CPI Exchange Rate Pass-Through Decomposition and Distribution Margins: The Case of Brazil versus Advanced Economies

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Abstract · Resumo

We analyze the channels through which the exchange rate affects final consumer prices. We compare advanced countries with one emerging economy, Brazil, to determine the corresponding exchange rate pass-through and its channels. A key aspect to the exchange rate pass-through is the relative importance of tradables in the consumption basket as well as the share of imported inputs. Since non-tradables are usually cheaper in developing economies, the share of non-tradeables is smaller in theses countries. We illustrate this scenario using data from Brazil vis-a-vis a group of advanced economies.

1. Introduction

Recent swings in the exchange rates over the world have raised interest in understanding the degree of exchange rate pass-through. Moreover, the mechanisms behind the transmission of exchange rate movements to domestic prices are relevant to determine monetary policy.

In this work, we analyze the channels through which the exchange rate affects final consumer prices. We focus on the role of imported inputs, imports of final imported consumer goods and on the distribution costs' impacts. We evaluate whether different contexts, either developed countries or developing countries, imply different channels in action. We compare advanced countries with the case of Brazil to determine the corresponding exchange rate pass-through and its channels.

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The exchange rate pass-through impacts the economy in many ways. First, movements in prices impact inflation, being relevant to monetary and exchange rate policies. The degree of exchange rate-pass-through affects the trade balance and its adjustments, the so-called expenditure switching effect. When there is a currency depreciation, it is expected an improvement in the trade balance of a country. This occurs due to an expansion in exports and contraction in imports. However, this occurs only if there is a pass-through of the changes in the exchange rates to prices: if the prices of imported goods are not affected there is no reason for imports to be reduced. A very low pass-through, then, implies that this adjustment would not occur. In this way, it is relevant for macroeconomic policies.

It is possible to measure the exchange rate pass-through to different prices. One source of interest is on the the pass-through to the import prices with the intent to measure how prices of imported goods react to the exchange rate at the dock, i.e., even before reaching the consumer. Empirical evidence suggests that in the last 20 years, the exchange rate pass-through has declined among advanced economies (Marazzi & Sheets, 2007; Gust, Leduc, & Vigfusson, 2010). They have documented a decrease in this pass-through to import prices, especially for the U.S., possibly due to increased trade integration, competition in global markets and also due to adjustments in the mark-ups charged with firms absorbing part of the change in the exchange rate (Dong, 2012).

Market structure may also affect the response of import prices when it affects pricing decisions of the firms. Auer and Schoenle (2016) show that the pass-through rates depend on the distribution of the firms leading to heterogeneous responses to exchange rates across trade partners and sectors. For instance, Gaulier, Lahrèche-Révil, and Méjean (2008) estimate that the average long-run pass-through estimated at the product level is 80% with complete pass-through in 25% of the sectors but with a strong heterogeneity across sectors.[1]

Most commonly, the studies on the exchange rate pass-through to the CPI focus on the prices of imported goods for final consumption. New interest have arisen on the role of imported inputs and distribution costs in affecting the exchange rate pass-through to the consumer prices (CPI). Empirical studies have turned more attention to the role of pass-through to prices of imported inputs (Goldberg & Campa, 2010; De Loecker, Goldberg, Khandelwal, & Pavcnik, 2015). These studies range from macro studies that measure the relative importance of imported inputs to final consumer prices to the micro ones that estimate the pass-through at the firm-product level of imported inputs to final prices. Our work measures the response to exchange rate shocks at a macro perspective, more aggregated, the role that imported inputs may play in the CPI.

Goldberg and Campa (2010) show that for the OECD countries, contrary to what previous literature suggested, the imported inputs channel was more relevant than the consumption side for the exchange rate pass-through. Most advanced economies are similar in terms of the share of imported inputs used in production, the importance of tradables in consumption and the share of imported goods for final consumption.

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[1]Another strand of the literature exploits the role of currency invoicing for the incomplete exchange rate pass-through (Goldberg & Tille, 2016; Gopinath, Itskhoki, & Rigobon, 2010).

Goldberg and Campa (2010) show that, for these countries, around 70 percent of the pass-through is accounted for by the imported inputs component. However, it is not clear whether these patterns would persist in a divergent scenario.

Using the comparison of patterns of data of Brazil and OECD countries as a motivation, we show how the pass-through is affected when varying these numbers, including the case of Brazil. We find a different picture from the OECD countries and we disentagle the possible different channels. In the case of Brazil, the consumption side of imports accounts for slightly more than half of the exchange rate pass-through.

We follow Goldberg and Campa (2010) and Corsetti and Dedola (2005) in our theoretical framework to decompose the price aggregators and the exchange rate pass-through into different components. We quantify the channels through which the exchange rate affects the domestic prices for Brazil, comparing the results with those of advanced countries. Special attention is paid to the importance of distribution margins as well as the relative importance of imported inputs component.

For this analysis we use data obtained in Goldberg and Campa (2010) such as information on input-output matrices for advanced economies and additional parameters. For Brazil, we obtain information on input-output matrices from the Brazilian Statistical Office (IBGE) and additional sources. We also perform additional exercises starting from some scenarios to measure the sensitivity of the composition of the pass-through to changes in the distribution margin, in the share of consumption of tradables and the usage of imported inputs.

Our work is related to the extensive literature on exchange rate pass-through. Studies in exchange rate pass-through vary from those that analyze the pass-through to import prices, to wholesale prices among others. Our work focus on the impact to final consumer prices which is more directly related to the inflation and the conduct of monetary policy. The main emphasis of our work is on the relative importance of imported inputs in affecting the response of final prices to the exchange rate. Recent work has focused in this important channel as Goldberg and Campa (2010). It is complementary to those studies that look at the imported inputs channel using firm level data (De Loecker et al., 2015) or else that use micro-data from CPIs (Gopinath et al., 2010) by looking at the aggregate level response.

2. Theoretical Framework

To understand the response of the final consumer prices to exchange rate movements and to disentagle its transmission, we need to decompose the final consumer prices into its components. The basic prices are the cost of intermediate goods plus inputs, such as labor and capital, and net of taxes. Producer prices correspond to basic prices plus some taxes and subsidies. Final consumer prices correspond to the sum of producer prices to the distribution margins and taxes, usually the VAT.[2] Other additional taxes are included which are related to production. The final consumer price index may be modeled as originated by a utility function of consumption CES over tradable and

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[2]In Brazil, this correspond to the ICMS.

non-tradable goods:

$$P_t = \left[\alpha\left(P_t^T\right)^{1-\phi} + (1-\alpha)\left(P_t^N\right)^{1-\phi}\right]^{\frac{1}{1-\phi}},$$

where P_t^T is the price aggregator for tradable goods; P_t^N is the price aggregator for non-tradable goods; ϕ is the price elasticity of substitution; α is the share of tradable goods in total consumption.

The exchange rate may affect P_t through both P_t^T and P_t^N. More directly, it has an impact on P_t^T since a share of the tradable goods are foreign goods. The indirect impact on P_t^T occurs through the impact of the exchange rate on the goods produced domestically that use imported inputs in production. The impact on P_t^N is more subtle occurring through the use of imported inputs, which is minor in these sectors. The price index for tradable goods, then, can be written as

$$P_t^T = \left[\alpha_T\left(P_t(h)\right)^{1-\phi_T} + \left(1-\alpha_T\right)\left(P_t(f)\right)^{1-\phi_T}\right]^{\frac{1}{1-\phi_T}},$$

where $P_t(h)$ is the price index for tradables produced domestically; $P_t(f)$ is the price index for foreign tradable goods consumed directly (price paid by the final consumer), measured in local currency; ϕ_T is the price elasticity of substitution; $(1-\alpha_T)$ is the import penetration ratio for tradables.

The exchange rate affects $P_t(f)$ directly, and $P_t(h)$ through imported inputs. It also affects $P_t(h)$ and $P_t(f)$ through the use of non-tradable goods which correspond to the costs on distribution, which on its own may depend on imported inputs, although this tends to be much smaller. In addition, the share of imports consumed directly may also be affected by the exchange rate, through the substitution towards domestic goods.

The final price paid by the consumer for the domestically produced good corresponds to the producer price plus the distribution costs[3] which are the expenditure with non-traded goods, as described below:

$$P_t(h) = \overline{P}_t(h) + m(h,\epsilon)P_t^N,$$

where $m(h,\epsilon)$ measures how many units of nontraded goods are necessary to bring one unit of domestically produced good to the final consumer; $P_t(h)$ is the producer price of the domestically produced good. Since the domestic good is produced using imported inputs we need to include those imported inputs into the price aggregators. Following **?**, optimal pricing leads to the producer price:

$$\overline{P}_t(h) = \frac{\theta}{(\theta-1)}\left[\frac{W_t}{Z_{H,t}} + \mu(h,\epsilon)\epsilon_t\frac{W_t^*}{Z_{F,t}^*}\right] + \frac{m(h,\epsilon)}{\theta-1}P_t^N,$$

where to produce one unit of the domestic good it costs $W_t/Z_{H,t}$ from domestic inputs plus $\mu(h,\epsilon)(\epsilon_t W_t^*/Z_{F,t}^*)$ of imported inputs, and $Z_{H,t}$ and $Z_{F,t}^*$ are the domestic and foreign productivity, respectively.

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[3] Here, we follow Corsetti and Dedola (2005).

As a result, the final price to the consumer is given by

$$P_t(h) = \frac{\theta}{(\theta - 1)}\left[\frac{W_t}{Z_{H,t}} + \mu(h, \epsilon)\epsilon_t\frac{W_t^*}{Z_{F,t}^*}\right] + \frac{m(h, \epsilon)}{\theta - 1}P_t^N + m(h, \epsilon)P_t^N.$$

Rearranging,

$$P_t(h) = \frac{\theta}{(\theta - 1)}\left(\bar{Z}_{H,t} + \mu(h, \epsilon)\bar{Z}_{F,t} + m(h, \epsilon)P_t^N\right),$$

where $\bar{Z}_{H,t} = (W_t/Z_{H,t})$ and $\bar{Z}_{F,t} = (\epsilon_t W_t^*)/Z_{F,t}^*$ correspond to the effective wage per unit of productivity.

Non-tradables may also use imported inputs, hence, analogously to the domestic goods price, we can write

$$P_t^N = \frac{\theta}{\theta - 1}\left[\bar{Z}_{N,t} + \mu(n, \epsilon)\bar{Z}_{F,t}\right],$$

where $\bar{Z}_{N,t} = W_t/Z_{N,t}$ corresponds to the effective wage per unit of productivity in the nontradable goods sector.

The price aggregator for foreign goods for direct consumption is analogous to the domestic good, depending on distribution costs to reach the final consumer:

$$P_t(f) = \frac{\theta}{\theta - 1}\left[Z_{F,t} + m(f, \epsilon)P_t^N\right],$$

where $m(f, \epsilon)$ measures how many units of nontradable goods are necessary to bring the foreign good to the final consumer. To analyze the pass-through we need to calculate the elasticities with respect to the exchange rate, by differentiating the expressions above with respect to the exchange rate, we obtain these elasticities:

$$\eta^{P,e} = \alpha\left(\frac{P_t^T}{P_t}\right)^{1-\phi}\left[\alpha_T\left(\frac{P_t(h)}{P_t^T}\right)^{1-\phi_T}\eta^{P_t^H,e} + \left(1 - \alpha_T\right)\left(\frac{P_t(f)}{P_t^T}\right)^{1-\phi_T}\eta^{P_t^F,e}\right]$$

$$+ (1 - \alpha)\left(\frac{P_t^N}{P_t}\right)^{1-\phi}\eta^{P_t^N,e}$$

and

$$\eta^{P^N,e} = \frac{\theta}{\theta - 1}\left(1 + \eta^{\mu_F(n,\epsilon)}\right)\left[\mu_F(n, \epsilon)\frac{\bar{Z}_{F,t}}{P_t^N}\right],$$

where η indicate the elasticity with respect to the exchange rate of each variable.

Assuming $\phi = \phi_T$, we have that:

$$\eta^{P,e} = \alpha\left(\frac{P_t^T}{P_t}\right)^{1-\phi}\left[\alpha_T\left(\frac{P_t(h)}{P_t^T}\right)^{1-\phi}\eta^{P_t^H,e} + \left(1 - \alpha_T\right)\left(\frac{P_t(f)}{P_t^T}\right)^{1-\phi}\eta^{P_t^F,e}\right]$$

$$+ (1 - \alpha)\left(\frac{P_t^N}{P_t}\right)^{1-\phi}\eta^{P_t^N,e},$$

$$\eta^{P_t(h),e} = \frac{\theta}{\theta - 1} \left[\eta^{P^N,e} + \eta^{m(h,e),e} \frac{m(h,e)P_t^N}{P_t(h)} + \left(1 + \eta^{\mu(h,e),e} \right) \frac{\mu(h,e)\overline{Z}_{F,t}}{P_t^N} \right],$$

$$\eta^{P_t(f),e} = 1 - \frac{\theta}{\theta - 1} \frac{m(f,e)P_t^N}{P_t(f)} \left[1 - \left(\eta^{m(f,e),e} + \eta^{P^N,e} \right) \right].$$

Empirically, however, we do not observe $m(f,e)$, $m(h,e)$, $\mu(h,e)$, and $\mu(n,e)$ but only the margins of distribution and the share of imported inputs used in the production of nontraded goods and domestically produced tradable goods.

To calculate the price aggregators using this empirical information available, we rewrite the expressions above as:

$$\eta^{P^N,e} = \frac{\theta}{\theta - 1} \delta_N \left(1 + \eta^{\mu_F(n,\epsilon)} \right),$$

$$\eta^{P_t(h),e} = \frac{\theta}{\theta - 1} \left[\gamma \left(\eta^{P^N,e} + \eta^{m(h,e),e} \right) \right] + \delta_H \left(1 + \eta^{\mu(h,e),e} \right),$$

$$\eta^{P_t(f),e} = 1 - \frac{\theta}{\theta - 1} \gamma_F \left[1 - \left(\eta^{m(f,e),e} + \eta^{P^N,e} \right) \right],$$

where:

$$\gamma = \frac{m(h,e)P_t^N}{P_t(h)},$$

$$\delta_H = \frac{\mu(h,\varepsilon)\overline{Z}_{F,t}}{P_t^N},$$

$$\delta_N = \frac{\mu_F(n,\varepsilon)\overline{Z}_{F,t}}{P_t^N},$$

$$\gamma_F = \frac{m(f,e)P_t^N}{P_t(f)}.$$

Note that γ is the share of distribution costs contained in the consumer price of domestically produced goods; δ is the share of imported inputs costs contained in the consumer prices of domestically produced goods; δ_N is the share of imported inputs contained in the nontradables price and γ_F is the share of distribution margin contained in the consumer price of imported goods for final consumption. These parameters are observed empirically and can be obtained from data.

Following the literature, we calibrate $Z_{H,t}$ and $Z_{F,t}$ being equal to 1.[4,5]

Having information on $P_t(h)$ and $P_t(f)$, we can calculate the tradables price aggregator and the final consumer, P_t as well as their elasticities. The aggregate price

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[4]Effective wage per unit of productivity does not vary significantly across countries and sectors. In general, productivities levels differ but not when related to wage the dicrepancies are much less pronounced.

[5]To obtain the elasticity of the consumer price, P_t, we need information on the level of the price indexes as well. In the appendix, we present the details of the calculations.

for tradables and the overall aggregator are presented below:

$$P_t^T = \left[\alpha_T\big(P_t(h)\big)^{1-\phi_T} + \big(1-\alpha_T\big)\big(P_t(f)\big)^{1-\phi_T}\right]^{\frac{1}{1-\phi_T}},$$

$$P_t = \left[\alpha\big(P_t^T\big)^{1-\phi} + (1-\alpha)\big(P_t^N\big)^{1-\phi}\right]^{\frac{1}{1-\phi}}.$$

The elasticity of the CPI with respect to the exchange rate can be written as:

$$\eta^{P,e} = \alpha\left(\frac{P_t^T}{P_t}\right)^{1-\phi}\left[\alpha_T\left(\frac{P_t(h)}{P_t^T}\right)^{1-\phi}\eta^{P_t^H,e} + \big(1-\alpha_T\big)\left(\frac{P_t(f)}{P_t^T}\right)^{1-\phi}\eta^{P_t^F,e}\right]$$

$$+ (1-\alpha)\left(\frac{P_t^N}{P_t}\right)^{1-\phi}\eta^{P_t^N,e}.$$

Finally, we are able to disentagle the pass-through due to the imported inputs and due to the imported goods for final consumption, which we do in accordance to:

$$ERPT^{\text{ImpGoods}} = \alpha\left(\frac{P_t^T}{P_t}\right)^{1-\phi}\big(1-\alpha_T\big)\left(\frac{P_t(f)}{P_t^T}\right)^{1-\phi}\left(\frac{\eta^{P_t^F,e}}{\eta^{P,e}}\right),$$

$$ERPT^{\text{ImpInputs}} = \alpha\left(\frac{P_t^T}{P_t}\right)^{1-\phi}\left[\alpha_T\left(\frac{P_t(h)}{P_t^T}\right)^{1-\phi}\frac{\eta^{P_t^H,e}}{\eta^{P,e}}\right] + (1-\alpha)\left(\frac{P_t^N}{P_t}\right)^{1-\phi}\left(\frac{\eta^{P_t^N,e}}{\eta^{P,e}}\right).$$

To discuss the exchange rate pass-through and its channels one needs to look mainly at the distribution margins, the share of imports to tradables, the share of tradables in total consumption and the imported inputs share used in the production of tradables and non-tradables.

The distribution margin affects the exchange rate pass-through mainly by dampening the pass-through. Imported goods for final consumption are distributed locally using nontradable goods, hence, the more nontradables are necessary to reach the final consumers the less important becomes the exchange rate impact on prices. The distribution margin includes mostly costs that do not depend or depend in a low extent on the exchange rate (nontradables) and therefore it reduces the relative importance of imported goods and inputs in the final consumer price.[6]

The share of imports to tradables weights the impact of the prices of imports for final consumption. The higher this share the larger will be the impact of the exchange rate on final price of consumers. Imported inputs share used in production affects the final consumer price through the tradables produced domestically, mainly. A higher usage of imported inputs tends to increase the impact of exchange rates on prices. In

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[6]The domestically produced goods also incur in costs to reach the final consumption. In this case, the distribution margin, that depends mainly on nontradables, is a channel of transmission of impacts of the exchange rate to domestic prices. The higher the importance of this margin, the higher is the impact of $\eta^{P^{N,\epsilon}}$ on the elasticity of domestic goods.

a lower extent, it may affect the prices of nontradables depending on how large this share is.[7]

The share of tradables in total consumption is also relevant since it weights the prices of tradables on the price aggregator. A larger share of tradables leads to a higher impact of the exchange rate on final consumer prices. For the OECD countries alone, this component tends to be of similar magnitude, however, for developing economies the scenario might be different. The main difference arises because non-tradables are cheaper in these countries and as a result the non-tradables correspond to a smaller share of the consumption basket. In the next sections, we show how the estimates for the exchange rate pass-through change when we adjust this component and how the relative importance of the consumption and imported inputs channels may be affected.

3. Distribution Margins, Imported Inputs and the Composition of Consumption: Comparison

In this section, we present the comparison of data from some OECD countries and Brazil. We compare information on the distribution margins, the share of imports to tradables, the share of tradables in total consumption and the imported inputs share used in the production of tradables and non-tradables.

3.1 Distribution Margins

The distribution margins include the share corresponding to wholesalers and retailers and the share in transport and storage. In Brazil, for the average across industries, we observe an increase from 11.13% to 13.20% in the wholesalers and retailers' margins , while the margin of transport has not moved, going from 1.79% to 1.76%. (see Table B-2 in Appendix B—include the variation within industries). Hence, expenditures on wholesale and retail services correspond to the majority of these margins, following the patterns documented for advanced countries that ranged from 8 percent to 24 percent. When comparing the aggregate margins, Brazil is located in the bottom part, with at most 15 percent of aggregate margin, while the advanced economies show some variation between 15 to 25 percent.[8]

The distribution margin affects the exchange rate pass-through mainly by dampening the pass-through since it reduces the relative importance of imported goods and inputs in the final consumer price. Compared to the other countries listed, Brazil appears as having the lower average distribution margin being closer to Germany and Portugal. This tends to make the pass-through in Brazil to be higher than in other countries.

3.2 Imported inputs into Production and the Composition of Consumption

We measure the importance of imported inputs for final prices from the input-output tables available from the Brazilian Statistical Office (IBGE), for different industries.

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[7]For some countries, such as Portugal it may reach 14% of the costs of production whereas for the U.S. and Brazil reaches only 3%.

[8]Detailed information of distribution margins across industries is presented in the Appendix.

Table 1. Average Distribution Margins.

Country	Year	Average Distr. Margin
Australia	2000/2001	21.4
France	2000	19.4
Germany	2000	15.1
Portugal	1999	14.8
USA	1997	23.9
Brazil	2000	12.9

Source: Data for advanced economies obtained in Goldberg and Campa (2010). Data from Brazil obtained from input-output matrices from IBGE.

Imported inputs account for approximately 9% of the final prices, ranging from 9.16% to 9.46%. (or purchaser's prices) on average. The role of imported inputs varies significantly across industries accounting for larger shares in the Electronic equipment (38.5%) and Machines and Equipment (29.7%) industries, whereas much smaller shares for (0.03%) in the Iron industry.

In terms of share of imports to tradables and imported inputs usage, Brazilian numbers seem very close to the United States. Both countries have lower numbers than the countries of comparison: the share of imported goods for direct consumption relative to tradables reaches 20 percent for them whereas for Portugal it reaches more than 40 percent.

Even more pronounced pattern is observed with respect to the imported inputs used for production of tradables and nontradables. Both Brazil and the United States have the share of imported inputs accounting for 10 to 12 percent of total cost of tradables while Australia and Germany have 20 percent, France 29 percent and Portugal 37 percent. Similar pattern occurs in the production of nontradables with Brazil and the United States having only 3 percent of imported inputs. Hence, Brazil and the United States use low share of imported inputs and consume lower proportion of imported goods having lower indices of openness which is generally attributed to both countries being large economies.

A major difference occurs with respect to the share of tradable goods in the consumption basket. Brazil presents a high share of tradables and as consequence a low share of participation of nontradables in the consumption basket. Brazil has a 47 percent of tradables in the consumption basket in contrast to 25 percent of the United States. This is probably due to the low cost of nontradables in some countries such as Portugal and in emerging economies As nontradables goods depend in a low extent on imported inputs (or much lower than tradables), a low participation of nontradables in the consumption basket tends to make the response of final consumer prices to the exchange rate higher.

Hence, the comparison across countries of the composition of the consumption basket suggests that the exchange rate pass-through to the CPI in Brazil should be higher than in the other countries considered. This then could explain different levels of pass-through and not an evolution over time. On the other hand, the comparison of

Table 2. Composition of CPI.

Country	Year	Imports to Tradables	Tradables to Consumption	Share of Imported Inputs Tradables	Share of Imported Inputs Non-Tradables
Australia	2000/01	0.27	0.31	0.18	0.09
France	2000	0.24	0.38	0.2	0.08
Germany	2000	0.33	0.36	0.27	0.09
Portugal	1999	0.45	0.42	0.37	0.14
USA	1997	0.20	0.25	0.10	0.03
Brazil	2000/09	0.18	0.47	0.12	0.03

Source: Data for advanced economies obtained in Goldberg and Campa (2010). Data from Brazil obtained from input-output matrices from IBGE. The share of Imported Inputs are measured relative to costs (H) and (N), respectively.

the relative importance of imports for direct consumption suggests that Brazil should have a lower pass-through to the CPI once it consumes less of imported goods.

    This analysis of the consumption side is in general the only analysis considered when discussing the exchange rate pass-through to the CPI. As noted before, other channels may be relevant to this response of prices as it is the case of imported inputs used in the production.

    The numbers presented shed some light on although do not clarify the composition of this response. Brazil presents lower usage of imported inputs in its production which tends to reduce the impact of the exchange rate on domestically produced prices. This tends to reduce the impact of the exchange rate on the CPI. At the same time, Brazil consumes a low proportion of imported goods for final consumption which also lowers the response of the CPI. These two effects together indicate a low pass-through to consumer prices. However, the low consumption of non-tradables tends to increase the impact of consumption goods and imported goods as a result on the final consumer price. This tends to increase the response of prices to the exchange rate.

    The ultimate response of the CPI to movements in the exchange rate then depends on the relative importance of the consumption component of this response as well as on the imported inputs importance. Goldberg and Campa (2010) show that for the OECD countries , contrary to what the previous literature suggested, the imported inputs channel was more relevant than the consumption side. Using the comparison of patterns of data of Brazil and OECD countries as a motivation we show how the pass-through is affected when varying these numbers. We find a very different picture from the OECD countries and we disentagle the different channels. Finally, as a second exercise, we also analyze what affects the composition of this response.

4. Results

We first present in Table 3 the pass-through estimated and its components for the OECD countries[9] and for the case of Brazil. Although in terms of the CPI elasticity the

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[9]These calculations were already present in Goldberg and Campa (2010). Here, we recalculate them for the OECD countries, with very close results. We show them in this table for the sake of comparison with the Brazilian case.

pass-through of 14 percent is not far from the pass-through for the OECD countries, we see clearly that the composition of the pass-through is quite different.

For the OECD countries, the majority of the pass-through is accounted for by the imported inputs part, reaching 75 percent for Australia, 70–71 percent for France and Germany and 62 percent for Portugal. For Brazil around 51 percent of the pass-through comes from the consumption part.

For Brazil, the consumption of imports part is much more sensitive to the exchange rate. This result comes from the fact that although the import penetration ratio of imports is low (18 percent) the usage of imported inputs is also very low, reaching for domestic tradable goods 12 percent. This combined with the fact that distribution costs are low and that the participation of tradables is larger for Brazil imply the high participation of the consumption side on the total pass-through.

If one compares only the US and Brazil, the differences between the two countries are the share of tradables in consumption (Table 2) and the distribution margin (Table 1). Brazil consumes a larger share of tradables, which should increase the pass-through if compared to the US and that is what we observe in fact. At the same time, the composition of the pass-through differs significantly. This suggests that the share of tradables in the consumption basket is relevant to determine the pass-through to the CPI even in the data.[10]

In this section, we exploit in detail the possible sources for these differences and the role of each parameter in determining the pass-through and its components.

To analyze and disentagle the relevance of each channel of transmission of the exchange rate shocks we proceed by selecting two scenarios and making some parameters variations to assess the response of the exchange rate pass-through and its decomposition.

The first scenario is based on Portugal which is one of the OECD countries that presented the highest pass-through. We, then, change parameters one at a time to see how the pass-through and its components are affected. Table 4 presents the results.

Table 3. Composition of CPI Elasticity.

Country	Year	CPI Elasticity	Imported Inputs	Consumption of Imports
Australia	2000/01	0.17	75	25
France	2000	0.19	71	29
Germany	2000	0.21	70	30
Portugal	1999	0.33	62	38
USA	1997	0.08	59	41
Brazil	2000/09	0.14	49	51

Source: Data for advanced economies obtained in Goldberg and Campa (2010). Data from Brazil obtained from input-output matrices from IBGE. This table reports the results when the elasticity of substitution is θ equals 10.

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[10]It is worth noticing that the prediction is for this share to decrease in the next few years in Brazil, which should reduce the pass-through to the CPI as well it should alter its composition—the relative importance of tradables being reduced it reduces the importance of foreign goods for conusmption, increasing the relative importance of imported inputs.

Table 4. Composition of CPI Elasticity.

Country	Year	CPI Elasticity	Imported Inputs	Consumption of Imports
Australia	2000/01	0.21	0.81	0.19
France	2000	0.21	0.75	0.25
Germany	2000	0.24	0.75	0.25
Portugal	1999	0.36	0.65	0.35
USA	1997	0.09	0.65	0.35
Brazil	2000/09	0.15	0.55	0.45

Source: Data for advanced economies obtained in Goldberg and Campa (2010). Data from Brazil obtained from input-output matrices from IBGE. This table reports the results when the elasticity of substitution is θ equals 4.

Table 5. Sensitivity Analysis – High Exchange Rate Pass-Through.

	Actual	$\Delta\alpha$	$\Delta\alpha_t$	$\Delta\delta_h + \Delta\delta_n$
α	0.42	0.20	0.42	0.42
$(1 - \alpha_t)$	0.45	0.45	0.30	0.45
δ_n	0.14	0.14	0.14	0.03
δ_h	0.37	0.37	0.37	0.20
γ	0.148	0.148	0.148	0.148
η_P	0.36	0.26	0.33	0.23
% Imported Inputs	0.52	0.69	0.65	0.30
% Imported Consumption	0.48	0.31	0.35	0.70

Source: Data for advanced economies obtained in Goldberg and Campa (2010). Data from Brazil obtained from input-output matrices from IBGE.

Notes: The first column reports the parameters and results for the benchmark case (actual data) which in this case is Portugal. The remaining columns report sensitivity analysis when changing parameters from the benchmark. Parameters: α corresponds to the share of consumption of tradables; $(1 - \alpha_t)$ is the share of consumption of imported goods in the tradable goods; δ_h and δ_n are the share of imported inputs used in production of domestic goods and non-tradables, respectively; γ is the margin of distribution.

The reduction of the importance of the tradables in the consumption basket (Column 2) leads to a decrease in the exchange rate pass-through to final consumer prices, as expected. At the same time, most of the pass-through in this case comes from the imported inputs channel, since the consumption of tradables is less important, increasing its importance by more than 10 percentage points.

A decrease in the importance of foreign goods for final consumption (Column 3) increases the importance of imported inputs for the pass-through, although keeping the overall pass-through close to original level, 0.33 versus 0.36. The importance of imported inputs increases by a large amount, by almost 15 percentage points.

However, when there is a reduction in the use of domestic imported inputs (Column 4) the role of imported inputs accounting for the pass-through is very diminished. The sensitivity of the pass-through to these parameters seems very large. The imported inputs part accounts for only 30 percent of the total pass-through in this case. Overall, the total pass-through also decreases for about 10 percentage points compared to the original level, but it is close to the level obtained in Column 2.

The second scenario has as starting point the calibrations for France since it was the country that presented the highest importance of imported inputs for the pass-through. Table 6 shows the results.

The share of tradables in the consumption basket affects the pass-through importantly and the importance of imported inputs. When calibrating this share to the levels of Portugal and Brazil (from 30 to 47 percent), for instance, the pass-through increases by 6 percentage points whereas the decomposition of it is not as much affected. (see Table 5, Column 2).

On the other hand, if the share of imported goods (import penetration) for final consumption is increased by a considerable amount, close to Brazilian standards (from 24 to 55 percent), the total pass-through is affected by 4 percentage points, but the relative importance of the imported inputs channel is very much reduced, going from 73 percent (Column 1) to 54 percent in this scenario (Column 3). Hence, a dramatic increase in the share of imported goods—around 20 percentage points—increases the overall pass-through by only 4 percentage points suggesting that the overall pass-through is not very sensitive to the import penetration ratio corroborating what was obtained for the first scenario.

In the last columns, columns 4 to 6, we analyze the impact of the usage of imported inputs for the pass-through. A decrease in the usage of imported inputs in the tradables sector by 9 percentage points (Column 4) reduces the total pass-through in 2 points and decreases the importance of inputs by 3 points, maintaining the imported inputs channel as responsible for more than 70 percent of total pass-through, suggesting a low impact of this channel in this context.

A decrease in the usage of imported inputs in the nontradable sectors (Column 5) by 7 percentage points decreases the pass-through in 6 percentage points and decreases the participation of the imported inputs channel from 73 percent (Column 1) to 62 percent (Column 5). This considerable impact of the usage of foreign inputs in the nontradable sector in contrast to what occurs in the tradable sector arises due to the

Table 6. Sensitivity Analysis – High Share Imported Inputs.

	Actual	$\Delta\alpha$	$\Delta\alpha_t$	$\Delta\delta_h$	$\Delta\delta n$	$\Delta\delta_h + \Delta\delta_n$
α	0.30	0.47	0.30	0.30	0.30	0.30
$(1 - \alpha t)$	0.24	0.24	0.55	0.24	0.24	0.24
δ_n	0.10	0.10	0.10	0.10	0.03	0.03
δ_h	0.29	0.29	0.29	0.20	0.29	0.20
γ	0.194	0.194	0.194	0.194	0.194	0.194
η_P	0.21	0.27	0.25	0.19	0.15	0.13
% Imported Inputs	0.73	0.65	0.54	0.70	0.62	0.57
% Imported Consumption	0.27	0.35	0.46	0.30	0.38	0.43

Source: Data for advanced economies obtained in Goldberg and Campa (2010). Data from Brazil obtained from input-output matrices from IBGE.

Notes: The first column reports the parameters and results for the benchmark case (actual data) which in this case is Portugal. The remaining columns report sensitivity analysis when changing parameters from the benchmark. Parameters: α corresponds to the share of consumption of tradables; $(1 - \alpha_t)$ is the share of consumption of imported goods in the tradable goods (import penetration ratio); δ_h and δ_n are the share of imported inputs used in production of domestic goods and non-tradables, respectively; γ is the margin of distribution.

additional impact of the nontradable in the distribution margins. In this scenario, the elasticity of the nontradable prices to the exchange rate is very much affected and this impacts the overall price movements through the distribution margin, which in this case is non-negligeable (19.4). Hence, in this context, considering the level of distribution margin for France of 19.4 percent, the nontradable sector has an important role in affecting the total pass-through.

When the usage of imported inputs in both sectors is reduced to the US levels (Column 6), total pass-through is reduced by 8 percentage points, almost by half. The relevance of the imported inputs in accounting for the total pass-through also decreases by large, reaching only 57 percent vis-a-vis 73 percent originally, although this part still responds for more than half of the pass-through.

5. Additional Exercises

In this section, we perform two additional exercises to analyze how the pass-through is affected by diverse economic environments. Brazil and the United States are similar with respect to several aspects sharing the fact that they are considered closed economies when compared to others, not presenting large degrees of openness, which is in general due to the size of the domestic consumer markets. For this reason, we evaluate how changes in the characteristics of the US economy affect the total pass-through as well as the relative importance of imported inputs for this pass-through. In particular we look for which component of the pass-through may be responsible for the difference in the calculated pass-through between the two countries.

The results for the USA are presented in Table 7. The first column shows the actual data for the US and the other columns correspond to changes in specific parameters as indicated at the top of each column.

If we change only the distribution margin by imputing the data for Brazil (13%, Column 2), reducing it by almost half, we observe an impact of 2 percentage points

Table 7. Sensitivity Analysis — USA Parameters.

	Actual	$\Delta\gamma$	$\Delta\alpha$	$\Delta\delta_h$	$\Delta\delta_h + \Delta\delta_n$
α	0.25	0.25	0.47	0.25	0.25
$(1 - \alpha_t)$	0.20	0.20	0.20	0.20	0.20
δ_n	0.03	0.03	0.03	0.10	0.10
δ_h	0.12	0.12	0.12	0.12	0.29
γ	0.24	0.129	0.24	0.24	0.24
η_P	0.08	0.10	0.13	0.15	0.20
% Imported Inputs	0.58	0.51	0.48	0.76	0.80
% Imported Consumption	0.41	0.49	0.52	0.24	0.20

Source: Data for advanced economies obtained in Goldberg and Campa (2010). Data from Brazil obtained from input-output matrices from IBGE.

Notes: Parameters: α corresponds to the share of consumption of tradables; $(1 - \alpha_t)$ is the share of consumption of imported goods in the tradable goods; δ_h and δ_n are the share of imported inputs used in production of domestic goods and non-tradables, respectively; γ is the margin of distribution.

on the total pass-through to final prices but a more pronounced effect on the relative importance of imported inputs versus consumption of imported goods.

If we change only the share of tradables in the consumption basket, by almost doubling it, this decreases the relevance of imported inputs significantly, going from 58 percent to 48 percent (Column 1 and Column 3), since the consumption of foreign goods becomes more important in total consumption. In this case, however, total pass-through is very much affected, it goes from 8 percent to 13 percent, an increase of 5 percentage points.

If there is an increase in the usage of imported inputs in tradables and nontradables (Columns 4 and 5), the relative importance of imported inputs increases by a large amount as expected (from 58 percent to 76 and 80 percent, respectively, and the total pass-through also increases significantly, going from 8% to 15% or 20%. (Column 1 to 4 and 5).

For Brazil, results are in Table 8. Contrary to the results for the OECD countries, the consumption of foreign goods accounts for slightly more than 50 percent of the total pass-through. Cutting by almost half the share of tradables (to US levels) reduces the total pass-through by 5 percentage points but increases the importance of imported inputs by 9 percentage points, making imported inputs respond for 58 percent of total pass-through.[11]

Changing the distribution margin from 13 percent to 20 percent does not affect much the results, it does not affect the total pass-through (Columns 1 and 4) neither its composition. However, note that this was not the case for the US. As it can be seen, the distribution margin had a much larger impact on the composition of the pass-through of around 8 percentage points.

In terms of total pass-through what really seems to make a difference is the usage of imported inputs—more than doubling the usage (to 29 percent (close to Germany levels) causes the pass-through to go from 14 percent to 26 percent. The relative

Table 8. Sensitivity Analysis – Brazil Parameters.

	Actual	$\Delta\alpha$	$\Delta\delta_h + \Delta\delta_n$	$\Delta\gamma$	$\Delta\delta_h + \Delta\delta_n + \Delta\gamma$
α	0.47	0.25	0.47	0.47	0.47
$(1-\alpha_t)$	0.18	0.18	0.18	0.18	0.18
δ_n	0.03	0.03	0.10	0.03	0.10
δ_h	0.12	0.12	0.29	0.12	0.29
γ	0.13	0.13	0.13	0.20	0.20
η_P	0.14	0.09	0.26	0.14	0.26
% Imported Inputs	0.49	0.58	0.70	0.52	0.49
% Imported Consumption	0.51	0.42	0.30	0.48	0.51

Source: Data for advanced economies obtained in Goldberg and Campa (2010). Data from Brazil obtained from input-output matrices from IBGE.

Notes: Parameters: α corresponds to the share of consumption of tradables; $(1-\alpha_t)$ is the share of consumption of imported goods in the tradable goods; δ_h and δ_n are the share of imported inputs used in production of domestic goods and non-tradables, respectively; γ is the margin of distribution.

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[11]Actually, Column 2 of Table 8 is almost the same as Column 2 of Table 7, the only difference is the $(1-\alpha_t)$ component which is 0.82 for Brazil and 0.80 for the US.

importance of imported inputs, as expected, becomes very large going from 49 percent to 70 percent. Similar results, in the same direction and magnitude, were obtained for the USA.

Overall, for Brazil, we observe that the distribution margin does not have a large impact neither on the total pass-through nor on the relative importance of each component for the pass-through.

6. Decomposing the Exchange Rate Pass-through – Components

The impact of the exchange rate on the prices of nontradables depends crucially on the importance of imported inputs used in the production. Hence, for Brazil and the United States we have a low pass-through to prices while for Portugal the elasticity increases 5 times.

The response of domestically produced tradable goods to movements in the exchange rate is low due to reduced participation of imported inputs in their production, therefore, we observe a pass-through similar to the United States.

We see that in this model the pass-through for the foreign goods is very sensitive to the distribution margin - if there were no distribution costs the pass-through would be complete, whereas for Brazil is around 83% (86%) and for the US is of 70% (74%). We can also note that the pass-through for Brazil is 13 percentage points higher than for the US, whereas the distribution margin corresponds to 13% for Brazil and 24% for the US.

It is worth noticing that regarding the parameters that affect $P_t(h)$, i.e., γ, δ_h and $\eta^{P^N,e}$, Brazil and the US differ only by γ, which is the distribution margin parameter. The pass-through to domestically produced prices is very similar to Brazil and the US suggesting that the distribution margin does not affect this elasticity in a large extent.

These numbers combined with the fact that tradables account for a significantly larger share of the consumption basket in Brazil results in a high response of the CPI to shocks in the exchange rate, as it becomes evident in Table 9.

Table 9. Nontradable Goods Sector.

Country	Year	Share of Imported Inputs Relative to costs	$\eta^{P^N,e}$ $\theta = 4$	$\eta^{P^N,e}$ $\theta = 10$
Australia	2000/01	0.09	0.12	0.10
France	2000	0.08	0.11	0.09
Germany	2000	0.09	0.12	0.10
Portugal	1999	0.14	0.19	0.15
USA	1997	0.03	0.04	0.03
Brazil	2000/09	0.03	0.04	0.03

Source: Data for advanced economies obtained in Goldberg and Campa (2010). Data from Brazil obtained from input-output matrices from IBGE.

Table 10. Tradable Goods Sector.

Country	Year	Share of Imported Inputs Relative to costs	$\eta^{P^H,e}$ $\theta = 4$	$\eta^{P^F,e}$ $\theta = 4$
Australia	2000/01	0.18	0.31	0.52
France	2000	0.20	0.31	0.60
Germany	2000	0.27	0.43	0,53
Portugal	1999	0.37	0.57	0.64
USA	1997	0.10	0.14	0.69
Brazil	2000/09	0.12	0.17	0.83

Source: Data for advanced economies obtained in Goldberg and Campa (2010). Data from Brazil obtained from input-output matrices from IBGE.

Table 11. Tradable Goods Sector.

Country	Year	Share of Imported Inputs Relative to costs	$\eta^{P^H,e}$ $\theta = 10$	$\eta^{P^F,e}$ $\theta = 10$
Australia	2000/01	0.18	0.25	0.59
France	2000	0.20	0.25	0.67
Germany	2000	0.27	0.34	0,60
Portugal	1999	0.37	0.47	0.69
USA	1997	0.10	0.12	0.74
Brazil	2000/09	0.12	0.14	0.86

Source: Data for advanced economies obtained in Goldberg and Campa (2010). Data from Brazil obtained from input-output matrices from IBGE.

7. Conclusion

This work analyzes the channels through which the exchange rate affects final consumer prices focusing in the comparison of advanced countries and emerging economies. We find that a key aspect to the exchange rate pass-through is the relative importance of tradables in the consumption basket as well as the share of imported inputs.

To illustrate we can compare Brazil to the US. Both countries are similar in many aspects, with the usage of imported inputs and the share of imported goods of very close magnitude. The differences arise only with respect to the share of tradables in the consumption basket with Brazil having a larger share and the distribution margin with US having 24 percent versus Brazil with 13 percent.

The higher share of tradables in the consumption basket of Brazil may reflect the fact that non-tradables are usually cheaper in developing economies. Hence the share of non-tradeables is smaller in these countries with Brazil having a share of non-tradables equal to 53 percent versus around 75 percent for the US. This has a direct impact on the exchange rate pass-through to final prices, η_P and also to the composition of this pass-through.

If you calibrate the model to the US parameters but imputes the share of tradables of Brazil, the pass-through increases by 5 percentage points. Also, the composition of

this pass-through is largely affected having the relative importance of imported inputs gone from 58 percent to 48 percent.

This result comes from the combination that although the import penetration ratio of imports is low (18 percent) the usage of imported inputs is also very low, reaching for domestic tradable goods 12 percent. This combined with the fact that distribution costs are low and that the participation of tradables is larger for Brazil imply the high participation of the consumption side on the total pass-through.

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Appendix A.

In this appendix, we show the expressions for the price aggregators which enter the elaticities with respect to the exchange rate presented in the text.

$$P_t^N = \frac{\theta}{\theta - 1}\left[\bar{Z}_N + \mu(n, e)\bar{Z}_F\right],$$

$$P_t(h) = \frac{\theta}{\theta - 1}\left[\bar{Z}_H + m(h, e)P_t^N + \mu(n, e)\bar{Z}_F\right],$$

$$P_t(f) = \frac{\theta}{\theta - 1}\left[\bar{Z}_F + m(f, e)P_t^N\right].$$

First, solve for P_t^N. From the expression below, we know δ_N,

$$\delta_N = \frac{\mu_N(n, e)\bar{Z}_F}{P_t^N}$$

$$\delta_N P_t^N = \mu_N(n, e)\bar{Z}_F.$$

Substituting back into the expression for P_t^N:

$$P_t^N = \frac{\theta}{\theta - 1}\left[\bar{Z}_N + \delta_N P_t^N\right]$$

$$P_t^N = \frac{\theta}{\theta(1 - \delta_N) - 1}\bar{Z}_N.$$

Final Consumer Domestically produced prices:

$$P_t(h) = \frac{\theta}{\theta - 1}\left[\bar{Z}_{H,t} + \mu(h, e)\bar{Z}_{F,t} + m(h, \epsilon)P_t^N\right]$$

$$\gamma = \frac{m(h, e)P_t^N}{P_t(h)}$$

$$\delta = \frac{\mu(h, \epsilon)\bar{Z}_F}{P_t(h)}$$

$$\gamma P_t(h) = m(h, e)P_t^N$$

$$\delta P_t(h) = \mu(h, \epsilon)\bar{Z}_F$$

Substituting back into the expression for $P_t(h)$, we obtain that:

$$P_t(h) = \frac{\theta}{\theta - 1}\left[\bar{Z}_H + \delta P_t(h) + \gamma P_t(h)\right]$$

$$P_t(h) = \frac{\theta}{\theta(1 - \gamma - \delta) - 1}\bar{Z}_H.$$

Final Consumer Foreign produced prices

$$P_t(f) = \frac{\theta}{\theta - 1}\left(\bar{Z}_F + m(f,e)P_t^N\right)$$

$$\gamma_F = \frac{m(f,e)P_t^N}{P_t(f)}.$$

Rearranging:

$$\gamma_F P_t(f) = m(f,e)P_t^N$$

$$P_t(f) = \frac{\theta}{\theta - 1}\left(\bar{Z}_F + \gamma_F P_t(f)\right)$$

$$P_t(f) = \frac{\theta}{\theta\left(1 - \gamma_F\right) - 1}\bar{Z}_F.$$

Appendix B. Distribution Margins

Appendix B.1 Distribution Margin Elasticities

We estimate the distribution margins elasticity to the exchange rates from the industry level data we have for Brazil. As previously discussed, the distribution margins seem to play a relevant role in dampening the response of final consumer prices to the exchange rate. However, the reaction of the distribution margins to movements in the exchange rate may affect this response: if the margin is reduced during depreciation, for instance, the pass-through is magnified.

We then construct a panel by industry and for a ten-year period and we estimate the following regression:

$$\Delta m_t^s(e) = \alpha_t + \alpha_s + \beta \Delta \epsilon_t^s + v_t,$$

where Δ denotes the first difference of the variable in logs; ϵ_t^c corresponds to the exchange rate, here we consider effective exchange rate, sectoral and nominal exchange rates; $m_t^c(\cdot, e)$ the margin corresponds to sectoral margins of distribution obtained from the input-output matrix.

Hence, we have a panel of different industries from 2000 to 2009. Year fixed effects (α_t) and industry fixed effects (α_s) were included.

The results for this regression are presented in Table B-1. We consider the real exchange rate which allows us to compare with the results for the advanced countries.

Table B-1. Estimation Exchange Rate Pass-Through for Brazil.

	Nominal Exch. Rate	Nominal Exch. Rate	Real Exch. Rate	Real Exch. Rate	Sectoral Exch. Rate	Sectoral Exch. Rate
Elasticity	−0.14*	−0.14*	−0.26*	−0.25*	−0.20*	−0.19*
t-stat	−4.60	−4.84	0.03	0.04	−5.00	−4.43
Industry Fixed Effects	No	Yes	No	Yes	No	Yes
R^2	0.01	0.11	0.07	0.15	0.02	0.11
No. Obs.	62	62	62	62	62	62

Source: Data for advanced economies obtained in Goldberg and Campa (2010). Data from Brazil obtained from input-output matrices from IBGE.

Our results indicate that the reaction of the distribution margin is between 14 to 25 percent of the change in the exchange rate. With this, we could investigate the impact on the exchange rate. In the exercises presented we assume that this response is zero.

Appendix B.2   Distribution Margins and Imported Inputs Shares Across Industries

In this Appendix, we present the distribution margins and the imported input shares for Brazil across sectors. We present the average, the maximum and the minimum values for each industry.

Table B-2. Distribution margins across sectors and imported inputs use.

	Distribution Margin			Imported Input Share		
	Avg	Max	Min	Avg	Max	Min
Coffee (bean)	0.00	0.00	0.00	10.30	8.90	12.30
Sugar cane	0.00	0.00	0.00	0.00	0.00	0.00
Rice	1.50	0.20	5.50	9.40	7.70	11.70
Wheat (grain)	60.40	50.30	77.40	5.90	4.30	7.60
Soy bean	1.20	0.10	2.80	17.60	14.00	20.60
Cotton	0.00	0.00	0.10	2.10	1.50	2.80
Corn	0.90	0.40	2.40	10.90	8.70	14.70
Other agriculture products	3.70	3.40	4.20	13.60	12.00	16.10
Metal ores (Iron)	0.00	0.00	0.10	3.70	2.90	4.60
Other mining products	25.20	20.60	31.80	7.00	6.20	8.50
Crude petroleum and natural gas	25.30	20.90	31.40	0.00	0.00	0.00
Coal and lignite; peat	83.60	73.10	86.10	0.00	0.00	0.00
Non-metal mining products	4.60	4.00	5.20	16.60	15.40	18.40
Basic Metals	3.60	1.40	8.50	3.20	2.90	3.40
Steel Products	6.20	3.80	9.90	4.50	3.90	5.50
Fabricated basic metal products	18.60	15.10	22.20	2.30	2.10	2.40
Other Fabricated metal products	6.40	5.20	7.10	7.00	6.40	7.40
Machinery and Equipment	29.70	25.60	36.50	11.90	10.60	13.00
Transport Equipment	8.80	7.40	12.10	10.90	10.00	11.60
Electrical machinery	20.00	15.10	29.90	12.80	10.70	14.50
Electronic Equipment	38.50	36.10	41.10	15.20	12.70	19.80
Motor vehicles	9.40	5.50	13.70	14.20	12.70	15.80
Other motor vehicles	18.90	15.50	23.50	8.50	7.90	9.00
Wood, wood products and furniture	1.70	1.50	2.00	15.60	13.30	19.20
Pulp. paper and paper products	4.40	3.70	5.50	11.90	10.10	15.00
Rubber products	16.00	13.60	19.10	21.90	18.90	25.90
Chemicals and chemical products	21.90	18.90	26.50	10.50	8.50	12.90
Coke and refined petroleum	27.50	23.60	32.30	4.50	3.30	5.70
Other chemicals	20.00	17.50	22.60	6.70	5.10	8.40
Pharmaceuticals	21.70	19.00	26.20	24.30	22.90	27.50
Plastic Products	7.80	7.10	9.10	8.20	6.00	10.30
Natural Fibers	7.70	3.80	15.60	8.10	5.50	11.40
Natural Textiles	3.50	1.20	8.00	16.60	14.70	21.00
Synthetic Fibers	23.20	4.60	47.00	5.50	4.20	7.30
Synthetic Textile	19.60	15.10	22.00	13.90	10.80	16.40
Other Textile	5.40	4.10	7.40	12.90	10.40	17.30
Wearing apparel	2.20	1.30	3.70	25.50	23.60	28.30
Weather and Weather products	3.80	2.50	5.40	14.00	11.80	18.10
Food Products	2.72	1.88	4.10	13.95	12.54	16.26
Beverages	4.00	3.40	4.80	20.90	17.60	25.50

Source: Data for Brazil obtained from input-output matrices from IBGE (2000–2009).