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Exchange Rate Pass-Through in Brazilian Domestic E-Commerce

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Abstract

This paper investigates the exchange rate pass-through to the prices of Brazilian domestic e-commerce. The elasticities between exchange rates and prices of products sold in e-commerce were estimated using the approach of Pesaran et al. (2001), based on an ARDL model represented as a CECM. The results suggest that for each 1% of permanent appreciation in the exchange rate, the prices of products sold in the domestic e-commerce will increase 0.46% in the long run.

Keywords: exchange rate pass-through; e-commerce; cointegration.

1 Introduction

The study of exchange rate pass-through constitutes a recurring research topic. A large literature has emerged in international economics, as documented by Goldberg and Knetter (1997). The extent of such transmission can be related to different aspects associated with market structure, demand, and institutional features that are typically country and sector-specific. Aron, Macdonald, and Muellbauer (2014) provide an additional survey in the context of Latin America. A salient feature of less developed countries pertains to more frequent economic and political instabilities that may give rise to greater exchange rate volatility and ultimately will have an important role in the exchange rate pass-through dynamics.

In the case of the retail segment, one can observe an expressive growth in terms of online transactions, and usual motivations often involve convenience aspects related to transport avoidance and fast processing. Furthermore, it is noticeable the increased availability of price search engines that allow useful preliminary comparisons before the consumer decides to buy. Hortaçsu, Martínez-Jerez, and Douglas (2009) highlight the reduced cost of product and price research in e-commerce.

As a result of these conveniences, e-commerce grew 24% worldwide in 2018, reaching a mark of 2.9 trillion dollars in sales. Online sales are growing faster than the traditional retailing in practically every country that already operates e-commerce. Brazil is the most developed market in terms of e-commerce in Latin America, with revenues of R$ 52.3 billion in 2018. In this country, 4.3% of sales were online, and the growth of these sales was 12% in 2018. This year, there were 58 million online consumers in this country, equivalent to 27% of its population (Ebit, 2019).

As indicated in the aforementioned surveys, the literature on exchange rate pass-through in terms of offline transactions is large. In contrast, the analogous contributions are incipient in the context of e-commerce, not to mention in the specific case of emerging countries.

Gorodnichenko and Talavera (2017) investigated the exchange rate pass-through to e-commerce prices in Canada and the US. They found an incomplete pass-through of

approximately 60 to 75%, which is greater than 20 to 40% documented for regular markets. They found that the speed of price adjustment to equilibrium levels is 2 to 2.5 months.

Anson, Boffa, and Helble (2019) expand the literature on e-commerce but with a distinct perspective. These authors investigated consumer arbitrage in cross-border e-commerce. The effect of exchange rates on parcel dispatches was analyzed in terms of high-frequency data for several developed countries. The evidence indicated that a 1% appreciation of the domestic currency leads to an increase in e-commerce imports by 0.7 %.

This paper aims to contribute by assessing the exchange rate pass-through to the prices of products sold through e-commerce in Brazil. The analysis was based on the FIPE-Buscapé price index that is constructed upon disaggregated prices from the Buscapé price comparison engine. This index comprises products sold through domestic e-commerce in Brazil. An Autoregressive Distributed Lag Model (ARDL) represented as a Conditional Error Correction Model (CECM) was used to estimate the elasticities between the exchange rate and the prices of products sold through e-commerce, following the approach of Pesaran et al. (2001).

2 Empirical Analysis

2.1 Data

The FIPE-Buscapé price index was adopted in the proposed analysis. It monitors 41 thousand products sold through e-commerce in Brazil. This index is calculated based on more than 3 million monthly prices, extracted from the Buscapé platform (https://www.buscape.com.br), and on weights obtained from an annual survey of approximately 3.6 million e-consumers conducted by Ebit (https://www.ebit.com.br). It is estimated that 10 categories of products, that currently compose such index, represent around 80% of sales on the e-commerce: household appliances, electronics, computers, telephony, photography, cosmetics and personal care, sports and leisure, home and decoration, toys and games, and fashion and accessories.

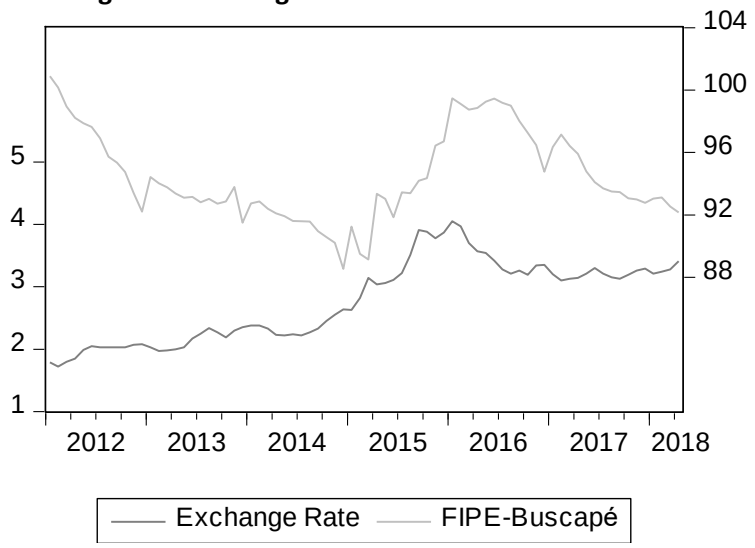
The monthly data of the FIPE-Buscapé index were collected on the website of the Institute of Economic Research Foundation (FIPE) (https://www.fipe.org.br). The index has a base equal to 100 in December 2010. The methodology of this index can also be accessed on this website. The monthly data on the nominal exchange rate were collected on the website of the Instituto de Pesquisa Econômica Aplicada (IPEA) (http://www.ipeadata.gov.br). Table 1 presents the relevant summary statistics. The data refer to the period from January 2012 to April 2018.

Table 1. Summary Statistics

Statistics	FIPE-Buscapé	Exchange Rate
Mean	94.46	2.77
Maximum	100.90	4.05
Minimum	88.54	1.72
Std. Dev.	2.88	0.65
No. of observations	76	76

A preliminary inspection of Figure 1 suggests that a long-run co-movement appears to prevail between the exchange rate and online prices, but a careful econometric analysis needs to be undertaken in a later section.

Figure 1. Exchange Rate and Prices in E-commerce



2.2 Empirical Model

To estimate the elasticity between the exchange rate and the prices of products sold through e-commerce, the approach of Pesaran et al. (2001) was adopted. This approach is based on an ARDL represented as a CECM and allows the estimation of short-run and long-run parameters. The ARDL approach can be applied when the variables are integrated in first order *I*(1), stationary *I*(0), or a mixture between I(1) and I(0) variables. It is therefore facultative that the order of integration of the regressors is checked by pre-tests.

In order to assess the exchange rate pass-through to e-commerce prices, we consider a CECM according to Equation 1:

$$\Delta \ln P_t = b_0 + \sum_{i=1}^{p} b_1 \Delta \ln P_{t-i} + \sum_{i=0}^{p} b_2 \Delta \ln E_{t-i} + \lambda_1 \ln P_{t-1} + \lambda_2 \ln E_{t-1} + e_t \qquad (1)$$

where P_t denotes the FIPE-Buscapé index, E_t stands for the exchange rate, and e_t is the error term. The variables are in logarithmic scale (ln). The long-run elasticity is given by $-\lambda_2/\lambda_1$, and the short-run effects are captured by the variables in first difference.

This equation allows testing the existence of cointegration between the variables, according to the approach of Pesaran et al. (2001). The null hypothesis (H_0) and the alternative hypothesis (H_1) of the non-cointegration test can be defined as:

$$\begin{aligned} &H_0: \lambda_1 = \lambda_2 = 0; \\ &H_1: \lambda_1 \neq 0 \; and \; \lambda_2 \neq 0. \end{aligned} \tag{2}$$

These hypotheses are tested based on an F-statistic, whose critical limits for finite samples were provided by Narayan (2005). If the value of the F-statistic found is lower than that of the lower bound, it is concluded that all variables are I(0), therefore, cointegration is not possible. On the other hand, if the value of the F-statistic is higher than that of the upper bound, it is concluded that all variables are I(1), therefore, cointegration is possible.

2.3 Empirical Results

Table 2 shows the CECM that relates these variables. This model was specified with constant and trend for a maximum of 12 lags for the variables. The lags were defined according to the Akaike Information Criterion (AIC). The estimators are autocorrelation and heteroscedasticity consistent (HAC).

Table 2. Estimated CECM

Variable	Coefficient	Standard Error
Constant	1.152***	0.336
Trend	-0.001***	0.000
$\Delta \ln P_{t-1}$	-0.392***	0.113
$\Delta \ln P_{t-2}$	-0.327***	0.118
$\Delta \ln P_{t-3}$	-0.135	0.121
$\Delta \ln P_{t-4}$	-0.208*	0.122
$\Delta \ln P_{t-5}$	-0.194	0.116
$\Delta \ln P_{t-6}$	-0.292**	0.114
$\Delta \ln P_{t-7}$	-0.204*	0.113
$\Delta \ln P_{t-8}$	-0.017	0.115
$\Delta \ln P_{t-9}$	-0.049	0.110
$\Delta \ln P_{t-10}$	-0.071	0.104
$\Delta \ln P_{t-11}$	-0.338***	0.099
$\Delta \ln E$	-0.064*	0.038
$\Delta \ln E_{t-1}$	-0.118**	0.048
$\Delta \ln E_{t-2}$	-0.016	0.044
$\Delta \ln E_{t-3}$	-0.107**	0.044
$\ln P_{t-1}$	-0.272***	0.076
$\ln E_{t-1}$	0.125***	0.023
Long-run relationship		
lnE	0.460***	0.115
Statistical Summary		
R^2		0.666
Adjusted R^2		0.543
F-statistic		5.401
F-statistic (p-value)		0.000
Breusch Godfrey LM test $\chi^2(1)$		0.016
Breusch Godfrey LM test (p-value)		0.898

Note. ***, ** and * denote, respectively, significant coefficients at the levels of 1%, 5% and 10% significance.

The results of the model are satisfactory, with most of the coefficients being significant. The existence of a long-run relationship between the variables was confirmed by the cointegration test presented in Table 3. The F-statistic is higher than the upper limit of the test, which suggests that there is cointegration.

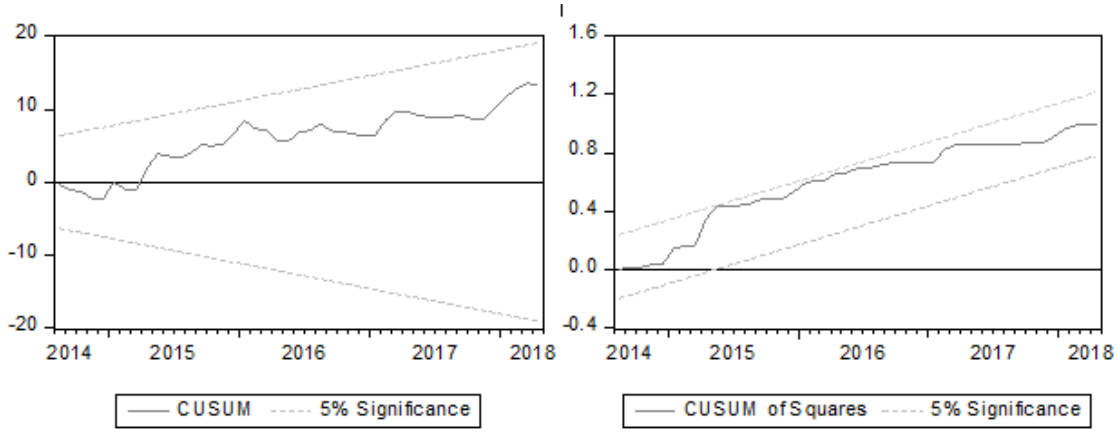
Table 3. Bounds Test

Test Statistic	Value	Significance	*I*(0)	*I*(1)
F-statistic	15.476	10%	5.755	6.470
		5%	6.890	7.660
		1%	9.475	10.515

Note. The critical values adopted refer to finite samples of 65 observations whereas the number of observations in the current application is 64.

The results, presented in Table 2, support the estimated model. The Breusch-Godfrey LM test does not reject the hypothesis of no autocorrelation. Besides, the CUSUM and CUSUMSQ of squares tests, shown in Figure 2, suggest the stability of the coefficients.

Figure 2. CUSUM and CUSUMSQ Tests



- **F31** Foreign Exchange
- **F41** Open Economy Macroeconomics
- **L11** Production, Pricing, and Market Structure; Size Distribution of Firms
- **L81** Retail and Wholesale Trade; e-Commerce

The coefficient of P_{t-1} suggests that the adjustment of e-commerce prices towards their long-run equilibrium value should take about 4 months. The long-run coefficient suggests that for each 1% of the permanent appreciation in the exchange rate, the prices of products sold in the domestic e-commerce will increase 0.46% in the long run. Compared to the results that Gorodnichenko and Talavera (2017) found with data from the United States (US) and Canada, the exchange rate pass-through to prices in Brazilian e-commerce is more incomplete and slower.

This pattern is likely to reflect, to a certain extent, specificities of the Brazilian case. The large currency depreciation that has been observed over recent periods cannot, in many cases, be expected to perfectly be transmitted into the prices of imported goods. A more incomplete exchange rate pass-through can be motived by the strong exchange volatility in Brazil, associated with frequent domestic political and economic shocks, which critically complicate inventory and price management by e-commerce stores. Moreover, the decline in consumption under the scenario of severe Brazilian crisis may have

influenced the transmission of the exchange rate to the prices of goods sold in e-commerce, despite the absence of significant competition by local goods.

3 Final Comments

The paper aimed at investigating the degree of exchange rate pass-through in the context of Brazilian retail e-commerce. The related literature suggests a gap in terms of the e-commerce segment and had mostly focused on more developed economies. The present study assessed the long-run association between the exchange rate and prices of online transactions in Brazil, taking as a reference a major search engine for price comparisons. The evidence indicated a more incomplete exchange rate pass-through, as compared with a previous study for the US and Canada.

A limitation of the present study refers to the aggregate character of the FIPE-Buscapé index. An interesting extension, should the data become available, would be to develop the analysis in terms of the main categories of goods that are sold through e-commerce in Brazil.

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