External debt and exchange-rate misalignment in Brazilian firms: developments and risks from 2000 to 2018[1]

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Abstract

This article investigates the effects of exchange-rate misalignment on the earnings of 201 Brazilian non-financial listed companies over the period 2010–2018. A measure of exchange-rate misalignment was constructed by compiling information on the value of currency derivative contracts and generating a new database. The results indicate that exchange-rate devaluation has a negative differential effect for firms that have borrowed in foreign currency, including exporting firms. Controlling for variables that protect firms with foreign currency debt, we find that the differential effect of devaluation is negative for firms with larger foreign currency liabilities and positive for those with larger foreign currency assets or greater hedging. These results are robust to different specifications.

Keywords

External debt, foreign exchange, foreign exchange rates, financial policy, business enterprises, profit, corporate debt, competitiveness, macroeconomics, Brazil

JEL classification

G11, G32, F31, F34

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I. Introduction

Two decades ago, a substantial number of emerging economies abandoned fixed or quasi-fixed exchange-rate regimes in favour of floating regimes. In the major economies of Latin America, this change of regime took place between 1998 and 2001, almost always in the context of crises. Since then, the new exchange-rate regime has proved to have a number of virtues. However, the promise of relatively well-behaved exchange rates that would respond moderately to changes in fundamentals (Friedman, 1953) did not materialize. On the contrary, sharp and severe exchange-rate movements have been quite frequent in the recent history of these economies.

The behaviour of Brazil's exchange rate during the floating regime was no exception. The 2010s were characterized by great volatility against the United States dollar, including two episodes that looked in several respects like currency crises. In the first, which occurred at the time United States monetary policy began to normalize in 2013 (a period known as the "taper tantrum"), the exchange rate depreciated by 21% over 11 months. The second, severer episode saw a depreciation of just upward of 70% over a 14-month period (from September 2014 to October 2015). Some economists have suggested that one reason the economy struggled to emerge from the 2015–2016 recession was the negative impact of the exchange-rate depreciation in this latter period on firms' earnings and ability to invest (Pastore, 2017; Rocca, 2016). However, given that many firms have access to currency derivatives and many are exporters, it is possible to argue that Brazilian firms may have adapted to exchange-rate volatility and become less vulnerable to possible exchange-rate misalignments.

There is a need for a more complete diagnosis of the impact of exchange-rate movements on firms' performance. The present article aims to contribute to this diagnosis by employing a database that incorporates flow and stock information at the firm level and indicators developed with a view to more precisely measuring any exchange-rate misalignment affecting firms. These measurements are then used to estimate the impact of exchange-rate movements on the performance of Brazilian firms in the period prior to the coronavirus disease (COVID-19) pandemic.

Specifically, the study sets out to determine whether exchange-rate devaluation had a differential effect on firms with larger foreign currency liabilities, firms with greater net currency exposure, firms with less currency hedging, and non-exporting firms as against exporting firms. To this end, we constructed a special database from the quarterly accounting information of a set of 201 Brazilian non-financial listed companies for the period 2000–2018, comprising not only company characteristics and measures of profitability, but also detailed information on foreign currency derivatives and assets provided by Economatica and, in the case of non-standardized financial statements, by the Securities and Exchange Commission.

The results indicate that exchange-rate movements did have a negative differential effect on the profitability of Brazilian firms with larger foreign currency liabilities, suggesting a balance sheet effect during the period analysed. The balance sheet effect was also significant for firms with greater net currency exposure. With respect to the level of currency hedging, the results confirm the positive effect of such hedging on firms' profitability, although it was weaker for exporting firms. This result (the weaker balance sheet effect for exporters) was to be expected, since exporting firms benefit from a natural hedge.

The article is divided into five sections including this introduction. The second section discusses some findings and arguments presented in the recent literature on the balance sheet and competitiveness effects of an exchange-rate devaluation. The third section presents the database, the profitability and currency exposure measures, the variables used and the underlying model employed in the estimations. The results are presented in the fourth section, followed by final considerations in the fifth.

II. The competitiveness effect and the balance sheet effect: a literature review

Sudden large exchange-rate depreciations are generally unpredictable and, for that reason, tend to impair the performance of firms whose foreign currency liabilities are not adequately hedged with foreign exchange assets or derivatives.[2] An unanticipated depreciation leads to both an increase in the stock of external debt (as measured in domestic currency) and a reduction in firms' net worth. While the first effect reduces profits and thus firms' source of domestic funding, the second reduces access to credit for firms facing borrowing constraints. In both cases, investment is often compromised, contributing to a slowdown in the country's economy. This is the essence of the so-called balance sheet effect, which appears to have been the main cause of the crises suffered by the dynamic and seemingly robust economies of Asia in the late 1990s (Krugman, 1999; Aghion, Bacchetta and Banerjee, 2001 and 2004).

The balance sheet effect may or may not offset the positive consequences of an exchange-rate devaluation for the profits and competitiveness of exporting firms and those competing with imports. In the tradition of open economy macroeconomics, and in the Mundell-Fleming model in particular, this competitiveness effect was considered to be the main consequence of an exchange-rate devaluation.

With two opposing forces at work, namely the competitiveness effect and the balance sheet effect, the final outcome should be determined empirically rather than theoretically. This is because the net result of an exchange-rate depreciation on profits and investment will depend on companies' degree of exchange-rate misalignment, the price elasticity of exports and imports and other variables affecting the magnitude of the two effects mentioned, all of which vary across countries and over time. Moreover, the growth rate of the economy is the macroeconomic variable with the largest effect on profits (and investment). Consequently, the economic growth rate needs to be controlled for when studying the balance sheet effect on the basis of data for a period in which it was highly variable.[3]

Unsurprisingly, a large empirical literature on the subject has been produced over the last two decades.

The empirical literature on the so-called balance sheet effect in emerging economies is inconclusive. Although many studies use fairly similar methodologies, the results are divergent, irrespective of whether country-specific or multi-economy datasets are used.

While it is possible that these divergent results will be reconciled as methodologies and information improve, it is also very possible that part of the difference in outcomes is simply due to the fact that the various studies deal with different economies and different periods and that the balance sheet effect is indeed differentiated, as argued above, because it depends on country- and period-specific factors.

The studies by Bleakley and Cowan (2002 and 2008) that served as a benchmark for much of the subsequent literature used a sample of 450 non-financial firms in five Latin American economies in the 1990s and obtained results supporting the conclusion that firms with more dollar debt did not invest less than their peers with less dollar debt or with local currency debt following episodes of exchange-rate devaluation.

In some of the specifications estimated, the authors actually found that firms with higher foreign currency debt invested more than their peers after an episode of exchange-rate depreciation. According to the authors, one possible explanation for this was that the firms with the highest dollar debts were

[2] Cowan, Hansen and Herrera (2005) examine this hypothesis for Chile over the period 1995–2003. They construct a measure of the deviations of actual depreciations from those implied by dollar futures contracts and conclude that most of the large depreciations in the period studied were unanticipated.

[3] The growth rate is controlled for in some of the models presented in section IV. To take one significant example of the relationship between profits and growth in Brazil, the average return on equity among the sample of 201 companies in the database declined from 11.2% in the period 2004–2010 (when the economy grew at a rate of 4.5% a year) to 5.4% between 2011 and 2018 (when growth slowed to 0.7% a year).

those that exported (exporting leads firms to borrow in dollars as a hedge), and a depreciating exchange rate benefited their export revenues. Exporting provides a "natural hedge", and for these firms the competitiveness effect more than offsets the balance sheet effect following an exchange-rate devaluation.

Álvarez and Hansen (2017), using a methodology similar to that of Bleakley and Cowan (2008) and a sample of Chilean firms for the period 2004–2014, shared this conclusion. The authors determined that Chilean firms' profits were unaffected by exchange-rate depreciations, indicating that they were matching their foreign currency liabilities with foreign currency assets or exports. However, they arrived at a result that seemed to conflict with this, namely that exchange-rate depreciation affected investment, indicating that the so-called balance sheet effect did affect investment, although not profitability. The authors did not attempt to explain this apparent contradiction, but one possible cause is that although short-term cash flow may be protected from depreciations (which thus do not affect profits), the reduction in net worth resulting from the increase in the domestic currency value of foreign currency liabilities could, in a context of borrowing constraints, limit the availability of funds for investment.

At first glance, the results presented by Cowan, Hansen and Herrera (2005) for Chilean firms also pointed to a balance sheet effect. The authors indicated that firms with higher external debt had a lower investment rate than others following an exchange-rate depreciation. According to the authors, however, this effect was offset by foreign currency assets. In other words, they concluded that Chilean firms had adequately hedged their currency exposure with assets and derivatives.

Caballero (2018), drawing on a monumental sample of 6,917 firms from 15 emerging economies, concluded that there was a significant balance sheet effect and provided evidence that firms did not offset their foreign currency liabilities with dollar revenues from exports or by using derivatives. However, the author's use of a vast sample of countries meant that a number of variables had to be sacrificed. For example, the author used information on securities debt (the stock of bonds denominated in foreign currency) as a proxy for foreign currency liabilities. In many economies, including Brazil, foreign currency debt owed by firms to banks and suppliers is a substantial part of external debt, which could compromise the results.

A more recent strand in the literature seeks to ascertain why firms might suffer exchange-rate misalignments and be vulnerable to the balance sheet effect. Using a sample of firms from 18 emerging economies between 2014 and 2016, Bruno and Shin (2018) found that firms took advantage of favourable international financial market conditions to issue foreign currency bonds, using the proceeds to purchase financial assets in local currency. In other words, firms became misaligned by taking on foreign debt with the aim of engaging in activities similar to carry trades and were therefore exposed to losses in the event of exchange-rate depreciation. Similarly, Caballero, Panizza and Powell (2016) found that a 10% increase in bond issuance was associated with an 8% increase in firms' net assets. Commenting on this literature, Du and Schreger (2016) found strong evidence that the decision to borrow in dollars was not motivated by hedging considerations (on the part of exporters, for example), so that firms were probably left vulnerable to exchange-rate depreciations.

Although the literature on the balance sheet effect in Brazil is fairly sparse, some studies for different periods have found evidence of some cases. Drawing on a sample of about 260 Brazilian firms for the period 1990–2002, Bonomo, Betina and Pinto (2004) found evidence for the balance sheet effect, a result that remained statistically significant after controlling for the impact of the exchange rate on investment via exports and imports of inputs.

Garcia, Janot and Novaes (2008) conducted the most detailed research known to us for Brazil, in terms of both the variables and the methodology used; however, it is limited to the effects of the 2002 currency crisis. Using the difference-in-differences method, the authors found a negative effect from the sharp movement in the exchange rate that year outweighing the competitiveness effect.

Using a much smaller sample of Brazilian firms (about 100) for the period 2003–2014, Valle and others (2017) concluded that foreign currency debt did have a negative effect on profits and investment after an exchange-rate devaluation (balance sheet effect). They also added an interesting point that had apparently gone unnoticed in the discussion of the topic: the negative correlation between the exchange rate and the terms of trade means that, in the event of an exchange-rate devaluation associated with a decline in the terms of trade, external debt increases in reais, but export revenues do not increase proportionally because while each dollar exported brings in more reais, export prices (for commodity exporters) decrease, reducing the value of the natural hedge.

With the literature briefly reviewed above as a backdrop, the strategy adopted for this paper concentrates on two points. First, the decision was taken not to address the effects on investment in order to prioritize the effects on earnings, specifically on a differentiated set of profitability measures.

This decision means that the balance sheet effect is not fully captured in the model estimated. In the first place, the model captures the negative effect of devaluations on profits due to the increase in the financial costs (measured in reais) of firms with foreign currency debts, whose foreign currency liabilities increase in relative terms. It also captures the increase in interest costs arising from tighter credit conditions, owing to the deterioration in firms' balance sheets associated with the increase in (dollarized) liabilities. However, it does not include the investment effect of any restriction on access to credit. Comparing the effects of devaluations on investment and earnings would allow the contributions of these different components of the balance sheet effect to be distinguished.[4]

In the second place, the paper attempts a more comprehensive exploration of the exchange-rate misalignment giving rise to the balance sheet effect. To this end, in addition to foreign currency debt as the main factor of vulnerability to exchange-rate movements, other firm-level variables such as foreign currency assets and foreign currency derivatives hedging are introduced. This allows the net currency exposure variable to be included as one of the regressors in the model.

III. The database and the models estimated

As mentioned earlier, the specific objective of this paper is to quantify the degree of exchange-rate misalignment among Brazilian firms and to estimate its impact on profitability when an exchange-rate depreciation occurs. In particular, the paper seeks to ascertain whether exchange-rate movements have a differential effect on the profitability of Brazilian firms with foreign currency liabilities. A differential effect on these firms would be an indicator of the so-called balance sheet effect, while the absence of a differential effect would indicate that exchange-rate movements affect firms with and without dollar liabilities alike, suggesting that firms with external liabilities protect themselves from exchange-rate movements.

As explained above, to determine the effects of exchange-rate misalignment on Brazilian firms, we constructed a special database in which, alongside characteristics and profitability measures, we collected detailed information on currency derivatives and assets at the firm level. Specifically, we conducted an empirical analysis of the quarterly accounting information of a set of 201 Brazilian non-financial listed companies for the period 2000–2018, drawing on information from Economatica and, in the case of non-standardized financial statements, from the Securities and Exchange Commission. The variables analysed were selected in the light of the objectives described above and included profit and loss variables (net earnings and earnings before interest, taxes, depreciation and amortization (EBITDA), among others) and balance sheet variables (e.g. total assets, equity, total debt and foreign currency debt).

[4] The authors plan to estimate investment effects and perform the decomposition suggested here in a forthcoming paper.

In addition, we surveyed explanatory notes and other accounting documents to construct a measure of exchange-rate misalignment by analysing the value of foreign currency assets, foreign currency liabilities (often unreported, but necessary to complete the balance sheet data) and currency derivative contracts. Sometimes hedging data were not provided or only the value of currency derivative gains or losses was reported and not the value of the underlying contracts, so the information had to be disregarded. Despite these exclusions, it was possible to obtain reasonably complete and consistent information on the value of foreign currency assets and derivative hedges, as well as a breakdown by currency of companies' debt. Since the information was presented in different documents and in a non-standardized form, this analysis entailed a major effort of data collection and systematization, but it did furnish us with a new dataset of unpublished information of considerable value to our study.

An important variable for this research that proved unobtainable were foreign trade flows by company. Brazil's Federal Internal Revenue Secretariat prohibits the disclosure of export and import figures by firm (because of purported confidentiality issues), so that only qualitative information was available, i.e. whether the firm exported or imported in a given period. For this reason, foreign trade variables took the form of dummy variables.

Regarding the representativeness of the sample, it was possible to retain a substantial set of companies despite the necessary purging of the sample base. We had to exclude 71 companies from the set of non-financial companies listed on the B3 stock exchange, for reasons ranging from a lack of information vital to the proposed analysis to protracted situations of court-supervised corporate reorganization. Corporate mergers and spin-offs also posed a difficult problem. Where possible, we attempted to construct artificial firms by aggregating the data of demerged firms following the demerger and combining the data of merged firms from before the merger. Often, however, this proved impossible and observations had to be discarded. Still, the 201 firms that remained in the sample retained 89% of the total assets of B3-listed non-financial firms in 2018. Moreover, their external liabilities represented 60% of the total external debt of non-financial firms (on average), according to the Central Bank of Brazil's external sector statistics (international investment position account).

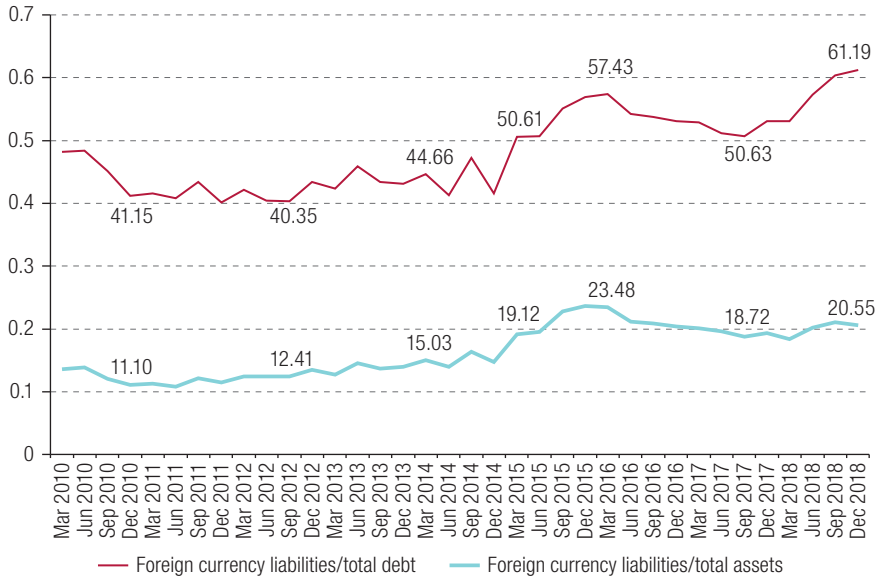
Lastly, the use of quarterly information allowed for a quite large sample with the additional advantage of capturing the effects of exchange-rate fluctuations within the annual period. However, to avoid distortions arising from high volatility in the quarterly values of the flow variables (e.g. profits and financial expenses), including volatility resulting from accounting procedures, these values had to be computed as four-quarter moving averages. The stock data taken for each period t were the mean of the values for the four quarters included in t. Descriptive statistics for the variables are presented in annex A1.

1. Net currency exposure and evidence from the database

The data indicate that the combined foreign currency debt of the 201 companies in the sample grew between 2010 and 2018 as a proportion of both the total assets and the total debt of the companies in the sample, which, as mentioned above, accounted for a large share of all listed companies and of the external debt of all Brazilian companies (see figure 1). Much of this growth can undoubtedly be attributed to successive exchange-rate depreciations over the period analysed.

Although foreign currency debt is often used in the literature as a measure of firms' exchange-rate vulnerability, it is actually a very incomplete and often misleading proxy for firms' true currency exposure, as it does not provide information on their foreign currency assets or derivatives position. For this reason, we constructed a measure of exchange-rate misalignment that much better reflects the true risk firms are exposed to in the event of exchange-rate movements.

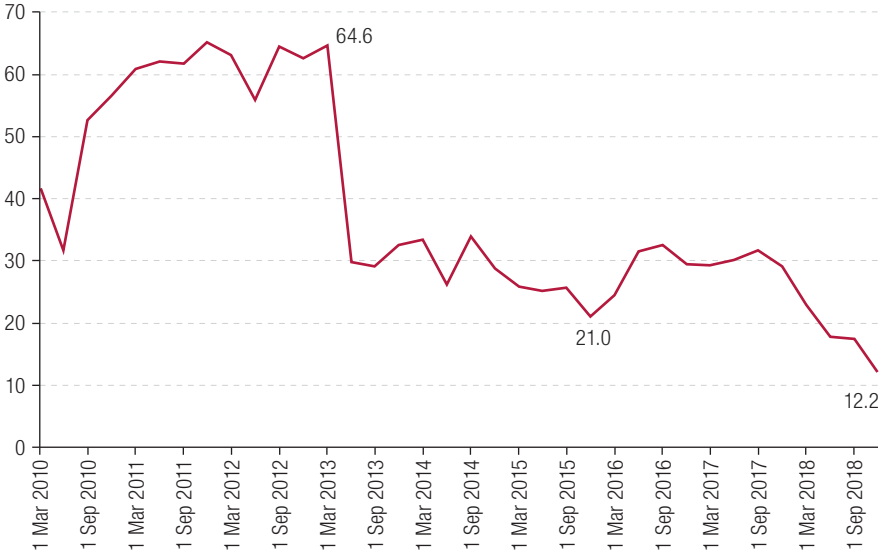
Figure 1
Brazil: foreign currency liabilities as a share of total assets and total debt of a sample of 201 non-financial listed companies, 2010–2018
(Percentages)



Source: Prepared by the authors, on the basis of Economatica and the Securities and Exchange Commission (CVM).

This measure, which we have called "net currency exposure", is foreign currency liabilities subtracted from foreign currency assets and foreign currency positions purchased via currency derivatives. On this measure, contrary to what the trend in foreign currency liabilities suggests, firms' level of exchange-rate misalignment progressively declined over the decade to approximately 12% of total debt by the end of the period (see figure 2).

Figure 2
Brazil: net currency exposure from foreign currency liabilities in a sample of 201 non-financial listed companies, 2010–2018
(Percentages)



Source: Prepared by the authors, on the basis of Economatica and the Securities and Exchange Commission (CVM).

Greater use of currency hedging might seem to be at odds with the increase in the cost of such hedging over the period analysed. However, at least in the case of short-term transactions, for which there is a more liquid market, the increase in the cost of hedging as measured by the "dollar premium" on dollar futures contracts only reflects the increased risk of exchange-rate devaluation. In other words, the obverse of the increase in hedging costs in the 2010s was the increase in the expected cost of the alternative (not hedging). Souza (2022), using data on the currency derivative contracts of Brazilian B3-listed firms for the period 2011–2021, accordingly showed that currency hedging strategies yielded gains on average for the firms adopting them.

In sum, the decrease in exchange-rate misalignment over the decade is not surprising and may have been the result of firms weighing the costs and benefits of currency hedging. It should also be noted that the measure in this paper is likely to overestimate the true currency exposure of firms, because part of the foreign currency debt of exporting firms is hedged against exchange-rate movements by net exports. Since Brazil's net exports were positive throughout the period 2010–2018, it is possible that firms were perfectly aligned from an exchange-rate perspective at the end of the period under consideration. Unfortunately, the lack of information on exports and imports by firm meant that we were unable to estimate this more precisely.

The data collected allow some observations to be made about the firms in the sample. First, given the expected importance of natural hedging, it is worth noting that an average of about 60% of the firms with foreign currency debt over the period analysed were exporters and therefore had some kind of natural hedge from foreign currency revenues, although the value of this hedge depended on the difference between the value of each firm's exports and imports, and this information is not available.

Second, it is important to note that the pooled debt and currency hedging data presented in figures 1 and 2 may conceal large differences between firms. For example, two thirds of the 201 firms in the sample (i.e. 136 on average) had foreign currency liabilities over the decade analysed. Of these, 49% hedged up to 25% of their foreign currency liabilities with derivatives contracts, 17% hedged between 25% and 75%, and 43% hedged 75% or more.

Foreign currency liabilities are more commonly hedged with foreign currency assets than with derivatives. The majority of firms (67%) hedge only a small portion of their liabilities (less than 25%) with foreign currency assets. A minority (14%) use foreign currency assets to hedge a large portion (over 75%) of their liabilities.

In short, the aggregate data conceal quite disparate situations among firms, and these may account for the effects of an exchange-rate depreciation on the performance of the aggregate if, for example, there is asymmetry between the impact of the gains and losses from exchange-rate movements.

2. The model estimated

The possible differential effects of a real exchange-rate movement on various measures of corporate profitability were estimated for firms with and without net currency exposure (measured as the difference between foreign currency liabilities and the sum of foreign currency assets and the purchased value of currency derivative contracts). By having both types of firm in the sample and classifying them into exporters and importers, it was possible to control for changes in profitability that might be associated with macroeconomic movements, as opposed to those arising from firms' exchange-rate exposure.

Since exports serve as a natural hedge against exchange-rate depreciations, firms' status as exporters or non-exporters was also controlled for.

The base model for this paper follows the one proposed by Álvarez and Hansen (2017):

$$Y_{it} = \alpha_i + FXD_{it-1}(\alpha + \beta\Delta er_t) + \delta X_{it-1} + \theta Z_t + u_{it}$$

where Y is a measure of profitability, FXD is foreign currency debt (specifically, foreign currency liabilities), er is the real exchange rate between the Brazilian real and the United States dollar, X represents a set of firm-specific controls and Z denotes macroeconomic controls. An important difference with the estimates in this paper is that, while Álvarez and Hansen (2017) use a dummy variable for hedging, the data here provide the actual values of hedging contracts. This allows possible non-linear effects of exchange-rate protection measures on firm profitability to be analysed.

Specifically, this paper centres on the β coefficient, which represents the differential effect of the exchange rate on profitability, in consideration of foreign currency debt. A negative and statistically significant coefficient indicates that the larger the foreign currency debt, the greater the effect of an exchange-rate devaluation on the profitability measure, confirming the balance sheet effect. Meanwhile, a non-significant differential effect indicates that on average firms with larger or smaller foreign currency liabilities were affected alike by the devaluation, indicating that firms acted to protect themselves against devaluations, either through hedging or naturally through exports, and suggesting that there was no balance sheet effect.

The variables actually used in the estimations are described in table 1.

Table 1
Profitability measures and other variables used in estimates

Profitability measures	
EBITDA	Earnings before interest, taxes, depreciation and amortization relative to total assets
Net earnings	Net earnings relative to total assets
ROE	Return on equity
ROIC	Return on invested capital
Other variables used in estimates	
Liabilities	Foreign currency liabilities relative to total assets
Assets	Foreign currency assets relative to total assets
Hedging	Foreign currency hedging relative to total assets
Exposure	Net exposure = (Liabilities - assets - hedging)/Total assets
Δer_t	Logarithmic change in the four-quarter moving average of the real exchange rate between the real and the United States dollar
ΔGDP_t	Logarithmic change in the four-quarter moving average of seasonally adjusted gross domestic product (GDP)
$\Delta Imports_t$	Rate of change in the seasonally adjusted world import volume index

Source: Prepared by the authors.

The first two profitability variables were calculated relative to the value of each firm's total assets reported for the same period, while the other two are also ratios between nominal variables, so that not only the numerators but also the denominators (equity and invested capital, respectively) are affected by inflation. In other words, changes in price indices affect the numerator and denominator equally, and thus cancel each other out, in all four profitability measures. The profitability measures thus represent an index unaffected by price changes. The same is true of the variables *liabilities*, *assets*, *hedging* and *exposure*.

The real exchange rate was calculated as a four-quarter moving average of the nominal exchange rate deflated by Brazil's extended national consumer price index (IPCA).[5] Quarterly real gross domestic product (GDP) (seasonally adjusted volume index) was obtained directly from the quarterly national

[5] In line with the procedure used in most of the literature on the topic, instead of using the conventional calculation of the real exchange rate, we only deflated it by the national price index in the interests of standardization with the other variables.

accounts series published by the Brazilian Institute of Geography and Statistics. Lastly, the seasonally adjusted quarterly merchandise import volume indices (2005 Q1 = 100) of the World Trade Organization (WTO) were used.[6]

For the estimates, the unit root test proposed by Im, Pesaran and Shin (2003) for panel data was applied. The null hypothesis of a unit root was rejected for all variables, which were thus considered stationary for the estimations (see results in table A1.2 of annex A1).

With the data represented in a panel of 201 firms observed over the period 2010–2018, the models were estimated using the ordinary least squares method with fixed effects for the firms.

IV. Results

In a first stage, we sought to ascertain whether exchange-rate movements differentially affected firms with foreign currency debt. To control for individual firm-level effects, all the models were estimated with fixed effects, while standard errors were adjusted for heteroskedasticity and autocorrelation. The results are presented in table 2 (debt-only model). To analyse the results obtained, we should briefly consider here the expected signs of the coefficients in the equations for the different measures of profitability.

Table 2
Results of foreign currency debt models

Dependent variable	All firms				Exporting firms			
	EBITDA	Net income	ROE	ROIC	EBITDA	Net income	ROE	ROIC
C	0.057705	-0.020276	0.052371	0.048912	0.084113	0.013388	0.051316	0.048104
	[0.0077]***	[0.0100]**	[0.0099]***	[0.0057]***	[0.0034]***	[0.0046]***	[0.0165]***	[0.0036]***
$Liabilities_{t-4}.\ \Delta er_t$	-0.671549	-3.10743	-1.544706	0.9093	0.258137	-0.666504	-3.979288	0.541674
	[0.3974]*	[0.7636]***	[1.3462]	[0.4044]**	[0.2659]	[0.2958]**	[1.4375]***	[0.1934]***
Δer_t	0.011155	0.286275	-0.078589	-0.246871	-0.046792	-0.134884	0.037214	-0.172715
	[0.0900]	[0.1982]	[0.2107]	[0.0895]***	[0.1156]	[0.1446]	[0.1875]	[0.0901]*
$Liabilities_{t-4}$	0.140998	0.086087	0.182637	0.009597	0.004156	-0.059947	0.116939	-0.008052
	[0.0444]***	[0.0513]*	[0.1200]	[0.0675]	[0.0200]	[0.0245]**	[0.1644]	[0.0220]
Observations	5 751	6 022	5 914	6 005	3 016	3 171	3 103	3 169
Adjusted R-squared	0.2024	0.0645	0.1336	0.1237	0.3891	0.3875	0.1308	0.2598
F-statistic	8.2236	3.045	5.4899	5.175	15.5464	16.0808	4.5104	9.3604
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: Prepared by the authors.
Note: White standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Regarding the indicators with net earnings in the numerator (net income/assets and return on equity (ROE)), these measures represent the difference between income and expenses, with the latter including both operating and financial expenses. For this reason, they tend to be negatively affected by any increase in domestic currency-denominated interest payments ensuing from an exchange-rate devaluation, so that the coefficient should have a negative sign. This outcome ought to be unambiguous for the net income dependent variable, but not necessarily for ROE. Indeed, since the equity of firms with foreign currency debts should contract when there is a devaluation, the ROE measure (which has equity in the denominator) may present an ambiguous result, given that both the numerator and the denominator contract with devaluation. Where these first two measures are concerned, in other words, a stronger balance sheet effect (if any) on the net income/assets variable is to be expected.

[6] See WTO (n.d.).

With regard to the earnings before interest, taxes, depreciation and amortization (EBITDA) and return on invested capital (ROIC) variables, a firm's result includes both earnings and financial expenses. This means that, in principle, devaluation should not have a negative differential effect on companies with more foreign currency debt.

The beta coefficient estimated represents the differential effect of a devaluation on the various profitability measures. In the sample containing all companies, devaluation is found to produce a statistically significant differential effect for three of the four profitability measures: net income, EBITDA and ROIC. When an exchange-rate devaluation occurs, there is a negative differential effect on the net earnings of firms with foreign currency debt and, as expected, the greater the debt, the greater the impact (balance sheet effect). In the case of ROIC, also as expected, the differential effect is positive, since this measure includes financial income. Among the model results presented in table 2, only in the case of EBITDA is the sign of the coefficient not the expected one.

The coefficients for exchange-rate movements in isolation, irrespective of the level of foreign currency liabilities, indicate the possible effect of an exchange-rate devaluation on profitability measures when foreign currency debt is zero.

In the case of exporting firms, while exchange-rate devaluation did have a negative differential effect on the profitability measures, this was found to be smaller for the net income of exporting firms than of all firms. As mentioned, exports provide a natural hedge against exchange-rate movements.

We also checked whether exchange-rate devaluation had a differential effect depending on the level of net currency exposure, measured as the difference between foreign currency liabilities and the sum of foreign currency assets and the purchased value of currency derivative contracts. The results are presented in table 3.

Table 3
Model results for net currency exposure

Dependent variable	All firms				Exporting firms			
	EBITDA	Net income	ROE	ROIC	EBITDA	Net income	ROE	ROIC
C	0.059203	-0.022867	0.051008	0.048926	0.082813	0.013266	0.045846	0.050076
	[0.0073]***	[0.0111]**	[0.0058]***	[0.0057]***	[0.0022]***	[0.0027]***	[0.0107]***	[0.0034]***
$Exposure_{t-4}.\Delta er_t$	-1.95642	-5.000682	-2.341707	1.343516	0.413077	-0.8630	-8.632429	0.672557
	[0.8292]**	[0.9606]***	[1.7506]	[0.7270]*	[0.2137]*	[0.2146]***	[2.3554]***	[0.2686]**
Δer_t	0.046017	0.343453	-0.267726	-0.298298	0.014472	-0.088957	-0.225004	-0.166851
	[0.1180]	[0.2215]	[0.1982]	[0.0955]***	[0.0976]	[0.1089]	[0.1752]	[0.1054]
$Exposure_{t-4}$	0.096136	0.091496	0.349993	0.056043	0.066162	0.007115	0.21759	0.096291
	[0.0591]	[0.0571]	[0.1059]***	[0.0981]	[0.0167]***	[0.0189]	[0.1837]	[0.0274]***
Observations	4 243	4 418	4 339	4 404	2 198	2 297	2 253	2 296
Adjusted R-squared	0.3928	0.083	0.1758	0.1017	0.497	0.4533	0.1871	0.2687
F-statistic	15.595	3.1043	5.8716	3.6233	19.0869	16.7344	5.2848	7.9683
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: Prepared by the authors.
Note: White standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

As expected, it was found that, on average, firms with greater net exposure were differentially affected by an exchange-rate devaluation. The differential effect was statistically significant and negative for these firms' net income, the preferred measure of profitability in this paper.

For exporting firms, the differential effect on net income was smaller, in absolute number terms, than that estimated for the sample of all firms. The differential effect on EBITDA was positive and significant for the sample of exporting firms. An exchange-rate devaluation increases the revenues of firms that

are net exporters without affecting operating expenses, raising profitability as measured by EBITDA. In contrast, net income is negatively affected by higher financial costs when there is an exchange-rate devaluation and the company has a positive net exposure.

Lastly, we sought to analyse whether an exchange-rate devaluation had differential effects when associated with the level of currency hedging, liabilities and assets separately. The results are presented in table 4.

Table 4
Model results for foreign currency liabilities, assets and hedging

Dependent variable	All firms				Exporting firms			
	EBITDA	Net income	ROE	ROIC	EBITDA	Net income	ROE	ROIC
C	0.058638	-0.021079	0.062494	0.050392	0.084563	0.019692	0.056147	0.052667
	[0.0080]***	[0.0113]*	[0.0119]***	[0.0068]***	[0.0024]***	[0.0027]***	[0.0206]***	[0.0036]***
$Liabilities_{t-4}.\ \Delta er_t$	-2.098985	-5.117687	-0.780767	1.411363	0.450721	-0.617229	-6.742197	0.706289
	[0.8717]**	[0.9769]***	[1.7451]	[0.7931]*	[0.2017]**	[0.2238]***	[2.5564]***	[0.2658]***
$Assets_{t-4}.\ \Delta er_t$	3.444796	4.37346	-14.341085	-0.304638	-0.860182	-0.276664	-5.756039	0.140102
	[1.4612]**	[1.2632]***	[5.2190]***	[1.3653]	[0.3429]**	[0.5797]	[8.4122]	[0.4400]
$Hedge_{t-4}.\ \Delta er_t$	1.689724	3.18858	4.997618	0.330964	-0.545262	1.648387	10.551523	0.384984
	[0.8033]**	[0.7463]***	[1.5394]***	[0.6034]	[0.2524]**	[0.3003]***	[2.4618]***	[0.3207]
Δer_t	0.03744	0.397119	-0.165512	-0.354283	0.026152	-0.107312	-0.08693	-0.224882
	[0.1357]	[0.2656]	[0.2383]	[0.1062]***	[0.1112]	[0.1206]	[0.2471]	[0.1203]*
$Liabilities_{t-4}$	0.098459	0.08676	0.3396	0.04944	0.058107	-0.019288	0.186391	0.08376
	[0.0627]	[0.0606]	[0.1184]***	[0.1050]	[0.0157]***	[0.0207]	[0.2068]	[0.0275]***
$Assets_{t-4}$	-0.088986	-0.177326	-1.08239	-0.07827	-0.09219	-0.107952	-0.491503	-0.115933
	[0.0527]*	[0.0577]***	[0.4558]**	[0.0932]	[0.0327]***	[0.0444]**	[0.5495]	[0.0462]**
$Hedge_{t-4}$	-0.081039	-0.107409	-0.317261	-0.091532	-0.076222	-0.051791	-0.218928	-0.127274
	[0.0480]*	[0.0451]**	[0.1039]***	[0.0662]	[0.0333]**	[0.0310]*	[0.1603]	[0.0440]***
Observations	4 243	4 418	4 339	4 404	2 198	2 297	2 253	2 296
Adjusted R-squared	0.3922	0.0822	0.1801	0.1011	0.4962	0.4547	0.1904	0.2681
F-statistic	15.2577	3.0389	5.9116	3.5517	18.4521	16.3136	5.2378	7.7261
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: Prepared by the authors.
Note: White standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

It can be seen that exchange-rate devaluation had a statistically significant differential effect on three of the four profitability measures. As expected, the differential effect was negative for firms with greater foreign currency liabilities and positive for firms with greater hedging. On the asset side, the differential effect was positive, as expected, for three of the four profitability measures, the exception being ROE, possibly reflecting the ambiguous effects of an exchange-rate devaluation on this variable.

In the case of exporting firms, the differential effect for those with larger foreign currency liabilities was significant on all four profitability measures and negative, as expected, for net income and ROE. In the case of net income, in particular, the differential effect of an exchange-rate devaluation was smaller in absolute number terms for exporting firms, indicating that these firms were less vulnerable on average to an exchange-rate devaluation when they had foreign currency liabilities.

Cowan, Hansen and Herrera (2005) argue that the positive differential effect for firms with larger foreign currency assets and hedging should at least partially offset the negative differential effect for firms with foreign currency liabilities. The results obtained do not support this. In particular, for the sample of all firms, when foreign currency assets and hedging are controlled for, the ratios for net income and EBITDA are greater in absolute number terms than the values observed in table 2.

1. Robustness analysis: macroeconomic controls

To check whether the results obtained were internally robust, the specification of the models was modified by introducing controls for the macroeconomic environment. Specifically, we controlled for changes in the level of domestic economic activity (real change in GDP) and world demand (change in the volume of world imports). We found that the results did not change significantly and remained robust after the inclusion of the macroeconomic controls.

Table 5 presents the results for the differential effect of an exchange-rate movement on firms with foreign currency debt. It can be seen that, for the sample of all firms, the coefficients of the main profitability measures selected, EBITDA and net earnings, remain similar, although the differential effect on EBITDA is no longer statistically significant. For exporting firms, the differential effect of an exchange-rate movement remains statistically significant for three of the four profitability measures (the same ones as when changes in GDP were not controlled for), and the values of the coefficients are also similar. The effect of changes in world imports was neither significant nor numerically important.

Table 5
Model results for foreign currency debt, controlling for GDP

Dependent variable	All firms				Exporting firms			
	EBITDA	Net income	ROE	ROIC	EBITDA	Net income	ROE	ROIC
C	0.010417	-0.051815	0.049685	0.020457	0.086184	0.003143	0.035746	0.043126
	[0.0158]	[0.0207]**	[0.0190]***	[0.0154]	[0.0035]***	[0.0052]	[0.0192]*	[0.0060]***
$Liabilities_{t-4}.\Delta er_t$	-0.468387	-3.008685	-3.727566	0.699823	0.257397	-0.732257	-4.036402	0.507089
	[0.3005]	[0.7620]***	[1.3277]***	[0.4268]	[0.2338]	[0.3158]**	[1.4420]***	[0.1894]***
Δer_t	0.137032	0.406934	0.059871	-0.16837	0.050402	0.092346	0.144919	-0.045684
	[0.0873]	[0.1976]**	[0.2102]	[0.0693]**	[0.0598]	[0.0700]	[0.2046]	[0.0658]
$Liabilities_{t-4}$	0.221933	0.159341	-0.000104	0.06105	0.046056	-0.010632	0.112285	0.021545
	[0.0467]***	[0.0382]***	[0.1092]	[0.0881]	[0.0173]***	[0.0279]	[0.1707]	[0.0235]
ΔGDP_t	2.53726	1.541578	0.719538	1.318793	2.233325	2.80565	-0.285939	1.681872
	[0.6065]***	[0.8440]*	[0.8861]	[0.4803]***	[0.1941]***	[0.2788]***	[1.2254]	[0.3641]***
$\Delta Imports_t$					-0.003352	-0.000353	0.004973	-0.000562
					[0.0009]***	[0.0013]	[0.0031]	[0.0018]
Observations	5 751	6 022	5 914	6 005	3 016	3 171	3 103	3 169
Adjusted R-squared	0.2023	0.0644	0.1344	0.1245	0.4017	0.4058	0.1306	0.2636
F-statistic	8.1825	3.0318	5.4997	5.1853	16.1043	17.0353	4.451	9.3996
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: Prepared by the authors.
Note: White standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

The differential effect of an exchange-rate devaluation according to the level of net currency exposure, controlling for the macroeconomic environment, is presented in table 6. In the sample of all firms, the result of controlling for changes in GDP, although statistically significant for three of the four profitability measures, did not substantially change the differential effect of an exchange-rate devaluation. The effect of an exchange-rate devaluation (when exposure is zero) becomes positive and statistically significant for ROE, indicating a competitiveness effect for firms with no net currency exposure.

In the case of exporting firms, the differential effect does not alter significantly when changes in GDP and world imports are controlled for. As mentioned above, it remains negative and statistically significant for net earnings and positive and significant, as expected, for EBITDA.

Lastly, we analyse whether the introduction of macroeconomic controls modifies the differential effects of an exchange-rate devaluation when associated with currency hedging, liabilities and assets separately. The results are presented in table 7.

Table 6
Model results for net currency exposure, controlling for GDP

Dependent variable	All firms				Exporting firms			
	EBITDA	Net income	ROE	ROIC	EBITDA	Net income	ROE	ROIC
C	0.058234	-0.019319	0.045325	0.04593	0.090417	0.010131	0.055951	0.041288
	[0.0072]***	[0.0110]*	[0.0055]***	[0.0053]***	[0.0037]***	[0.0043]**	[0.0194]***	[0.0069]***
$Exposure_{t-4}.\ \Delta er_t$	-1.955036	-4.991498	-2.33874	1.332235	0.472087	-0.810924	-8.599479	0.708695
	[0.8294]**	[0.9544]***	[1.7519]	[0.7255]*	[0.1996]**	[0.2119]***	[2.3588]***	[0.2673]***
Δer_t	0.083268	0.216148	-0.069113	-0.18998	0.081311	0.07066	-0.23602	0.004271
	[0.1094]	[0.1814]	[0.1321]	[0.0715]***	[0.0421]*	[0.0450]	[0.1417]*	[0.0740]
$Exposure_{t-4}$	0.096756	0.088804	0.354874	0.058249	0.079514	0.018635	0.224711	0.104125
	[0.0593]	[0.0575]	[0.1066]***	[0.0978]	[0.0173]***	[0.0179]	[0.1836]	[0.0265]***
ΔGDP_t	0.526774	-1.596536	2.538219	1.358107	2.05716	2.308366	1.091204	1.810258
	[0.3937]	[0.8198]*	[0.7764]***	[0.4332]***	[0.2151]***	[0.2116]***	[1.1734]	[0.4226]***
$\Delta Imports_t$					-0.003909	-0.000851	-0.003883	0.001242
					[0.0010]***	[0.0012]	[0.0045]	[0.0018]
Observations	4 243	4 418	4 339	4 404	2 198	2 198	2 198	2 198
Adjusted R-squared	0.3927	0.083	0.1772	0.1023	0.514	0.514	0.514	0.514
F-statistic	15.5136	3.0939	5.8925	3.6276	20.0441	20.0441	20.0441	20.0441
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: Prepared by the authors.
Note: White standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 7
Foreign currency liabilities, assets and hedging model results, controlling for GDP

Dependent variable	All firms				Exporting firms			
	EBITDA	Net income	ROE	ROIC	EBITDA	Net income	ROE	ROIC
C	0.056752	-0.014867	0.053506	0.045455	0.087051	0.011155	0.063958	0.039311
	[0.0080]***	[0.0113]	[0.0128]***	[0.0066]***	[0.0046]***	[0.0046]**	[0.0226]***	[0.0075]***
$Liabilities_{t-4}.\ \Delta er_t$	-2.097425	-5.101601	-0.773983	1.39537	0.488775	-0.598927	-6.722016	0.714897
	[0.8703]**	[0.9679]***	[1.7263]	[0.7880]*	[0.1694]***	[0.2177]***	[2.5593]***	[0.2655]***
$Assets_{t-4}.\ \Delta er_t$	3.45533	4.370947	-14.396222	-0.297226	-0.769531	-0.288225	-5.650937	0.059947
	[1.4611]**	[1.2570]***	[5.1882]***	[1.3668]	[0.3562]**	[0.5906]	[8.4768]	[0.4318]
$Hedge_{t-4}.\ \Delta er_t$	1.671175	3.287474	4.847426	0.254385	-0.638275	1.450051	10.584186	0.163176
	[0.8098]**	[0.7665]***	[1.5739]***	[0.5895]	[0.2452]***	[0.2623]***	[2.4464]***	[0.3286]
Δer_t	0.07854	0.257283	0.029452	-0.242757	0.10108	0.058944	-0.105204	-0.041204
	[0.1285]	[0.2223]	[0.1737]	[0.0817]***	[0.0580]*	[0.0596]	[0.2214]	[0.0964]
$Liabilities_{t-4}$	0.102296	0.075054	0.358999	0.058699	0.097982	0.017195	0.201298	0.113509
	[0.0636]	[0.0611]	[0.1196]***	[0.1048]	[0.0161]***	[0.0199]	[0.2139]	[0.0292]***
$Assets_{t-4}$	-0.065413	-0.247576	-0.982013	-0.022179	-0.05074	-0.044665	-0.485242	-0.05314
	[0.0483]	[0.0694]***	[0.4623]**	[0.0922]	[0.0362]	[0.0449]	[0.5597]	[0.0452]
$Hedge_{t-4}$	-0.067832	-0.147399	-0.261798	-0.059597	-0.048973	-0.018526	-0.208213	-0.098357
	[0.0459]	[0.0468]***	[0.1082]**	[0.0637]	[0.0318]	[0.0307]	[0.1655]	[0.0431]**
ΔGDP_t	0.568473	-1.702568	2.415173	1.357745	2.150126	2.283921	0.934932	1.868676
	[0.4171]	[0.8232]**	[0.8281]***	[0.4345]***	[0.2355]***	[0.2356]***	[1.5132]	[0.4586]***
$\Delta Imports_t$					-0.003995	-0.000867	-0.003548	0.001098
					[0.0010]***	[0.0012]	[0.0048]	[0.0018]
Observations	4 243	4 418	4 339	4 404	2 198	2 297	2 253	2 296
Adjusted R-squared	0.3922	0.0822	0.1813	0.1017	0.5136	0.4701	0.1899	0.2755
F-statistic	15.1803	3.0296	5.9254	3.5553	19.4147	17.0393	5.1568	7.8706
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: Prepared by the authors.
Note: White standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

We find that the statistically significant differential effect of an exchange-rate devaluation on three of the four profitability measures is still present when changes in GDP are controlled for. As expected, the differential effect is negative for firms with larger foreign currency liabilities and positive for firms with larger foreign currency assets or greater hedging.

In the case of exporting firms with greater foreign currency liabilities, as before, the differential effect is significant and negative for only two of the four profitability measures, net earnings and ROE, and positive for EBITDA and ROIC. Once again, we find a substantially smaller differential effect from an exchange-rate devaluation on net income in absolute number terms, indicating that exporting firms with foreign currency liabilities are less vulnerable to an exchange-rate devaluation.

V. Conclusions

This paper has sought to investigate the effects of exchange-rate misalignment on the earnings of Brazilian non-financial firms between 2010 and 2018, using a sample of 201 Brazilian non-financial listed firms. Its main contribution derives from the use of a specially constructed database containing detailed and hard-to-access information on currency derivatives and assets. Following what is a standard econometric strategy in the literature on the so-called balance sheet effect in emerging economies, we obtained results that corroborate those of previous studies on Brazil.

The main finding was that, when an exchange-rate devaluation occurs, there is a negative differential effect on firms with foreign currency debt and greater exchange-rate exposure, even when they are exporters, although in this case the effect is smaller. By including in the equation some variables that protect firms with foreign currency debt from the effects of devaluation, we obtained the expected result: the differential effect is negative for firms with larger foreign currency liabilities and positive for firms with larger foreign currency assets or a higher level of hedging. These results were consistent across different specifications.

It is important to note that the effects of an exchange-rate devaluation in a given economy cannot be generalized, because they depend on factors such as external debt and trade ratios, as well as firms' currency hedging strategies, which vary between countries and over time. We have presented evidence that the degree of exchange-rate misalignment among Brazilian firms declined substantially over the 2010s.

This last consideration suggests future lines of research to be pursued with this paper as a starting point. A first task is to divide the period into phases characterized by different levels of exchange-rate misalignment and recalculate the effect of exchange-rate depreciations on profits in these subperiods. A second suggestion for future research is to study a specific episode of severe exchange-rate devaluation, such as the depreciation of some 70% around 2015, using the difference-in-differences method. Lastly, given the importance of the export and import variables in determining the degree of exchange-rate misalignment, and in view of the lack of firm-level data for Brazil, one possible way forward would be to group firms into sectors for which these data are available.

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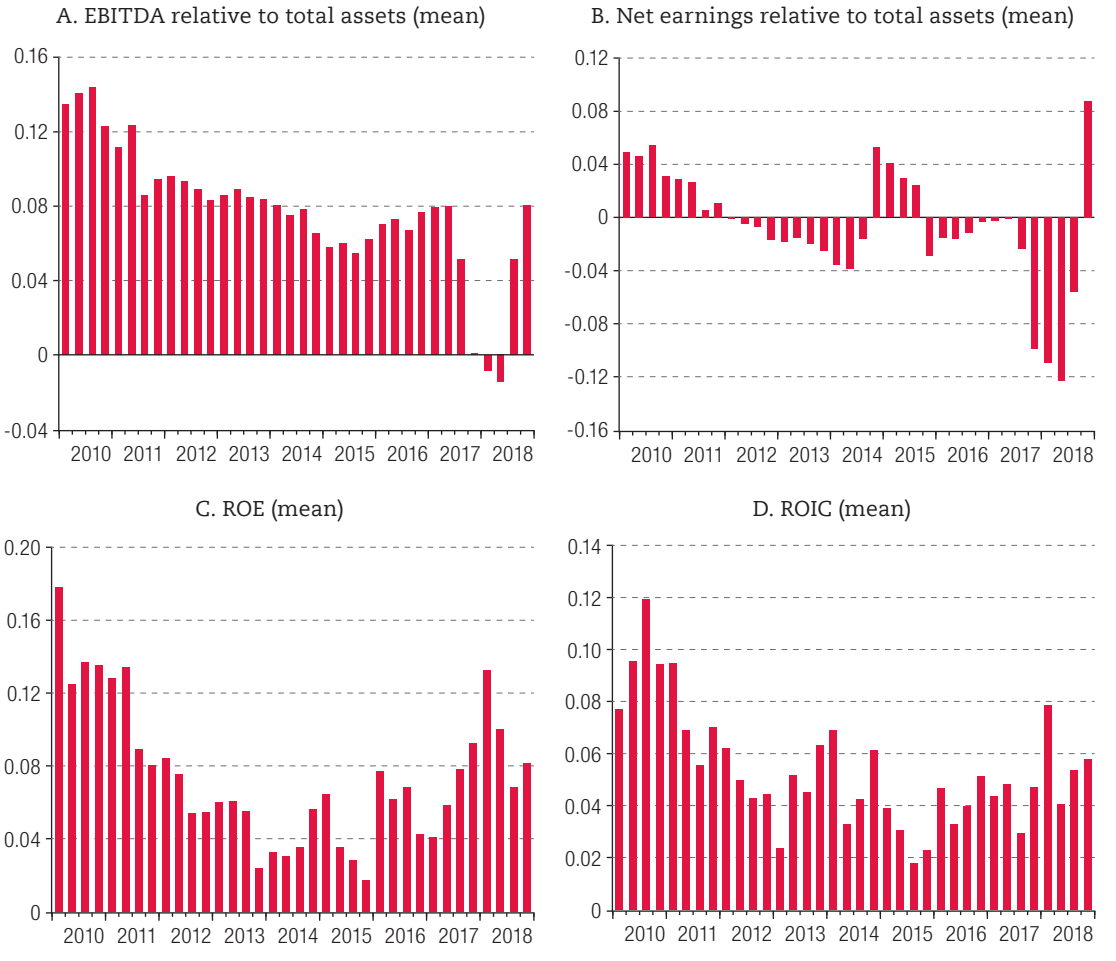
Annex A1

Table A1.1
Descriptive statistics

Sample: all firms								
	EBITDA	Net income	ROE	ROIC	Assets	Liabilities	Hedging	Net exposure
Mean	0.0771	-0.0041	0.0584	0.0510	0.0169	0.0768	0.0186	0.0413
Median	0.0913	0.0256	0.0797	0.0557	0.0000	0.0078	0.0000	0.0000
Maximum	2.6142	12.4243	2.9512	4.6221	0.3903	1.6513	0.6936	1.6513
Minimum	-1.6142	-8.1933	-2.9842	-4.5758	0.0000	0.0000	-0.3471	-0.5454
Standard deviation	0.1721	0.5376	0.4188	0.2811	0.0459	0.1354	0.0606	0.1143
Observations	3 735	3 735	3 735	3 735	3 735	3 735	3 735	3 735
Sample: exporting firms								
	EBITDA	Net income	ROE	ROIC	Assets	Liabilities	Hedging	Net exposure
Mean	0.0871	0.0137	0.0565	0.0565	0.0279	0.1089	0.0273	0.0538
Median	0.0905	0.0229	0.0699	0.0535	0.0000	0.0345	0.0000	0.0011
Maximum	0.9754	0.6266	2.9512	1.5617	0.3903	0.7675	0.6936	0.7614
Minimum	-1.0531	-1.2648	-2.9842	-1.5894	0.0000	0.0000	-0.3471	-0.5454
Standard deviation	0.0935	0.1074	0.4262	0.1200	0.0576	0.1476	0.0726	0.1178
Observations	1 947	1 947	1 947	1 947	1 947	1 947	1 947	1 947

Source: Prepared by the authors.

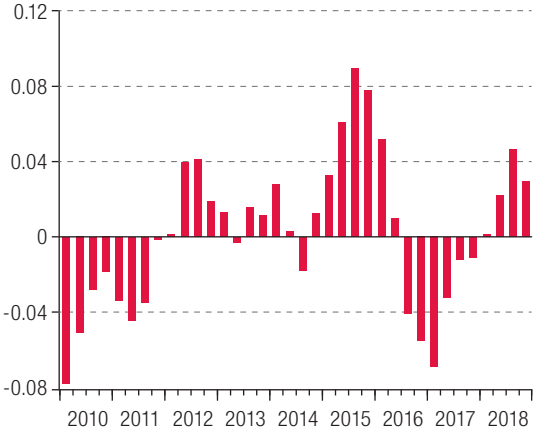
Figure A1.1
Brazil: profitability measures, 2010–2018



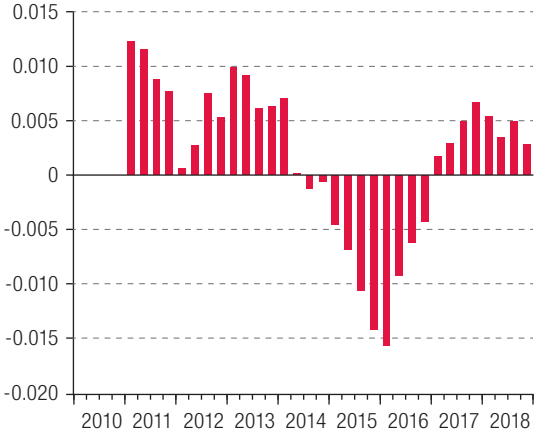
Source: Prepared by the authors.

Figure A1.2
Brazil: macroeconomic variables, 2010–2018

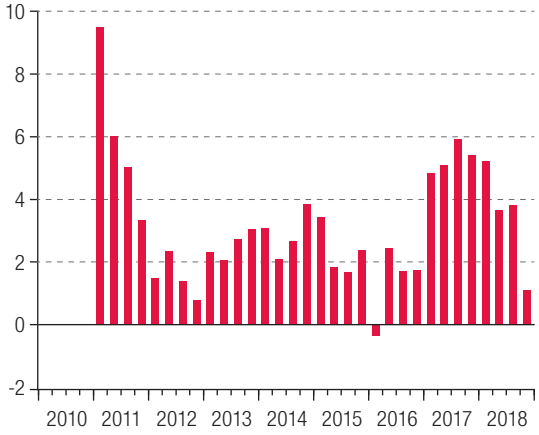
A. Real exchange rate of Brazilian real to United States dollar (changes in moving average)



B. Real seasonally adjusted GDP (changes in moving average)



C. Seasonally adjusted world import volume index (rates of change)



Source: Prepared by the authors.

Table A1.2
Unit root tests

Null hypothesis: individual unit root with individual effects and linear trend			
Variable	Statistic	p-value	Conclusion
EBITDA	-4.3673	0.0000	Null hypothesis of unit root rejected
Net income	-3.0665	0.0011	Null hypothesis of unit root rejected
ROE	-1.5368	0.0622	Null hypothesis of unit root rejected
ROIC	-3.2228	0.0006	Null hypothesis of unit root rejected
Liabilities	-5.9119	0.0000	Null hypothesis of unit root rejected
Assets	-7.0674	0.0000	Null hypothesis of unit root rejected
Hedging	-3.0250	0.0012	Null hypothesis of unit root rejected
Exposure	-28.1913	0.0000	Null hypothesis of unit root rejected
Δer_t	-16.1975	0.0000	Null hypothesis of unit root rejected
ΔGDP_t	-15.9391	0.0000	Null hypothesis of unit root rejected
$\Delta Imports_t$	-38.6561	0.0000	Null hypothesis of unit root rejected

Source: Prepared by the authors, on the basis of K. Im, M. Pesaran and Y. Shin (2003), "Testing for unit roots in heterogeneous panels", *Journal of Econometrics*, vol. 115, No. 1, Amsterdam, Elsevier.