Twin Deficits hypothesis: evidence from Brazil

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Resumo

O objetivo deste artigo é testar, com um modelo VAR, a hipótese dos déficits gêmeos para o Brasil. Procurar-se-á testar também se a taxa real de câmbio funciona como mecanismo de transmissão do déficit fiscal para o déficit em conta corrente. Não encontramos evidências para a hipótese dos déficits gêmeos no Brasil, pois uma piora no déficit fiscal melhora o saldo em conta corrente, e isso acontece diretamente e indiretamente (através da desvalorização cambial). Também encontrou-se evidência de que choques no déficit em conta corrente pioram a posição fiscal do setor público entre o segundo e o terceiro período.

Palavras chave: déficits gêmeos, déficit fiscal, déficit em conta corrente, taxa de câmbio real.

Abstract
The primary purpose of this paper is to test, through a VAR approach, the validity of the twin deficits hypothesis in Brazil. Additionally, we will test whether the real exchange rate operates as a transmission mechanism from fiscal deficit to current account deficit. The main results do not support the twin deficits hypothesis, because a worsening in the budget deficit improves the current account directly and indirectly (through currency devaluation). We also found evidence that current account deficit shocks worsens the public sector fiscal position between the second and third year.
Keywords: twin deficits, budget deficit, current account deficit, real exchange rate.

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1.   Introduction

Recent deterioration in the public sector fiscal position and in external accounts are macroeconomic phenomena that may affect investor confidence and reduce the potential growth of the Brazilian economy. Data demonstrates that the sum of the current account deficit (hereafter CAD) and the budget deficit (hereafter BD) rose from 2% of GDP in December 2005 to 10.9% of GDP in December 2014. The current context is not of greater concern because, in 2014, 70% of the external deficit was financed by foreign direct investment.

Given this scenario of simultaneous increases in the budget and external deficits, one question that emerges is whether the "twin deficits" proposition is valid for Brazil. According to this hypothesis, any worsening in the public deficit must cause a worsening in CAD. If this causal relationship is correct, policymakers must remain ever more vigilant in the management of public finances, since, as well as the well-known inflationary and destabilizing impacts of an expansionist fiscal policy in an economy near full employment, this type of policy may also cause external imbalances. High and persistent external deficits are particularly dangerous for developing economies, since these economies are more susceptible to the risks of a "sudden stop" of capital inflows.

It is important to highlight that the simple observation of correlation between two macroeconomic variables does not allow one to assert with any confidence that one variable determines another. Thus, different set of econometric techniques have been adopted in the empirical literature to test the twin deficits proposition in several developed and developing countries, although with mixed results. Despite such extensive literature, it is hard to find a work that aims to test the twin deficits hypothesis in Brazil. To the best of our knowledge, only Islam (1998), Neto and Teixeira (2004) and Souza and Gomes (2015) explicitly tested this hypothesis using data from Brazilian economy: the first with the Granger causality test, the second through vector autoregressive (VAR) approach and the third with autoregressive distributed lag (ARDL) models. None of these works, however, found evidence to support the twin deficits proposition in Brazil. Islam (1998) suggests the existence of bi-causality between trade and budget deficits, while Neto and Teixeira (2004) and Souza and Gomes (2015) suggests that the causality runs from the external balance to the public sector deficit.

This paper aims to verify whether the twin deficits hypothesis is valid for Brazil and whether the real exchange rate (hereafter RER) operates as a transmission mechanism between BD and CAD. To this end, we estimated a VAR model using quarterly data from 1999 to 2009. We chose 1999 as our starting point in line with Clarida and Prendergast (1999), Monacelli and Perotti (2006) and Kim and Roubini (2008), who recommend only making estimates for periods with unchanged exchange rate arrangements (the flexible exchange rate regime became effective in Brazil after January 1999).

The remainder of this paper is organized as follows. Section 2 explores the theoretical arguments and some empirical evidence. Section 3 presents the methodology and describes the data used in the analysis. Section 4 reports the results of the econometric estimates and

diagnostic tests. Section 5 contains some concluding remarks.

2. Twin deficits: arguments and evidence

Given the fundamental identity of national accounts, macroeconomic equilibrium (*ex post*) requires savings to be identical to investment. Since in an open economy savings may be divided into private savings, public savings and external savings, the equality between savings and investment assumes the following form:

Private Savings + Public Saving + External Saving = Investment

Since we know that, by definition, the fiscal balance is equivalent to public savings, and external savings are equivalent to CAD, the following relationship may be easily deduced:

CAD = Investment – Private Saving + BD

According to this accounting relationship, if private savings and investment are strongly correlated, any worsening of the government's fiscal position must be reflected in a worsening in the current account balance. However, if we assume that private savings and investment vary following deterioration in the BD, the CAD may remain unaltered. From this, it follows that variation or lack of variation in the CAD will depend on whether variation in private savings and/or investment resulting from consumer and investor behaviour is sufficient to offset for the initial variation in the BD.

Thus, the simultaneous occurrence of BD and CAD, with the causality relationship moving from the fiscal policy to the external balance, essentially depends on theoretical arguments and may not be demonstrated through accounting identities. In general, one could say that there are two traditional (and contradictory) approaches in economic theory to explain the effects of an expansionist fiscal policy on external accounts: the first approach is based on Keynesian theory and the second is the Ricardian Equivalence proposition.

Keynesian theory gives us the Mundell-Fleming model and absorption theory. According to the Mundell-Fleming model, an expansionist fiscal policy in a small open economy causes an increase in interest rates, attracts foreign capital and leads to national currency appreciation (if the exchange rate regime is flexible). With this change in the relative price of domestic goods, net exports are discouraged and the current account balance worsens. If we consider a fixed exchange rate regime, fiscal expansion generates an increase in the levels of both income and prices, which also discourages net exports and worsens the current account balance. For its part, absorption theory postulates that an increase in the BD generates a rise in aggregated demand together with an increase in the import of goods and services, and an increase in the CAD.

The Ricardian Equivalence proposition provides the opposite extreme (Barro, 1974). According to this approach, an increase in BD financed by public debt must cause an increase of equal magnitude in private savings, since government bonds are not perceived as net wealth. This happens because agents have rational expectations and expect higher taxes in the future, since it is assumed that the government must respect the intertemporal budget constraint. Thus, if the Ricardian Equivalence hypothesis is valid, variations in public deficit are not accompanied by variations in national savings, interest rates or the current account balance.

As well as these two traditional approaches, the theoretical literature also contains

propositions that suggest: it is CAD that causes BD (Summers, 1988); that the causality between deficits takes place in both directions (Feldstein and Horioka, 1980); and that an expansionist fiscal policy may improve the current account balance (Obstfeld and Rogoff, 1995). Empirical works have also had mixed results for the relationship between BD and CAD. In a non-exhaustive survey of the literature we found five main results: i) variations in BD cause variations in CAD in the same direction; ii) the deficits are independent; iii) the causal relationship moves from CAD to BD; iv) the deficits are simultaneous; and v) variations in BD cause variations in CAD in the opposite direction (twin divergence).

Abbas et al (2010) used data from 124 countries and concluded that an increase in government consumption generally contributed to a worsening in the current account balance, but that the duration of impact depended on the country's particular features. Furthermore, the authors suggest that the association between fiscal policy and current account balance is stronger in low-income emerging economies and in economies where output is above potential. Abel (1990) and Leachman and Francis (2002) also found evidence favourable to the twin deficits hypothesis in the United States, as did Vamvoukas (1999) in Greece, Salvatore (2006) in the G7 countries (the United States, Japan, Germany, the United Kingdom, France, Italy and Canada) and Baharumshah and Lau (2007) in Thailand.

Chang and Hsu (2009) used data from ten countries and found varied results. While it was CAD that caused BD in Hong Kong and Denmark, in Finland, Iceland, Sweden, South Korea, Taiwan and the United States the BD was the starting point of the causal relationship. In Singapore and Norway, the deficits were simultaneous. Simultaneity was also found by Zacaria and Ahmed (2007) in Pakistan and by Zamanzadeh and Mehrara (2011) in Iran.

Ricardian Equivalence was confirmed by Wheeler (1999) in the United States and by Kaufmann et al (2002) in Austria. The same result was found by Xie and Chen (2014) in France and the United Kingdom. However, these authors also suggest that: i) in Belgium, Finland, Greece and Iceland, budget and current account deficits are simultaneous; ii) in Norway and Sweden the BD is the starting point of the causality; and iii) in Ireland, Spain and Sweden it is CAD that causes BD. Marinheiro (2007) also concluded that the causality moves from CAD to BD in Egypt, just as Kalou and Paleologou (2011) did for Greece, and Merza et al (2012) for Kuwait. For its part, twin divergence has been observed in the United States and Australia by Corseti and Müller (2006), and in the United States by Kim and Roubini (2008).

In addition to such mixed results, including some for the same country, the empirical literature also demonstrates that there is no one unique methodological basis to verify the validity of the twin deficits hypothesis. These differences hinder comparison between available results. In any event, it seems clear that the VAR approach is quite common, particularly when the results of the time series diagnostic tests do not allow the researcher to undertake cointegration analysis.

3. Methodology

3.1 Estimation technique

Since the seminal paper of Sims (1980), VAR models have been used in a range of macroeconomic analyses using time series data. This kind of model, which is an extension of univariate models, enables a dynamic analysis of the impact of structural shocks on a set of

variables included in the model through a minimum set of identification restrictions. In VAR approach, it is not necessary to specify a structural theoretical model or classify a variable as endogenous or exogenous, since the model assumes that each variable of the system is a function of its lagged values, of the lagged values of all the other variables and of an error term (zero-mean white noise process). In this sense, VAR models allow the capture of some co-movement in the time series that cannot be detected in simple univariate models.

One of the fundamental questions of VAR models relates to orthogonalization procedures for the residuals. In this work, we use the standard Cholesky decomposition. Following this procedure, in the case of a trivariate model, we assume that the first variable is not contemporaneously affected by the other two variables, that the second is only affected by the first, and that the last is affected by the other two. With this recursive model, changes to the causal ordering of the variables alter the magnitude of model parameters. Thus, appropriate ordering of the variables in a VAR model must be derived from economic theory, which is not always possible.

The variables of interest in this paper are BD, CAD and RER. Our identification scheme assume that BD is the most exogenous variable of the system and will be ordered first, since it is a policy variable and must contemporaneously affect the other variables (see Blanchard and Perotti, 2002; Corseti and Müller, 2006). On the other hand, we assume that RER is the least exogenous variable and will be ordered last (see Clarida and Prendergast, 1999; Monacelli and Perotti, 2006; Kim and Roubini, 2008), since it is expected that a variable from the financial sector is affected contemporaneously by the real sector variables (BD and CAD), through expectations. We also assume that RER only affects BD and CAD after one quarter. Thus, the trivariate VAR model ordered {BD, CAD, RER} is exactly identified and the coefficients of each equation may be consistently estimated by ordinary least squares (OLS).

Through the appropriate specification of the model, with the number of lags suggested by the main information criteria, it is possible to extract the impulse response functions (IRFs), that is one analytical tool of the VAR model. Stock and Watson (2001) point out that IRFs are more informative than are the estimated VAR regression coefficients or R^2 statistics. The IRFs is useful to show, for example, the effects of a temporary and unexpected BD shock on the current and future values of BD itself, CAD and RER, assuming that this fiscal policy shock returns to zero in following periods and shocks in CAD and RER are zero. This same resource will be useful in demonstrating whether the RER is a transmission mechanism from one deficit to another (Abel, 1990; Baharumshah and Lau, 2007).

3.2 Data

BD is measured by the public sector public requirement (nominal concept with exchange devaluation), while CAD is measured by the negative current account balance. These two variables are measured as a percentage of GDP, accumulated in the last 12 months and multiplied by 100. Positive shocks involve a worsening in the deficit and negative shocks an improvement in the deficit. The variable RER is the logarithm of the real effective exchange rate index (a positive variation means depreciation). All these data are available in the Time Series Management System of Central Bank of Brazil, and were seasonally adjusted using the X12-ARIMA method. In line with most of the empirical literature about business cycles, we use quarterly data. The period for the empirical model estimation ranges from 1999:1 to

2009:4. It should be noted that the estimations used here are for the period up to 2009, because the BD set, with the same methodology, was interrupted in December of that year. The figure below shows each of these time series.

Figure 1: Budget deficit, current account deficit and real exchange rate in Brazil (1999Q1-2009Q4).

A first inspection of these data provides useful information about Brazilian economy in this period. First, we observe that the public sector fiscal position improved from 1999 currency crisis to early 2002, when the "electoral risk" began to deteriorate fiscal indicators, especially through the exchange devaluation channel. However, in the first quarter of 2003, the BD begins to converge between 2% and 4% of GDP, what may be explained by greater fiscal effort over the period (with higher primary surpluses) and by economic growth (between 2003 and 2008 the Brazilian economy grew on average 4.2%). Second, the external accounts increased from an unfavorable situation between 1999 and 2001, with deficits around 4% of GDP, to an favorable situation, especially from second quarter of 2002. This good dynamic in the current account, which can also be verified in the trade balance, is generally explained by commodities boom in the international market. We also observe that since 2005 the improvement trend in the current account balance change to reverse direction. These movement happens little sharply until second quarter of 2007 and very sharply thereafter. Third, we observe that the RER showed great volatility between 2000 and 2003. After that, these variable through a sustained period of appreciation (almost 27% of real appreciation, since 2004 to early 2008) that was interrupted by the international financial crisis.

4. Results

Traditional VAR models assumes that all the series of the system are stationary at level. The presence of unit root in each series was verified through the Augmented Dickey-Fuller (ADF) test. The null hypothesis of this test is that a time series is nonstationary against the alternative that it is stationary. As seen in Table 1, the general results of the ADF test suggest that all three series are I(0) at the 5% significance level.

Table 1
ADF unit root test

Series	lag	Inter	Trend and Inter	t-Statistic	Prob.
BD	0	No	No	-2.573	0.0113
CAD	1	No	No	-2.052	0.0398
RER	1	Yes	Yes	-3.687	0.0344

Note: The lag length of the ADF test is based on the Schwartz Information Criterion.

Taking into consideration the Akaike (AIC), Schwartz (SIC) and Hannan-Quinn (HQ) Information Criteria, two lags were selected for model estimation. One can see that with two lags the specified VAR model is stable (the six inverse roots of the autoregressive characteristic polynomial lie inside the unit circle), there is no autocorrelation in the residuals (as suggested by serial correlation LM test) and the residuals are homoscedastic (according to the White test for heteroscedasticity). Furthermore, it was not possible to reject the null hypothesis of the Jarque-Bera test (this means that the residuals are multivariate normal).

Figure 2 provides the IRFs for the VAR model estimated with a constant (benchmark model).

This figure demonstrates the responses in each model variable over four years due to unexpected shocks of one standard deviation in the other variables. A simple visual analysis of these graphs provides some interesting results a 95% confidence interval (calculated analytically).

Firstly, we can see that BD and RER shocks are less persistent than CAD shocks. While the BD and RER variables return to their steady state values one year following the shock, the CAD variable only returns to its pre-shock level after the second year. Secondly, we note that the current account balance improves between the third and fifth quarter following a positive BD shock. From the sixth quarter onwards, however, one can observe that the impact on CAD begins to be virtually null. This improvement in the external account following a positive fiscal shock is not compatible with the traditional twin deficits hypothesis. Thirdly, we can see that CAD shocks do not influence BD over the short term, but cause it to worsen between the second and third year. In fourth place, the RER is devalued during the period in which the BD suffers the shock, reaching a peak in the second quarter, then converging with its pre-shock level. This devaluation arising from a fiscal expansion is also an unpredicted result, according to conventional wisdom. Finally, one can see that, following devaluation, the CAD improves between the second and fifth quarter. This result suggests that the RER is a transmission mechanism from fiscal policy to CAD, but in the opposite direction to that predicted by the twin deficits proposition.

Figure 2: Benchmark model. The graphs show IRFs to one standard deviation shocks with two standard error bands (dotted lines) over 16 quarters.

After that, we performed some sensitivity exercises and we verified a good level of robustness. First, there was no significant changes in the previous results when we estimated alternative ordering ({BD, RER, CAD}, {CAD, BD, RER} and {CAD, RER, BD}). Second, these same results had been observed when we used Pesaran and Shin's (1998) generalized IRFs and when we added a deterministic trend in the benchmark model. Third, when we used Monte Carlo simulation (with 1000 and 10,000 repetitions) to calculate the confidence intervals of the benchmark model, only one result changed: it was not possible to verify that CAD shocks affect significantly the public sector fiscal position. Finally, we computed the IRFs of two Bayesian VAR models (one using the Litterman-Minnesota *prior* and another with the Normal-Wishart one) and we compared with the IRFs of the benchmark model. The main changes were observed in the model with Litterman-Minnesota prior, but the IRFs format were similar in the three models, even when accumulated IRFs were computed.

It is possible to find similar results in the literature, but we advise caution in any comparison, since the models specifications differ significantly. Monacelli and Perotti (2006), for example, suggest that in the United States, the United Kingdom and Australia the RER is devalued over the short term following an innovation in government consumption, something also observed over the long term in Canada. On the other hand, the authors note that a deterioration in the

trade balance following a fiscal shock occurred in all countries in the sample, except the United States. Using data from the same four countries, the results of Corseti and Müller (2006) were favourable to the twin deficits hypothesis in the case of countries which are more open to international trade (the United Kingdom and Canada), particularly when fiscal shocks are relatively persistent. In more closed economies (the United States and Australia) "twin divergence" is observed, in other words, positive fiscal shocks improve the trade balance. The results of both devaluation following fiscal expansion and twin divergence are consistent with the evidence found in Kim and Roubini (2008) for the period of the flexible exchange rate regime in the United States.

From a theoretical point of view, in the recent literature on open economy macroeconomics, such as in the works of Obstfeld and Rogoff (1995) and Betts and Devereux (2000), one may find the possibility that shocks to government spending improve the current account balance and depreciate the RER in fixed price models. However, as Kim and Roubini (2008) note, such unconventional results of fiscal expansion are heavily dependent on the two following hypothesis: i) that the marginal propensity to import from the government is identical to that of the private sector; and ii) that demand for currency depends on private consumption and not on income. Regarding the causal relationship moving from the external deficit to the fiscal balance, Marinheiro (2007) and Chang and Hsu (2009) point out that a deterioration of the CAD (for example, through adverse export shock) may reduce economic growth and negatively impact the tax indicators.

In the specific case of the Brazilian economy, it appears that fiscal expansion (as well as monetary contraction) involves a higher probability of default in public debt service, especially if international investors have increasing doubts about domestic macroeconomic fundamentals. Blanchard (2004) argues that, in a high public debt context, greater perceived risk provokes capital flight and currency devaluation, and has a damaging effect on inflation. Additionally, if devaluation of the nominal exchange rate is greater than the difference between variations in external and domestic inflation, the RER also depreciates, which improves the current account balance of payments. Therefore, an increase in perceived risk (the probability of default) may mean that any worsening in BD benefits external accounts through RER channel.

4. Final Remarks

This paper analysed empirically whether the twin deficits hypothesis is valid for Brazil and whether the exchange rate operates as a transmission mechanism between external and fiscal deficits. Once we had verified the stationarity of the series, we estimated a trivariate VAR model and collected the impulse response functions. The main results of the VAR model are robust for different specifications and do not corroborate the twin deficits hypothesis for the Brazilian economy, since we ascertained that fiscal expansion improves the current account balance both directly and indirectly, through currency devaluation. Furthermore, it was possible to show that an adverse CAD shock worsens the public sector fiscal position between the second and third year.

From a policy perspective, the non-validation of the twin deficits hypothesis should not be interpreted as an evidence against the fiscal responsibility. What may be said is that, for Brazilian case, there is a lack of evidence for the conventional suggestion to consolidate public accounts in order to reduce the external deficit. On the other hand, it appears that

policymakers should be concerned with improving external accounts by implementing policies to foster the competitiveness and promote exports, since improvements to the external situation benefit public accounts over the medium run.

Finally, we believe that the dynamic relationship between BD and CAD in Brazil, as well as the transmission mechanisms from one deficit to another, are issues that require careful treatment in future empirical researches. Such works may be undertaken using other econometric methods (and other approaches to identify the exogenous fiscal policy shock), and with a more wide-ranging set of macroeconomic variables.

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APPENDIX

Lag length selection criteria

lag	AIC	SC	HQ
0	6.898519	7.025185	6.944317
1	0.787407	1.294071	0.970600
2	0.290982*	1.177644*	0.611571*
3	0.340972	1.607632	0.798956
4	0.320492	1.967150	0.915871

*Indicates lag order selected by the criterion.

Roots of characteristic polynomial

Root	Modulus
0.784259 – 0.124320i	0.794051
0.784259 + 0.124320i	0.794051
0.659457	0.659457
0.587866 – 0.218475i	0.627151
0.587866 + 0.218475i	0.627151

	0.2674 17
0.267417	

Note: VAR model satisfies the stability condition.

Jarque-Bera normality test

Component	Jarque-Bera	df	Prob.
1	0.848747	2	0.6542
2	0.409001	2	0.8151
3	2.215393	2	0.3303
Joint	3.473141	6	0.7475

Null hypothesis: the residuals are normal.
Orthogonalization method: Cholesky's Covariance (Lutkepohl).

White test for heteroscedasticity

Chi-sq	DF	Prob.
85.80505	72	0.1274

Null Hypothesis: the residuals are homoscedastic.

Serial autocorrelation LM test

lag	LM-Stat	Prob.
1	19.05675	0.0247
2	5.746662	0.7650
3	7.697304	0.5649
4	26.42586	0.0017

Null Hypothesis: the residuals are not autocorrelated.

Variance decomposition of CAD

Period	BD	CAD	RER
1	0.82	99.17	0.00
4	13.60	69.68	16.70
7	18.18	54.31	27.50
10	18.73	49.18	32.07
13	18.65	47.37	33.97
16	18.57	46.80	34.63

Ordering for Cholesky: BD, CAD, RER.