previous model to incorporate the exchange rate. While letting short-run effects of economic policy to fluctuate freely without restrictions, they estimated the long-run impact of an international monetary policy and found evidence of effects on exchange rate movements. The effects are transitory and compatible with the theory of the price being PTM. The main problem of this strategy of permitting the short-run effects being free of restrictions over estimations is related to the identification problem of structural shocks with SVAR applications.

A more elaborate model of international transmission was achieved by [Giuliodori \(2004\)](#), calling attention to the identification problem. The author proposed a three-equation system: (i) the first formed by variations in the ratio of the domestic to the world output; (ii) second, variations in the exchange rate; and (iii) the ratio of the balance of payments to output. Also, the shocks on these variables are of the three natures: (a) supply; (b) demand; (c) structural monetary. The permanent shocks are defined as originating from supply shocks or technology shocks. By estimating the system for the OECD countries, the author found that permanent shocks do affect the exchange rate permanently, but not symmetrically. For instance, in countries such as Austria, Belgium, Denmark, Holland, Japan, Swedish, and the United Kingdom, the exchange rate depreciates. However, in the remaining countries there is appreciation of the exchange rate. In another words, world supply shocks may cause different impacts depending on countries' own characteristics and linkage to the world economy.

Also, [Fink and Schüller \(2013\)](#) apply the SVAR model to capture the transmission of adverse financial shocks from the U.S. economy to selected emerging countries, Brazil, Chile, Korea, Malaysia, Mexico, Philippines, South Africa, and Thailand. The results for the variance decomposition imply negative spillover effects of shocks arising from a financial index computed for the U.S. economy¹¹ to these emerging countries. In general and on average, American adverse financial shocks caused 21% of variation in the real economic activity, 12% of the variation in the foreign capital flows, 18% of the variation in the interest rate and 22% change in the exchange rate of emerging in the analysis.

Moreover, [Dias and McDermott \(2004\)](#) applied Vector Error Correction (VEC) models to the equations of the theoretical model of [Corsetti and Pesenti \(2001\)](#) for the case of Brazil and US. In general, the results confirmed the theoretical model for the output, household consumption, and real balances. The long-run relationship between the world fiscal position and the real effective exchange rate showed real appreciation resulting from expansionary fiscal policy shocks. It is worth mention that the period from 1980 to 2001, quarterly, received significant effects from exchange rate policy practiced in Brazil in the 1990s, varying within a predetermined interval. Improving the econometric method to account for the structural theoretical model, deepening the empirical approach, may bring greater robustness to the effects of transmission among trading partners.

Within the theoretical and empirical approach developed here, [Dias et al. \(2012\)](#) applied the SVAR methodology to evaluate international interdependence to two case studies, Argentina and European Union (EU) and Brazil and EU. The analyses emphasized the effects of permanent fiscal policy shocks arising from world government spending (domestic plus foreign country) on domestic consumption and domestic output of Brazil and of Argentina. In agreement with [Corsetti and Pesenti \(2001\)](#), the case of Argentina and European Union confirmed negative effects of world fiscal policy shocks on output and consumption of Argentines, causing deviations from their long-run averages, considering cumulative fiscal shocks. For the Brazilian economy, the results could not confirm beggar-thy-neighbor effects of EU fiscal policy shocks on Brazilian consumption and output.

The following section presents SVAR estimates to fiscal policy transmission in the long run, considering Brazil the domestic economy and United States, the foreign one. The estimations result of shocks simulations from impulse response functions applied to world fiscal policy position, a variable composed by the ratio of fiscal spending of Brazil and US as percentage of their respective output, on the Brazilian output, consumption, terms of trade, real money

¹¹ National Financial Conditions Index (NFCI) of the Federal Reserve Bank of Chicago. The shocks are unexpected changes in NFCI and are called U.S. Financial Stress, considering the period from 1999 to 2012, in monthly terms.

balances, and domestic prices. The variables were chosen from the theoretical framework provided by [Corsetti and Pesenti \(2001\)](#),¹² which indicates the relationship among the main variables of the model.

The implications of macroeconomic policies of [Corsetti and Pesenti's \(2001\)](#) model show that a permanent fiscal shock from a home country increases world fiscal spending through the variable g_w , raising home aggregate demand and output (Y_h). These reach the home nominal wage (W_h), affecting home prices (P_h) to rise. In consequence, there is a real appreciation of home terms of trade ($\xi P_F^*/P_H = \mathcal{T}$), implying home market buying less from abroad. Since real wages adjust by decreasing in the home country, the long-run increase in home output is lower than the initial increase in home government expenditure (g_h). Moreover, world household consumption diminishes as a whole and prices rise in both countries, home and abroad. This happens because the increase in home government expenditures at home should rely on home goods and not foreign ones. Therefore, if the positive externality of foreign depreciation is offset by the reduction in foreign purchasing power, throughout reductions in both real wages and real balances, worsening by decreasing world consumption, this home fiscal policy would bring negative effects over the foreign country. Then, it would be a beggar-thy-neighbor policy. The channel of international policy transmission should occur through relative prices, or the real exchange rates, called by the authors as terms of trade. However, the negative impact in foreign consumption and output could be smaller if goods trading between both economies are substitutes, which would affect foreign prices in different directions.

4. Analysis of the fiscal policy transmission from U.S. to Brazil¹³

4.1. Long run impact of world fiscal policy on Brazilian household consumption

According to [Corsetti and Pesenti \(2001\)](#), long-run real domestic household consumption depends on the government spending of the world (Brazil and US combined), or the world fiscal position (g_w).¹⁴ Here, the series is the variations around their respective long-run averages. In this bivariate model, the impacts of world fiscal position are evaluated by variations from respective long-run means, that is, changes in the moving averages of the variables.

The SVAR model allows testing the causality relations of fiscal shocks on long-run aggregate household consumption and provide two effects: (i) arising from a unique shock, equivalent to short-run changes in government fiscal spending of both countries combined; and (ii) cumulative shocks equivalent to long-run shocks in the world fiscal position. Thus, the system has the following SVAR specification:

$$y_t = \begin{bmatrix} \Delta \text{Ln} \left[\left(\frac{G^*}{\bar{G}^*} \right) / \left(\frac{G}{\bar{G}} \right) \right] \\ \Delta \text{Ln}(c/\bar{c}) \end{bmatrix} C = \begin{bmatrix} C(11) & \cdot \\ C(21) & C(22) \end{bmatrix} e_t = \begin{bmatrix} p_t \\ t_t \end{bmatrix} \quad (1)$$

The international interdependence of domestic economy can be measured through a permanent shock (p_t), or cumulative one, in which foreign government spending grows more than domestic one. These expenditures would cause direct impact on the growth rate of long-run real consumption of the domestic country. If positive, this impact would result in *prosper-thy-neighbor* welfare and if negative it would be *beggar-thy-neighbor* to domestic welfare. The transitory shocks (t_t) are those occurring only once, or a unique shock.

Concerning estimations, the long-run consumption function is log-linearized. Therefore, household consumption in the long run (cc) reflects the difference of the logarithm of current consumption to its long-run trend period to period. Positive effects indicate that consumption is growing faster through time, so an improvement in the long-run consumer's welfare increases the variable consumption (cc). The long-run consumption is obtained with the HP filter, from [Hodrick and Prescott \(1997\)](#). Considering deviations from trend, a permanent expansionary world fiscal policy means that government expenditure abroad, relative to its output, is increasing faster than government expenditure at home, relative to home output, increasing the variable gg . Thus, the difference of relative government expenditure abroad and home is rising.

¹² The SVAR model refers to the equations (A4), (A5), (A6), (A10), and (A11) from Table A1 of [Appendix A](#).

¹³ Technical notes on the econometric tests are available in [Dias and Dias \(2010\)](#).

¹⁴ Eq. (A4) of [Appendix A](#).

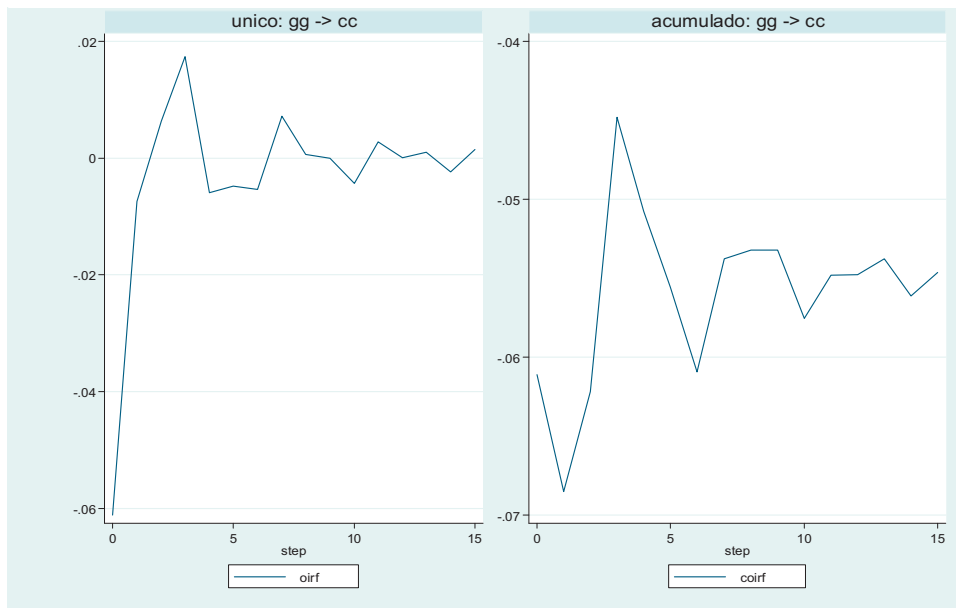


Fig. 1. Impulse-response functions: Foreign fiscal policy (*gg*) on domestic consumption (*cc*).

Among the initial tests performed are those about the stationarity of series, unit root tests. The tests used throughout the empirical section are DFGLS, augmented [Dickey and Fuller \(1979\)](#), PP, [Phillips and Perron \(1988\)](#), and AZ statistics, according to [Andrews and Zivot \(1992\)](#). All tests showed that the variables used in the estimations are stationary.

The test of lag order selection criteria initially indicated 04 (four)¹⁵ lags. Furthermore, SVAR estimations confirmed four lags through new LM (Lagrange Multiplier) and Wald tests of lag exclusion.

The structural VAR estimations of Eq. (1) followed the recommended number of lags, and its estimated coefficients are displayed in the system of Eq. (2).¹⁶

$$y_t(cc) = \begin{bmatrix} gg \\ cc \end{bmatrix} \quad C(cc) = \begin{bmatrix} 0.089 & 0 \\ (0.0006)^* & \\ -0.0864 & 0.0607 \\ (0.0081)^* & (0.0040)^* \end{bmatrix} \quad e_t(cc) = \begin{bmatrix} p_t \\ t_t \end{bmatrix} \quad (2)$$

The Eq. (2) results are significant at 1% showing the existence of a strong long run relationship with causality running from fiscal foreign fiscal policies to domestic consumption (*cc*). The Granger causality tests for Eq. (2) resulted in $\chi^2 = 2.03$. It indicates that the probability of *gg* Granger causing *cc* is close to zero in the short run, but not in the long run. The Jarque–Bera test of normality of the residuals is $\chi^2 = 271.92$ which rejects the hypothesis that the residuals are normal. However, most important is that the variance and the covariance of the residuals are stationary according to the tests:¹⁷ $AZ = -10.31^*$; $DFGLS = -10.14^*$; and $PP = -10.14^*$, with significance at 1%. Therefore, estimated residuals have a distribution that is not normal, but it is stationary. The SVAR stability test performed indicated that AR characteristic roots lie inside the unit circle.

Thus, the estimated model in Eq. (2) enables us to perform impulse-response functions considering unique and cumulative shocks. The shocks in all simulations ahead are set to last 15 quarters. The first shock in the forthcoming figures is displayed in graphs identified as (oirf), this is the transitory shock coming from an impulse that last one quarter. The cumulative shocks are displayed in the graph (coirf) and represent impulses lasting for 15 quarters.

The first result displayed in [Fig. 1](#), first graphic on the left (oirf graph), represents a unique shock coming from US fiscal policy (*gg*). This shock occurs when US government expenditure as percentage of GDP exceeds the Brazilian

¹⁵ See details of Lag Structure, Lag Order Selection, and Lag Length Criteria in [Hamilton \(1994\)](#).

¹⁶ The values in parentheses below the coefficients are long-run standard deviations of SVAR, while the star (*) indicates the degree of significance, in this case 1%.

¹⁷ These are unit root test described in [Dickey and Fuller \(1979\)](#), [Phillips and Perron \(1988\)](#) and [Enders \(1995\)](#).

one for one quarter. This causes the Brazilian domestic consumption to decrease relative to its long run trend for a short period of time, two quarters at most. As one notices after that the domestic consumption oscillates around its average long-run consumption until reaches its equilibrium. Then, foreign temporary fiscal shocks increase the variance of consumption initially, but do not affect the Brazilian consumption permanently.

The accumulated impulse function, the coirf graph in Fig. 1, display the US fiscal policy shock that lasts at least 15 quarters. This foreign policy would lead to a permanent reduction in long-run household Brazilian consumption from its trend. Then, household consumption would be below its long-run equilibrium when facing permanent increases in foreign fiscal policy. Therefore, permanent foreign fiscal policies cause *beggar-thy-neighbor* effects in the Brazilian economy.

This result shows a long run interdependence of the Brazilian economy in relation to the US economy. This *beggar-thy-neighbor* occurs because cumulative increase in fiscal expenditure in US causes increases in global aggregate demand. From this follow increases in foreign prices and wages. As a result, the prices of imported goods rise for Brazilian residents, increasing the level of domestic prices. Then, the terms of trade depreciates at home reducing the purchasing power of domestic agents. The increase in relative prices induces domestic demand for consumption and creates an incentive to export more. Therefore, there is a redistribution of activity toward foreign markets.

Though the exports rise for the domestic economy due to exchange rate depreciation the overall result for economic activity is negative. The reason is that the share of household consumption in the Brazilian GDP is far greater than the export share. Thus, export increase is not enough to cover the consumption downfall. In this case the negative externalities of terms of trade depreciation are larger than the increase in demand for Brazilian goods coming from the fiscal external shock, in agreement with the theoretical model. Hence, permanent fiscal policy shocks, considering Brazil and US, reduce Brazilian household consumption in the long run, confirming the *beggar-thy-neighbor* effect.

4.2. Long run impact of world fiscal policy on Brazilian output

From Corsetti and Pesenti (2001), home output in the long run would depend only on fiscal policy variables but monetary policy ones.¹⁸ In the international interdependence context, applied here to the Brazil and US case, long-run real domestic output responds to world position of government spending (Brazil and US combined), g_w .

Again, estimating a SVAR to this model required log-linearizing the variables around their long-run trend. HP filters were applied to find the trend to the Brazilian output. Therefore, the variable yy represents the difference of the log of home output from its trend, period by period. Positive impact of world fiscal policy expansion on yy indicates that the current growth rate of Brazilian output is surpassing its long-run average.

Tests from DFGLS, PP, and AZ statistics prove stationarity for the variable yy . Preliminary lag structure tests showed 04 (four) lags. LM and Wald lag exclusion tests confirmed four as the optimal number lags. As before, the regression residuals did not show normality with the Jarque–Bera of $\chi^2 = 420.07$. However, stationarity tests to the residuals distribution attest 1% significance, with AZ = -10.24*; DFGLS = -10.12*; and PP = -10.13*.

Thus, the estimated model is similar to Eq. (2), but substituting equation cc for yy . The results of this equation are as follows.

$$y_t(yy) = \begin{bmatrix} gg \\ yy \end{bmatrix} \quad C(yy) = \begin{bmatrix} 0.088 & 0 \\ (0.0058)^* & \\ -0.086 & 0.0502 \\ (0.0074)^* & (0.0033)^* \end{bmatrix} \quad e_t(yy) = \begin{bmatrix} p_t \\ t_t \end{bmatrix} \quad (3)$$

Since all the coefficients are significant at 1%, SVAR results indicate the relationship proposed by the theory that there is a long-run relationship between world fiscal policy and variations of domestic product is confirmed. However, additional Granger causality tests imply gg does not Granger cause yy , with $\chi^2 = 3.95$, or 41%. This test indicates that the causality might not hold on the short run, but only on the long run.

Considering that long-run coefficients estimates from SVAR are significant, the impulse-response functions are performed for 15 quarters.

¹⁸ Eq. (A5) of Appendix A.

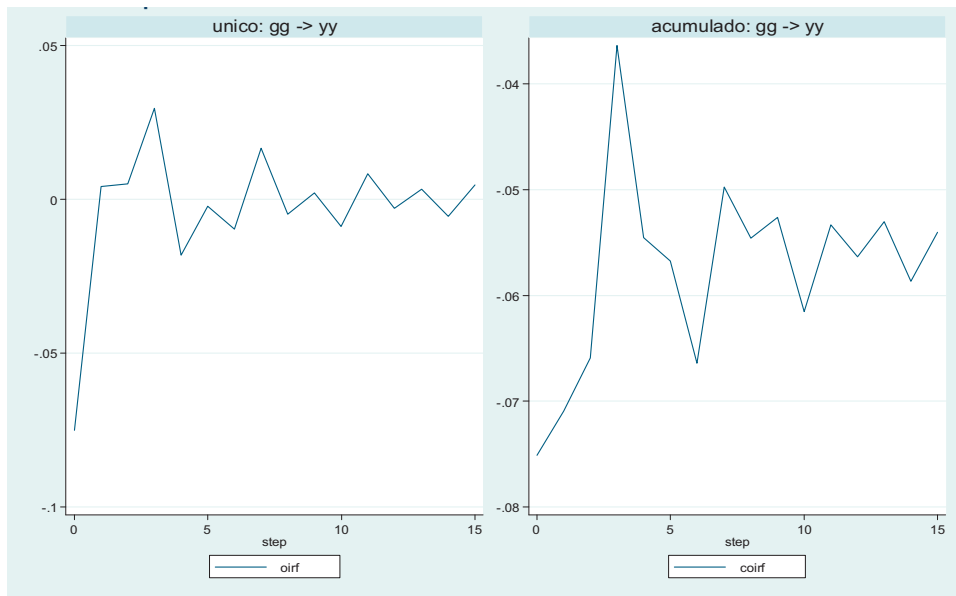


Fig. 2. Impulse-response functions: Foreign fiscal policy (*gg*) on domestic output (*yy*).

The transitory impulse due to a unique shock from world fiscal position diminishes output growth rate in the long run, down to 0.07%. However, over time impulse response function shows oscillations of home output around the growth rate of long-run trend.

Otherwise, the accumulated impulse of the world fiscal position, referring to 1% increases in U.S. government spending proportionally higher than those of Brazil, permanently reduce the rate of growth of the Brazilian economy to its long-run rate to 0.05%. Therefore, beggar-thy-neighbor effects of long-run fiscal policy of Corsetti and Pesenti (2001) is confirmed for the growth rate of the Brazilian output, when considering the United States as a foreign economy (Fig. 2).

As indicated by the theoretical model, the transmission of fiscal policy can be associated with impacts in terms of trade of the home country. Relative prices rise due to high pricing of tradable goods coming from higher foreign prices. In effect, this can create an increased demand for tradable goods from, but a fall in domestic consumption of households. Recall that the weight of consumption in home aggregate demand is higher than tradable goods. Then, a rising world fiscal position coming from increasing U.S. government spending causes a drop in the growth rate of output to its long-run trend in Brazil. Therefore, international fiscal policy has *beggar-thy-neighbor* effects.

4.3. Long run impact of world fiscal policy on Brazilian real money balances

This section aims to verify if there is an interdependence of the purchasing power of domestic money regarding U.S. fiscal policy, considering the world relative fiscal position between Brazil and the United States.¹⁹

In this SVAR estimation long-run real money balances comes from HP filter. The variable *mm* denotes time differences of the logarithm of real balances relative to its trend. Long-run deviations of domestic real quantity of money from trend indicate real balances, or the purchasing power of the domestic currency, are undergoing structural changes due to its dependence on world fiscal policy (*gg*).

The tests indicate stationarity for the variable *mm*. Initially, lag selection tests indicate the number four of lags as appropriate. After performing regressions structural tests, LM tests indicated five lags due to autocorrelation still present with four lags. However, the lag exclusion Wald test also confirmed the number of lags as four. Jarque–Bera results of $\chi^2 = 130.44$ indicate that the residuals are not normally distributed. However, the distribution is stationary according to the following performed testes: $AZ = -9.87^*$; $DFGLS = -9.82^*$; and $PP = -9.80^*$; all significant at 1%.

¹⁹ Eq. (A6) of Appendix A.

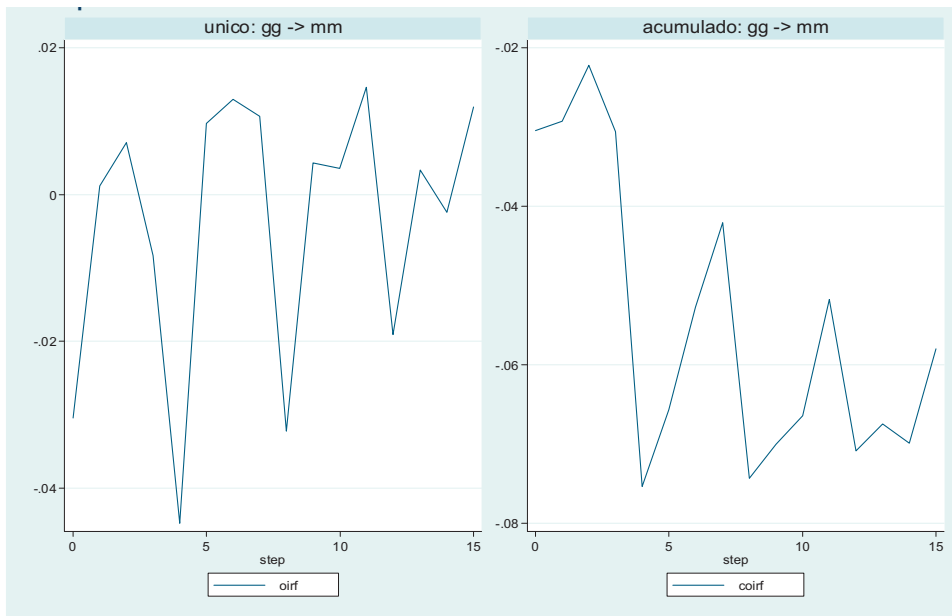


Fig. 3. Impulse-response functions: Foreign fiscal policy (*gg*) on domestic real balances (*mm*).

The empirical model to long-run real money balances (*mm*) as dependent variable, representing variations in the growth rate of real money relative to its trend, and world fiscal government spending as independent variable, taking Brazil as domestic country and the United States as foreign one. The results are:

$$y_t(mm) = \begin{bmatrix} gg \\ mm \end{bmatrix} \quad C(mm) = \begin{bmatrix} 0.1019 & 0 \\ (0.0067)^* & \\ -0.0932 & 0.1162 \\ (0.0125)^* & (0.0077)^* \end{bmatrix} \quad e_t(mm) = \begin{bmatrix} p_t \\ t_t \end{bmatrix} \quad (4)$$

Additional Granger causality tests indicate that *gg* precedes *mm*, with a statistics of $\chi^2 = 10.95$, not rejecting at significance level of 5%, and accepting *gg* effects on *mm*, at significance level of 1%.

According to Fig. 3, world fiscal policy temporarily higher relative to Brazil does not affect permanently the purchasing power of the national currency. Instead, permanent world fiscal policy shocks, in which the U.S. government spending participation grows proportionally more than Brazilian government expenditure participation on output from its trend, implies permanent negative effects on real balances, since these expenditures shocks are cumulative. The permanent effects of 1% increase in *gg* can lead to a reduction in Brazilian real balances from -0.02% to -0.08% , which is relatively small, but cannot be neglected.

Nevertheless, in this case, the fiscal policy of increasing U.S. government spending relative to Brazil can be classified as *beggar-thy-neighbor*. According to Corsetti and Pesenti’s (2001) model, the process of international fiscal policy transmission occurs via changes in the terms of trade from one country to the other.

Theoretically, increasing U.S. government spending relative to Brazil raises U.S. aggregate demand, causing higher U.S. prices. This would depreciate Brazilian real exchange rate, which could raise demand for domestic export goods. Initially, the prices of tradable goods rise, transmitting to the overall domestic prices index. With higher domestic prices, the purchasing power of the domestic currency decreases, reducing real incomes and domestic demand for goods as well as world consumption. This effect is consistent with those found by empirical applications here.

4.4. Long run impact of world fiscal policy on Brazilian real exchange rate

The Brazilian terms of trade from the model represents real effective exchange rate, from a concept that considers the relative prices to trading partners of a basket of sixteen countries, including US. The long-run terms of trade deviations for both countries are just the actual series minus the trend from the HP filter.²⁰

²⁰ Eq. (A10) of Appendix A.

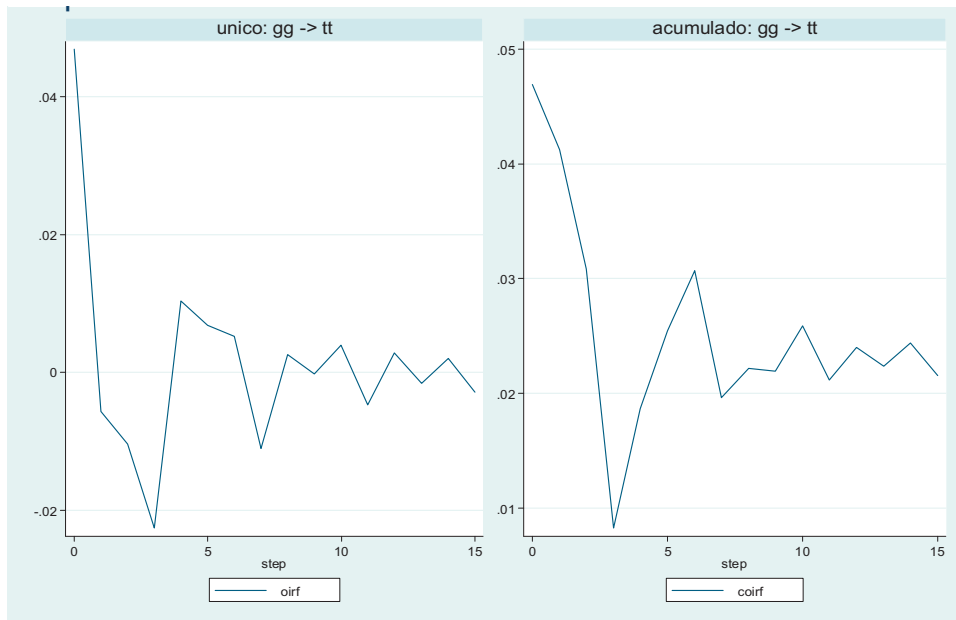


Fig. 4. Impulse-response functions: Foreign fiscal policy (gg) on domestic terms of trade (tt).

The required tests for robustness of SVAR result of stationarity for the long-run terms of trade (tt). LM and Wald Lag Exclusion tests indicated four lags. The results of the estimates of the structural VAR are:

$$y_t(tt) = \begin{bmatrix} gg \\ tt \end{bmatrix} \quad C(tt) = \begin{bmatrix} 0.0861 & 0 \\ (0.0057)^* & \\ 0.0482 & 0.0447 \\ (0.0052)^* & (0.00297)^* \end{bmatrix} \quad e_t(tt) = \begin{bmatrix} p_t \\ t_t \end{bmatrix} \quad (5)$$

The results indicate that the coefficient $C(21) = +0.0482$ is significant at 1%, the terms of trade are influenced directly by gg , composed by the U.S. fiscal policy as foreign country and Brazilian government expenditures, confirming previous analyzes and the transmission mechanism of international shocks. However, Granger causality tests imply gg does not Granger cause tt at 10%, $\chi^2 = 3.28$. Therefore, short-run world fiscal policy may not have significant impact to deviations of long-run Brazilian terms of trade from its trend, or to the growth of domestic real exchange rate.

Considering the estimated coefficients, simulations of shocks from 1% change in the world fiscal position are presented in Fig. 4.

The results show impacts of a unique shock of 1% change in world fiscal policy on the Brazilian terms of trade as deviations from its trend over 15 quarters. Initially, a transitory shock from gg causes depreciation in tt , however oscillating around its average afterwards. Through time, deviations of Brazilian terms of trade tend to zero.

Although shocks of 1% increase of world fiscal position begin with a process of depreciation of the Brazilian terms of trade, over 0.04%, its variations tends to reduce over time, but remains with depreciation in the long run in relation to its trend.

Accordingly, considering that the U.S. fiscal spending occur in order to divert more than proportionally to the Brazilians and deviations are cumulative, this implies that there is a depreciation of the Brazilian terms of trade remaining in the long run.

Theoretically, the depreciation would initially bring higher domestic competitiveness to home output traded with U.S. However, the cumulative effects indicate that there could be negative effects on aggregate domestic demand by boosting prices internally and causing reduction in the purchasing power of the national currency and real wages. These negative aggregate demand externalities arising from the depreciation resulting from the world government spending position would bring *beggr-thy-neighbor* effects.

Thus, the results are consistent with long-run negative effects of expansionary fiscal policy acting through international depreciation of terms of trade and reaching the home consumption, output, and Brazilian real money balances in the long run.

4.5. Long run impact of world fiscal policy on Brazilian domestic prices

As Corsetti and Pesenti (2001), domestic prices are affected by long-run world fiscal position, domestic monetary policy, and national government spending.²¹ This empirical analysis however represents a challenge. From 1980 to 2009, Brazilian prices have suffered significant changes due to the different inflationary processes in the economy. Therefore, the specification of the empirical model to be estimated requires clarification as to their effects.

First, domestic prices are represented by a ratio of the current price level and the price level in the long run, obtained by the HP filter. The difference of the logarithm of home prices in the concept expresses the difference between the inflation rate and its expectations in the long run (*pp*). Secondly, the quantity of money (means of payments, M1 concept) used in the analysis also underwent to transformations capturing the effects of monetary policy over home prices. Similarly, the stock of long-run money was constructed with the HP filter. The difference of the logarithm of the ratio of the stock of money to its long-run amounts refers to differences in their growth rates (*mm*). Therefore, cumulative shocks on the difference in the rate of money growth to its expected long-run average indicate an expansionary monetary policy. Thirdly, cumulative shocks from U.S. fiscal policy *vis-a-vis* Brazil in the world fiscal position represent an expansionary fiscal policy (*gg*). In short, this specification is equivalent to log-linearize Eq. (A11) of Table A1 of Appendix A over its long-run behavior.

Considering stationarity for the variables of the model, from DFGLS and PP statistics, and the tests for lag selection, Wald and LM tests, indicating 04 (four) lags, the SVAR system equations are the following:

$$y_t(mm, pp) = \begin{bmatrix} gg \\ mm \\ pp \end{bmatrix} \quad C(mm, pp) = \begin{bmatrix} 0.0899 & 0 & 0 \\ (0.0059)^* & & \\ -0.0881 & 0.1057 & 0 \\ (0.0115)^* & (0.0070)^* & \\ -0.0462 & -0.0025 & 0.1153 \\ (0.0112)^* & (0.0108) & (0.0076)^* \end{bmatrix} \quad e_t(mm, pp) = \begin{bmatrix} p_t \\ dm_t \\ pp_t \end{bmatrix} \quad (6)$$

The coefficient of monetary policy in Eq. (6) *pp*, $C(32) = -0.0025$ was not significant however. Then, the equation is estimated by eliminating the coefficient $C(32)$ and an over-identification test was performed. The over-identifying test produced a χ^2 statistic of 0.057, therefore it does not reject the hypothesis that the remaining coefficients are different from zero. Thus, the result indicates that long-run variations in domestic prices are associated with supply shocks and demand shocks nationally and internationally. The estimated results are shown in SVAR system Eq. (7).

Then, the equation is estimated by eliminating the coefficient $C(32)$ and the over-identification of causality was performed. The coefficient of monetary policy in *pp*, $C(32)$ was not significant however. The over-identifying test produced a χ^2 statistic of 0.057, therefore does not reject the hypothesis that the coefficient is zero. This result indicates that long-run variations in domestic prices are associated with supply shocks and demand shocks nationally and internationally. The estimated results are shown in SVAR system Eq. (7).

$$y_t(mm, pp) = \begin{bmatrix} gg \\ mm \\ pp \end{bmatrix} \quad C(mm, pp) = \begin{bmatrix} 0.0899 & 0 & 0 \\ (0.0059)^* & & \\ -0.0881 & 0.1057 & 0 \\ (0.0115)^* & (0.0070)^* & \\ +0.0881 & 0 & 0.1153 \\ (0.0059)^* & & (0.0077)^* \end{bmatrix} \quad e_t(mm, pp) = \begin{bmatrix} p_t \\ mm_t \\ pp_t \end{bmatrix} \quad (7)$$

Moreover, the coefficient (*gg*) in (*mm*) proved to be significant, the U.S. fiscal policy affects Brazilian monetary policy in the long-run. The reason is simple, the increases in U.S. government expenditures expand U.S. income internally and their aggregate demand rise, raising American prices. On the one hand, the initial impact of higher aggregate demand in the U.S. rests in part on imported products. In turn, if there are more Brazilian exports, this increases domestic reserves, which are converted into domestic currency. Therefore, the permanent increase in world

²¹ Eq. (A11) of Appendix A.

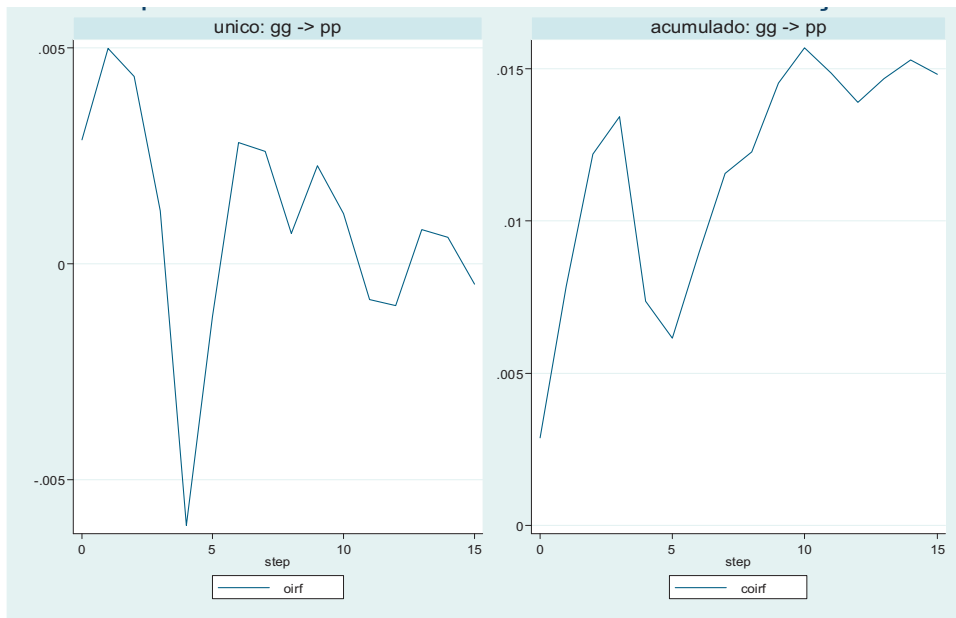


Fig. 5. Impulse-response functions: Foreign fiscal policy (gg) on domestic prices (pp).

fiscal position (gg) increases (mm) in Brazil, implying that long-run growth of domestic money is higher than its long-run trend.

In analyzing the effects of the world fiscal position on Brazilian domestic prices, both transitory and permanent shocks are observed in Fig. 5. First, temporary shocks are effects of a single change in the world fiscal policy (unique shock), and second, permanent shocks represents cumulative changes.

Thus, transitory shocks from world fiscal policy (gg) cause increase in the growth rate of Brazilian price index above 0.005%. In the long run a unique shock is likely to vanish because their oscillations reduce toward prices trend.

However, the accumulated shocks of 1% increase in the U.S. fiscal policy above the Brazilian one (gg) on Brazilian prices result in permanent price increase above its trend. Note that this cumulative effect can raise the growth rate of the price level up to 0.015% in 15 quarters.

According to Corsetti and Pesenti (2001), this behavior of domestic prices in relation to the international fiscal position, linking government spending of the United States and Brazil, proportional to their output respectively, indicates the trade between Brazil and U.S. are predominantly of substitute goods, considering the long run means. Thus, in accordance with the theoretical and empirical results, despite the beggar-thy-neighbor effects found for U.S. fiscal policy, these are mitigated by commercial relations. When the United States increase their government expenditures, raising world fiscal position, the Brazilian terms of trade depreciate and domestic aggregate demand loses purchasing power, but turns to the purchase of domestic goods, partly offsetting the losses in Brazilian income, but increase prices in the long-run.

5. Final considerations

The implications of economic interdependence among trade partners have been discussed concernin the need for coordination of economic policies and the degree of efficiency to ensure increasing or at least keeping welfare.

The literature presents conflicting results on the effects of macroeconomic policies practiced in a country to its trade partners. The theoretical and empirical approaches have developed over time, responding to eminent problems arising in national markets. In the new open macroeconomics, Obstfeld and Rogoff (1995) showed that in face of producer price rigidities (Devereux and Engel, 2003), a temporary increase in government spending implies a proportional increase in global output and maintenance of private consumption. On the other hand, a permanent increase in fiscal spending

raises output in the short run above its long-run, temporarily decreasing the real interest rate, inducing agents to smooth their consumption over time. Thus, fiscal policy would have no *beggars-neighbor* effect. In contrast, [Corsetti and Pesenti \(2001\)](#) deepen a particular case of [Obtsfeld and Rogoff \(1995\)](#) on labor and goods market rigidities coming from imperfect competition. The macroeconomic transmissions of expansionary fiscal policy on the welfare cause *beggars-neighbor* effects to trade partners.

In this context, we tested the theoretical propositions of [Corsetti and Pesenti \(2001\)](#) to identify the effects of world fiscal policies on long-run consumption, gross domestic product, real money balances, real effective exchange rate, domestic prices and monetary policy to Brazil, the U.S. being the foreign economy.

According to the empirical results, an expansionary world fiscal policy, that exceeds U.S. spending over the Brazilian one permanently, in proportion to their GDP, shifts their terms of trade. Initially, the depreciation of the real exchange rate benefits domestic exports and makes imports more expensive. Consequently, there is higher inflow of foreign money, improving the balance of trade. However, in the long run, domestic real balances decrease, reducing the purchasing power of households. Furthermore, the long-run real variables are reduced, such as GDP and consumption, confirming negative externalities of the shock and *beggars-neighbor* effects, as indicated by [Corsetti and Pesenti \(2001\)](#).

Acknowledgements

All results and comments are the sole responsibility of the authors and do not reflect the views of the Institutions they pertain.

Appendix A.

In what follows, we replicate Table II of [Corsetti & Pesenti \(2001\)](#) that displays the short-run and the steady state solutions of the model in a reduced format.

Table A1
Solutions from [Corsetti and Pesenti's \(2001\)](#) model.

Determinants of	Home welfare
(A1) $C = a_1(\bar{M}_W)^{1/\rho}$	Short-run consumption
(A2) $Y = a_2(\bar{M}_R)^{1-\gamma}(\bar{M}_W)^{1/\rho} + G$	Short-run output
(A3) $\bar{M}/\bar{P} = a_3\bar{M}_W$	Short-run real money balances
(A4) $\bar{C} = a_4(\bar{g}_W)^{-1/(1+\rho)}$	Long-run consumption
(A5) $\bar{Y} = a_5(\bar{g})^{1/2}(\bar{g}_W)^{-(1-\rho)/[2(1+\rho)]}$	Long-run output
(A6) $\bar{M}/\bar{P} = a_6(\bar{g}_W)^{-\rho/(1+\rho)}$	Long-run real money balances
Prices	
(A7) $1 + r = a_7(\bar{M}_W)^{-1}(\bar{g}_W)^{-\rho/(1+\rho)}$	Short-run real interest rate
(A8) $E(P_F^*/P_H) = a_8\bar{M}_R$	Expected short-run terms of trade
(A9) $E(\bar{E}) = a_9\bar{M}_R$	Expected nominal exchange rate
(A10) $\bar{E}(\bar{P}_F^*/\bar{P}_H) = a_{10}(\bar{g}_R)^{-1/2}$	Expected long-run terms of trade
(A11) $\bar{P}_H = a_{11}\bar{M}(\bar{g}_W)^{-(1-\rho)/[2(1+\rho)]}(\bar{g})^{1/2}$	Long-run home goods price

Source: [Corsetti and Pesenti \(2001, p. 433\)](#).

$$a_1 = \gamma(\gamma_W)^{(1-\rho)/(1+\rho)}(g_{W_0})^{-1/(1+\rho)}(M_{W_0})^{1/(1+\rho)};$$

$$a_2 = \gamma^{(1-\rho)/2}(\gamma_W)^{(1-\rho)^2/[2(1+\rho)]}(g_{W_0})^{-(1-\rho)/[2(1+\rho)]}(g_0)^{-1/2}(M_{R_0})^{-(1-\gamma)}(M_{W_0})^{-1/\rho}\Phi^{1/2}(\Phi_W)^{(1-\rho)/[2(1+\rho)]};$$

$$a_3 = \chi[(1 + \delta)/\delta]\gamma^\rho(\gamma_W)^{\rho(1-\rho)/(1+\rho)}(g_{W_0})^{-\rho/(1+\rho)}M_{W_0}^{-1}(\Phi_W)^{\rho/(1+\rho)};$$

$$a_4 = \gamma(\gamma_W)^{(1-\rho)/(1+\rho)}(\Phi_W)^{1/(1+\rho)};$$

$$a_5 = \gamma^{(1-\rho)/2}(\gamma_W)^{(1-\rho)^2/[2(1+\rho)]}\Phi^{1/2}(\Phi_W)^{(1-\rho)/[2(1+\rho)]};$$

$$a_6 = \chi[(1 + \delta)/\delta]\gamma^\rho(\gamma_W)^{\rho(1-\rho)/(1+\rho)}(\Phi_W)^{\rho/(1+\rho)};$$

$$a_7 = \beta^{-1}(g_{W_0})^{\rho/(1+\rho)}M_{W_0};$$

$$a_8 = [\gamma/(1 - \gamma)]^{-(1+\rho)/2}(g_{R_0})^{-1/2}M_{R_0}^{-1}(\Phi_R)^{1/2};$$

$$a_9 = \chi^*\chi^{-1}[\gamma/(1 - \gamma)]^{-\rho};$$

$$a_{10} = [\gamma/(1 - \gamma)]^{-(1+\rho)/2}(\Phi_R)^{1/2};$$

$$a_{11} = (a_4)^\rho a_5(a_6)^{-1}\Phi^{-1}.$$

The index R refers to ratios of Home to Foreign variables. The index W refers to geometric averages of Home and Foreign variables with weights γ and $1 - \gamma$. The constants are defined in Corsetti and Pesenti (2001).

Appendix B.

B.1. SVAR model

The SVAR (Structural Vector Autoregressive) model was developed by Sims (1980) and Bernanke (1986). We follow Hamilton (1994) in presenting the SVAR model. The VAR (Vector Autoregressive) model can be represented as follows:

$$\mathbf{y}_t = \mathbf{A}_0 + \mathbf{A}_1 \mathbf{y}_{t-1} + \dots + \mathbf{A}_p \mathbf{y}_{t-p} + \mathbf{u}_t \quad (\text{B1})$$

where $\mathbf{y}_t = (y_{1t}, \dots, y_{kt})$ is a random vector of $k \times 1$ elements; \mathbf{A}_0 is a vector of $k \times 1$ parameters; \mathbf{A}_1 through \mathbf{A}_p are parameter matrices of dimension $k \times k$; and \mathbf{u}_t is an orthogonalized vector with the following characteristics: $\mathbf{u}_t \sim \mathbf{N}(\mathbf{0}, \mathbf{S})$ and $E(\mathbf{u}_t, \mathbf{u}_s) = 0$ for all $t \neq s$. This VAR model can be rewritten in the following way:

$$\mathbf{A}(\mathbf{I}_k - \mathbf{A}_1 L + \mathbf{A}_2 L^2 - \dots - \mathbf{A}_p L^p) \mathbf{y}_t = \mathbf{A} \boldsymbol{\varepsilon}_t = \mathbf{B} \mathbf{e}_t \quad (\text{B2})$$

where L is the lag operator; $\boldsymbol{\varepsilon}_t$ is the innovation vector with $\boldsymbol{\varepsilon}_t \sim (\mathbf{0}, \mathbf{S})$ and $E(\boldsymbol{\varepsilon}_t \boldsymbol{\varepsilon}'_s) = 0$ for all $t \neq s$; $\mathbf{u}_t = \mathbf{B} \mathbf{e}_t$ with the following characteristics $\mathbf{e}_t \sim \mathbf{N}(\mathbf{0}, \mathbf{I}_k)$ and $E(\mathbf{e}_t \mathbf{e}'_s) = 0$ for all $t \neq s$.

The matrices \mathbf{A} and \mathbf{B} represent the system state in the short run. The long-run analysis of this system requires the VAR to be stable or \mathbf{y}_t to fluctuate around its mean and the matrices \mathbf{A} and \mathbf{B} not to be singular. Therefore, by making $\bar{\mathbf{A}} = (\mathbf{I}_k - \mathbf{A}_1 L + \mathbf{A}_2 L^2 - \dots - \mathbf{A}_p L^p)$ we obtain its inverse as $\bar{\mathbf{A}}^{-1}$. By pre-multiplying Eq. (2) by this inverse matrix we have a long-run system as

$$\mathbf{y}_t = \bar{\mathbf{A}}^{-1} \mathbf{B} \mathbf{e}_t = \mathbf{C} \mathbf{e}_t \quad (\text{B3})$$

Here $\mathbf{C} = \bar{\mathbf{A}}^{-1} \mathbf{B}$ is the long-run matrix of response to shocks. This result implies that $\mathbf{S} = \mathbf{B} \mathbf{B}'$ is the matrix of variance and co-variance of \mathbf{u}_t . By imposing restrictions on the parameters in this matrix we can identify the system in order to analyze long-run policy shocks. The restrictions are of two orders: (i) ordering the variables in the equations; (ii) contemporaneous exogeneity. Both restrictions should be derived from the theory being analyzed.

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