# Domestic Wedges and the (In)Sensitivity of CPI to Exchange Rates

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**Abstract**

Earlier literature has examined the role of domestic wedges in limiting the pass-through of exchange rates to consumer prices, highlighting factors such as distribution costs, variable markups, and nominal rigidities. Using granular data from Chile, I quantify the impact of these domestic wedges, accounting for input-output linkages and sectoral heterogeneity. I find that domestic wedges reduce the sensitivity of the consumer price index (CPI) to exchange rate fluctuations by 60% relative to an economy that abstracts from them. Among these wedges, distribution costs alone account for a 35% reduction in CPI sensitivity, while variable markups and nominal rigidities contribute 20% and 15%, respectively. Taken together, these domestic wedges dampen CPI sensitivity more than the incomplete pass-through of exchange rates into import prices. Moreover, eliminating heterogeneity in these wedges across sectors increases the CPI's response by 20% relative to the full model, as import exposure and consumption shares are positively correlated with the strength of domestic wedges. Ignoring this heterogeneity leads to misidentifying the key sectors through which exchange rate fluctuations affect consumer prices. Contrary to prior findings, I show that most of the CPI sensitivity stems from changes in the prices of imported consumption goods. This result arises, in part, because domestic wedges weaken the amplification role of input-output linkages.

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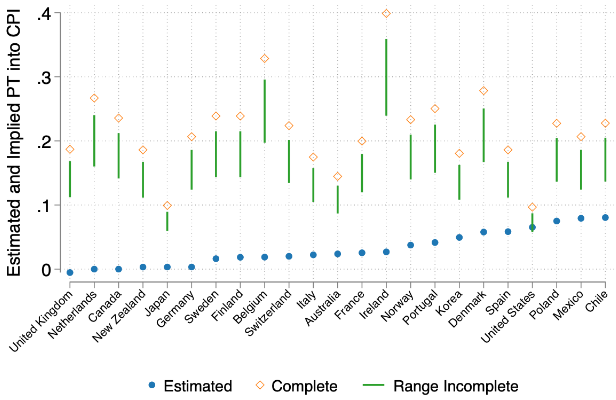
A well-documented stylized fact in international economics is the low sensitivity of inflation to exchange rate fluctuations. This phenomenon has far-reaching implications, ranging from the design of optimal monetary policy in open economy to the dynamics of domestic inequality.[1] Figure 1 illustrates that exchange rate fluctuations are only weakly transmitted to domestic prices, with an average pass-through rate of just 0.032 percentage points across OECD countries during the period 1990–2019. Remarkably, the sensitivity of the CPI to exchange rate fluctuations is, on average, four to six times lower than what the import content of consumption baskets would predict, even after accounting for the incomplete pass-through of exchange rate changes into import prices. This paper provides extensive empirical evidence and calibration results to show that the limited responsiveness of domestic prices primarily arises from domestic wedges –such as distribution costs, variable markups, and nominal rigidities – rather than from a muted response of import prices to exchange rate movements.

Figure 1: Estimated and Implied CPI Sensitivity




**Note:** The figure compares the estimated CPI sensitivity to a 1% depreciation in the exchange rate with the average implied sensitivity across a set of OECD countries. The blue circle represents the CPI sensitivity to exchange rate fluctuations estimated at the quarterly level over the period 1990–2019 (see Appendix B.4 for estimation details). The orange diamond depicts the implied CPI sensitivity, calculated as the sum of the share of imported final consumption goods and the share of imported inputs used in the production of domestic final consumption goods. The green line illustrates the range of implied CPI sensitivity when accounting for incomplete pass-through into import prices. The upper and lower bounds reflect assumptions of 90% and 60% incomplete pass-through, respectively. Exchange rate and CPI data are sourced from the IMF, while the share of imports in the final consumption basket is computed using annual input-output tables from the OECD. Implied sensitivities are averaged over the 1990–2019 period.

I begin by developing an analytical framework to quantify the expected sensitivity of the CPI to exchange rate fluctuations, accounting for domestic wedges and the low responsiveness of import prices to exchange rate movements (Goldberg and Campa, 2010; Nakamura and Zerom, 2010). The CPI's sensitivity arises from three channels: direct exposure through the

[1] A key aspect of monetary policy trade-offs in open economies is determining which inflation measure is most relevant for policymakers, a decision shaped by the extent of exchange rate pass-through to domestic prices (Mishkin, 2008; Benigno and Benigno, 2003; Corsetti et al., 2010). Similarly, exchange rate fluctuations influence domestic redistribution as firms and consumers rely on varying mixes of domestic and imported goods (Cravino and Levchenko, 2017a; Jaravel, 2021). Understanding the relationship between the CPI and exchange rates, as well as the factors that shape it, also has important implications for the transmission of international shocks, the comovement of international business cycles, and the dynamics of external imbalances (Corsetti et al., 2008; Backus and Smith, 1993).

consumption of imported goods, indirect exposure via the use of imported intermediate inputs in the production of domestic goods, and domestic input-output linkages. However, domestic wedges create a disconnect between the border price of imports and producers' costs, on the one hand, and the domestic retail price, on the other, dampening the CPI's response to exchange rate fluctuations. Distribution costs – including transportation, insurance, and wholesaling – constitute a significant share of retail prices, reducing the weight of import border prices and domestic producers' costs in the CPI (Goldberg and Campa, 2010; Burstein et al., 2003). Additionally, variable markups further limit pass-through, as domestic firms absorb part of the changes in their marginal costs by adjusting their markups rather than fully passing the changes onto prices (Klenow and Willis, 2016; Amiti et al., 2019). Finally, nominal rigidities in domestic pricing further dampen the responsiveness of retail prices, as firms face frictions in adjusting their prices to changes in marginal costs (Nakamura and Steinsson, 2008).

I apply the theoretical framework to the case of Chile during the period 2008–2019, leveraging highly disaggregated data sources to discipline each margin of the model and assess the role of domestic wedges. To account for both direct and indirect exposure to imports and capture the transmission of exchange rate changes through the domestic production network, I construct a detailed, product-level (180×180) input-output table for the Chilean economy. Each domestic wedge is calibrated using micro-level data, allowing for heterogeneity at the product level. Distribution costs are computed for each product as the difference between producer and basic prices, disaggregated by origin (domestic vs. imported) and use (intermediate vs. final consumption). Markups and their elasticities are estimated using firm-level data under the assumption that demand follows the Kimball specification outlined in Klenow and Willis (2016). Nominal rigidities are calibrated at the product level using micro-level estimates of price adjustment frequencies from Pasten et al. (2024). Finally, I utilize the universe of import transaction data to calibrate the pass-through of exchange rate fluctuations into import prices, accounting for heterogeneity across product categories.

The main quantitative result demonstrates that domestic wedges, both individually and jointly, account for the majority of the low sensitivity of the CPI to exchange rate fluctuations. Compared to a counterfactual economy where exchange rate changes are fully passed through to both import and domestic prices, the presence of domestic wedges reduces the CPI's sensitivity to exchange rates by 60%. By contrast, the incomplete pass-through of exchange rate fluctuations into import prices accounts for a 40% reduction in CPI sensitivity. Each domestic wedge contributes significantly to this insensitivity. Distribution costs alone reduce the CPI's sensitivity by approximately 35%, while variable markups and nominal rigidities account for reductions of 20% and 15%, respectively, as they primarily affect the sensitivity of domestic final goods prices. The fully calibrated benchmark model successfully replicates the untargeted estimated sensitivity of the CPI to exchange rate fluctuations. This result underscores the importance of jointly modeling domestic wedges and border price insensitivity, while also validating the calibration strategy employed.

Product-level heterogeneity in sensitivity to exchange rate fluctuations further dampens the

CPI's overall responsiveness relative to the fully calibrated benchmark model. The model is calibrated at the product level, with sensitivity varying across products due to heterogeneity in domestic wedges, import exposure, consumption shares, and import price sensitivity. Neutralizing these sources of heterogeneity by setting each wedge to its average value across products increases the CPI's response by 20% relative to the benchmark, primarily driven by a 60% increase in the sensitivity of domestic goods prices. While joint heterogeneity across all wedges dampens CPI sensitivity, I find that heterogeneity in individual wedges can either amplify or dampen it. Specifically, removing heterogeneity in distribution costs and import price dynamics reduces CPI sensitivity by 31% and 7%, respectively, aligning with the dampening effects of joint heterogeneity. In contrast, heterogeneity in nominal rigidities and variable markups amplifies CPI sensitivity by 4% and 1%, respectively. For variable markups, sectoral differences play a larger role than within-sector heterogeneity in the use of imported inputs across firms, contributing 0.65% and 0.3% to the amplification, respectively.

In analyzing the effects of cross-product heterogeneity on the CPI's sensitivity to exchange rate fluctuations, I uncover a range of empirical findings with broad relevance, shedding light on the aggregate composition effects. For example, the share of imported inputs used in the production of domestic goods—an indicator of domestic goods' exposure to exchange rate fluctuations—is positively correlated with both the frequency of price adjustment and the pass-through induced by variable markups within a sector. As a result, sectors that play a larger role in determining the overall sensitivity of the CPI are also those that transmit cost shocks more strongly into their prices. This correlation explains why removing heterogeneity in these two domestic wedges reduces the aggregate sensitivity of the CPI. Similarly, the share of imported inputs is negatively correlated with the border price sensitivity of imported inputs but positively correlated with the share of distribution costs in retail prices. These relationships clarify why abstracting from heterogeneity in border price sensitivity and distribution costs amplifies the CPI's sensitivity. Although these findings are derived from the empirical application to Chile, they serve as a robust diagnostic test of the empirical framework, demonstrating its ability to capture key economic relationships underlying the aggregate sensitivity of the CPI.

Accounting for the presence and heterogeneity of domestic wedges has significant implications for identifying the products or groups of products most relevant to the overall sensitivity of the CPI. Unlike previous studies, I find that domestic wedges amplify the importance of direct exposure – the presence of imported goods in the final consumption basket – as the dominant channel for CPI sensitivity. This contrasts with earlier quantification exercises, which suggest that direct exposure and indirect exposure, arising from the use of imported intermediate inputs in domestic production, are equally important (Goldberg and Campa, 2010). My results reveal that domestic wedges dampen the spillover effects of the domestic input-output network, thereby reducing the role of indirect import exposure. Additionally, the identity of the products most relevant to CPI sensitivity shifts significantly when domestic wedges and their heterogeneity are considered. Relative to a frictionless neoclassical benchmark or a model without wedge heterogeneity, product rankings change substantially, with some products moving by as many as 80 positions. The identity effect strongly depends on the wedges included in the model, underscoring the importance of carefully accounting for all dimensions of heterogeneity when assessing the transmission of exchange rate fluctuations and identifying the products most critical to CPI sensitivity.

**Related Literature** This paper contributes to the literature on the low sensitivity of domestic inflation to exchange rate fluctuations. Several studies have examined the role of domestic wedges. At the macroeconomic level, Goldberg and Campa (2010) quantify CPI sensitivity while accounting for import exposure and distribution costs across OECD economies. Burstein et al. (2003) and Corsetti and Dedola (2005) similarly show that distribution costs dampen the response of import and consumer prices to exchange rate changes. Bacchetta and Van Wincoop (2003) and Atkeson and Burstein (2008) focus on firms' optimal pricing strategies and market structure. Building on these contributions, I integrate key wedges into a unified theoretical framework and demonstrate their quantitative relevance.

At the industry level, Goldberg and Verboven (2001) and Hellerstein (2004) decompose the sources of incomplete pass-through into non-traded costs and markup adjustments in the automotive and beer industries, respectively, while Nakamura and Zerom (2010) also account for nominal rigidities in the coffee industry. I extend this analysis from an industry-specific to an aggregate perspective, incorporating input-output linkages and sectoral heterogeneity, which significantly shape aggregate dynamics.

My work relates to the literature on production networks, heterogeneity in wedges, and the propagation of shocks.[2] Rubbo (2020) and Pasten et al. (2020) show, in a closed-economy setting, that heterogeneity in price rigidity is crucial for the transmission of monetary shocks. Dhyne et al. (2021) quantify the propagation of foreign demand shocks through domestic firm-to-firm transactions. Using Chilean data, Huneeus (2018) examines the effects of foreign demand shocks in a model with an endogenous network. Di Giovanni et al. (2017), Cravino and Levchenko (2017b), and Di Giovanni and Levchenko (2010) investigate how multinational firms and international input-output linkages transmit productivity and inflation shocks across borders. Additionally, Jones (2011), Bigio and La'o (2020), and Baqaee and Farhi (2019), among others, analyze the properties of inefficient networks with generic wedges. Relative to these studies, my analysis is complementary, focusing on the transmission of exchange rate fluctuations and the domestic wedges that shape their propagation.

An extensive body of work examines firm-level determinants of incomplete pass-through into border prices, including firm size and market share (Berman et al., 2012; Atkeson and Burstein, 2008), reliance on imported inputs (Amiti et al., 2014), strategic complementarities (Amiti et al., 2019), product quality (Chen and Juvenal, 2016), bargaining and buyer market power (Drozd and Nosal, 2012; Heise, 2019; Alviarez et al., 2021; Errico, 2022), intra-firm versus arm's-length relationships (Neiman, 2010), and invoicing choices (Gopinath et al., 2010; Chen et al., 2022). I contribute to this literature by demonstrating that incomplete pass-through

[2] See Carvalho and Tahbaz-Salehi (2019) for a recent survey.

into border prices is quantitatively as significant as domestic wedges in shaping the overall sensitivity of CPI to exchange rate fluctuations, highlighting the aggregate relevance of firm-level determinants.

The rest of the paper is structured as follows. Section 1 presents the theoretical framework of pass-through, with a focus on key domestic frictions. Section 2 details the calibration strategy, and Section 3 reports the main results on the role of domestic wedges for the (in)sensitivity of domestic prices to exchange rate fluctuations. Section 4 concludes.

# 1 A Model of Exchange Rate Pass-Through into CPI

This section outlines the theoretical framework used to analyze the role of domestic wedges in shaping the aggregate exchange rate pass-through to the consumer price index (CPI). The framework focuses on characterizing the domestic transmission of exchange rate fluctuations. I propose a parsimonious, static, multi-industry model, building on Goldberg and Campa (2010). The model incorporates several wedges that influence the domestic transmission of exchange rate changes and cost shocks in general, including distribution costs (Burstein et al., 2003; Corsetti and Dedola, 2005), variable markups (Goldberg and Verboven, 2001), and nominal rigidities (Gopinath and Itskhoki, 2011; Mukhin, 2022). Given the focus on domestic wedges, the response of import prices to exchange rate movements at the border is treated as exogenous. The framework highlights how heterogeneity in domestic wedges, along with differences in input-output linkages and the use of imported inputs in domestic production across sectors, shapes the domestic transmission of exchange rate fluctuations.

## 1.1 Environment

The section introduces the assumptions about preferences, production, and wedges. I then derive a set of measurement equations for the aggregate exchange rate pass-through into CPI.

**Price Aggregator.** I consider a small open economy where local wages and prices are expressed in a national nominal unit of account. The economy is populated by a representative household whose preferences over consumption and labor are given by:

$$W(C, L) = U(C) - V(L), \tag{1}$$

where $C$ and $L$ represent the household's final consumption and total labor supply, respectively.[3] The household consumes a set of N sectoral goods $i \in \{1, \cdots, N\}$. Specifically, the household's final consumption basket, $C$, is represented by a homogeneous-of-degree-one consumption aggregator over sectoral goods, $C = \mathcal{C}(c_1, \cdots, c_N)$. The household's utility maximization problem

[3] Typical regularity conditions are imposed on $U$ and $V$: strictly increasing, twice differentiable, and $U'' < 0$, $V'' > 0$ and the Inada conditions are satisfied.

is subject to a standard budget constraint given by:

$$PC \equiv \sum_{i=1}^{N} p_i c_i \leqslant wL + \sum_{i=1}^{n_D} \int_0^1 \pi_{ik} dk, \tag{2}$$

where $P$ is the nominal price index of the final consumption bundle, $wL$ is the labor income, and the last term captures the dividends from owning the domestic firms.

I assume that $C$ takes the form of a Cobb-Douglas aggregator:[4]

$$C(c_1, \cdots, c_N) = \prod_{i=1}^{N} \left(\frac{c_i}{\beta_i}\right)^{\beta_i}, \qquad \text{with } \sum_{i=1}^{N} \beta_i = 1 \tag{3}$$

where $c_i$ is the amount of good $i$ consumed, and the constants $\beta_i \geqslant 0$ represent the share of each good in the household's final consumption.

The utility-based final consumption price index, which serves as the model-implied measure of the consumer price index (CPI), is given by:

$$P(p_1, \cdot, p_n) = \prod_{i=1}^{N} p_i^{\beta_i}, \tag{4}$$

where $p_i$ is the retail price of the good of sector $i$, as paid by the household.

The pass-through of exchange rates into CPI, defined as the elasticity of CPI with respect to changes in the nominal exchange rate, $e$, and denoted by $\eta^{P,e}$, is expressed as:

$$\eta^{P,e} \equiv \frac{d \log P}{d \log e} = \boldsymbol{\beta} \times \boldsymbol{\eta}^{\mathbf{p},e}, \tag{5}$$

where $\boldsymbol{\beta}$ refers to the $N \times 1$ vector of expenditure shares, $(\beta_1, \cdots, \beta_N)$, and $\boldsymbol{\eta}^{\mathbf{p},e}$ represents the $N \times 1$ vector of price elasticities, $(\eta^{p_1,e}, \cdots, \eta^{p_N,e})^T$.

The pass-through of exchange rate movements into CPI is a weighted average of the pass-through rates into the prices of all goods consumed in the final consumption basket. Given the Cobb-Douglas specification in Equation (3), the relative weights correspond to the constant expenditure shares in total consumption, $\beta_i = \frac{p_i c_i}{PC}$.

The response of inflation to exchange rate fluctuations arises from both the direct and indirect consumption of imported goods, whose prices are directly influenced by exchange rate fluctuations. I assume that a subset $n_D$ ($n_F = N - n_D$) of sectoral goods are produced domestically (imported from abroad). Thus, I disentangle the effects of direct and indirect import exposure, where the former refers to the presence of imported final consumption goods and the latter accounts for the use of imported intermediate inputs in the production of domestic

[4] A Cobb-Douglas aggregator assumes low expenditure switching and and limited substitutability across goods. Elasticity of substitution values in the range of 1 to 2 are commonly used to describe aggregate import demand in the macroeconomic real business cycle literature (Ruhl et al., 2008). In the international real business cycle literature, matching the observed terms-of-trade volatility and the negative relationship between terms of trade and trade balance typically requires low trade elasticity values (Hillberry and Hummels, 2013).

goods. Formally, Equation (5) can be rewritten as:

$$\eta^{P,e} = \boldsymbol{\beta} \times \boldsymbol{\eta}^{\mathbf{p},e} = \underbrace{\boldsymbol{\beta}^D \times \boldsymbol{\eta}^{\mathbf{p}^D,e}}_{\substack{\text{Indirect exposure} \\ \text{(Imported Intermediate Inputs)}}} + \underbrace{\boldsymbol{\beta}^F \times \boldsymbol{\eta}^{\mathbf{p}^F,e}}_{\substack{\text{Direct exposure} \\ \text{(Imported Final Consumption)}}}, \tag{6}$$

where $\boldsymbol{\eta}^{\mathbf{p}^D,e}$ ($\boldsymbol{\eta}^{\mathbf{p}^D,e}$) is the vector of pass-through rates into the retail price of a domestically (imported) sectoral goods.

In the following paragraphs, I first characterize the pass-through rate into the price of domestically produced goods, $\boldsymbol{\eta}^{\mathbf{p}^D,e}$ in Equation (6), by introducing several elements that influence the transmission of exchange rate fluctuations. I then elaborate on the pass-through rate into the price of imported goods, $\boldsymbol{\eta}^{\mathbf{p}^F,e}$.

**Production of Domestic Goods - Local Distributor.** I assume that each domestic sectoral good, $i \in n_D$, is produced by a local competitive distributor who aggregates a mass of sectoral varieties (La'O and Tahbaz-Salehi, 2022) and combines the aggregated good with local distribution services (Burstein et al., 2003). In turn, sectoral varieties are produced within each sector by a continuum of domestic monopolistically competitive firms, indexed by $k \in [0, 1]$.

The competitive distributor in each industry $i$ aggregates the mass of differentiated varieties into an homogeneous sectoral good, $y_i$, using an homothetic Kimball aggregator, Kimball (1995):[5]

$$\sum_k A_{ik} \mathcal{K}_i \left( \frac{y_{ik}}{y_i} \right) = 1, \tag{7}$$

where $y_{ik}$ is the consumption of variety $k$ in industry $i$, and $A_{ik}$ is a quality parameter; $\mathcal{K}(\cdot)$ is such that $\mathcal{K}(\cdot) > 0$, $\mathcal{K}'(\cdot) > 0$, $\mathcal{K}''(\cdot) < 0$ and $\mathcal{K}(1) = 1$. The distributor's VES technology represents the demand schedule faced by monopolistically competitive firms. In the quantitative analysis in Section 2, I adopt the common Klenow and Willis (2016) formulation for the Kimball aggregator. In this case, Marshall's weak second law holds, implying that as firms lower their prices, their demand becomes more inelastic and their markup increases. Thus, larger firms will exhibit higher markups, higher markup elasticity, and a lower pass through rate of cost shocks (Atkeson and Burstein, 2008; Kimball, 1995).[6]

The distributor sells the homogeneous sectoral good $y_i$, incurring in distribution costs. These costs represent the per-unit service inputs required to deliver the homogeneous sector

[5] The assumption of perfect competition can be relaxed without altering the key theoretical insights, under the assumption that distributors charge constant markups. Allowing for variable markups would enable distributors to adjust their markup in response to exchange rate fluctuations, introducing an additional source of incomplete pass-through. However, Goldberg and Campa (2010) provide an empirical estimate of the sensitivity of distribution services to exchange rate, showing that distribution margin only weakly decreases following an exchange rate depreciation.

[6] Amiti et al. (2019), among others, shows that monopolistically competitive firms with Kimball demand generate qualitatively similar predictions regarding pass-through and heterogeneity to a model of oligopolistic firms with nested CES demand, as in Atkeson and Burstein (2008). I favor the former specification because its calibration strategy better aligns with the available data.

goods to consumers and firms, e.g. transportation, wholesales and retail services, marketing, etc (Burstein et al., 2003; Corsetti and Dedola, 2005). I assume that distribution services are combined with one unit of sectoral homogeneous good using a Cobb-Douglas technology, and that distribution services are produced using labor (Atkeson and Burstein, 2008).[7] Thus, the retail price of good $i$, $p_i$, is:

$$p_i = \widetilde{p_i}^{\phi_i} w^{1-\phi_i} \qquad \text{with } \phi \leqslant 1, \tag{8}$$

where $\widetilde{p_i}$ is the price of the aggregate homogeneous good $i$, and $1-\phi_i$ represents the share of distribution services in the retail price of good $i$. I assume that distribution costs are heterogeneous across sectors, as indicated by the $i$-specific weights in the production technology.

**Production of Domestic Goods - Sectoral Varieties.** The monopolistically competitive firms within each domestic industry use a firm-specific, constant returns to scale production function. Both domestic and imported sectoral goods can be used as inputs in the production of domestic varieties, along with labor. For simplicity, I assume that firms employ the following Cobb-Douglas technology:

$$y_{ik} = F_i(l_{i,k}, x_{i1,k}, \cdots, x_{iN,k}) = \zeta_{ik} l_{i,k}^{\alpha_{ik,l}} \prod_{j=1}^{N} x_{ij,k}^{\alpha_{ik,j}} \qquad \text{with } \alpha_{ik,l} + \sum_{j=1}^{N} \alpha_{ik,j} = 1 \quad \forall k, \tag{9}$$

where $y_{i,k}$ is firm $k$'s output, $\zeta_{ik}$ is the firm's productivity parameter, $l_{i,k}$ is the labor input, $x_{ij,k}$ is the amount of good $j$ used as input by firm $k$ in sector $i$, and $\alpha_{ik,j} \geqslant 0$ denotes the share of good $j$ in the production of firm $k$ in sector $i$.[8] [9]

Each firm potentially has heterogeneous direct and indirect exposure to exchange rate fluctuations due to its use of a different mix of inputs, as reflected by the firm-specific exponents, $\alpha_{ik,j}$. A firm's production cost is directly exposed to exchange rate fluctuations when it directly uses imported inputs in production. However, a firm may also be exposed indirectly, even if it does not use any imported input. This occurs through domestic input-output linkages to other domestic firms that employ imported inputs.

Given the assumption about the distributor's aggregating technology, monopolistically competitive producers charge a variable markup over marginal cost:

$$\widetilde{p_{ik}} = \mu_{ik} mc_{ik} \qquad \text{with } mc_{ik} = \frac{1}{\zeta_{ik}} w^{\alpha_{ik,l}} \prod_{j=1}^{N} p_j^{\alpha_{ik,j}}, \tag{10}$$

where $\widetilde{p_{ik}}$ is the price paid by the distributor for variety $k$, $\mu_{ik}$ is the markup charged, and the

[7] Compared to Corsetti and Dedola (2005), who use additive distribution costs, the qualitative implications on pass-through are the same. However, the calibration is more straightforward, as the shares $\phi_i$s can be computed directly from the input-output tables.

[8] I assume that $\alpha_{ik,l} > 0$, i.e. that labor is an essential input for the production of all varieties, in the sense that $F_{ik}(0, x_{i1,k}, \cdots, x_{iN,k}) = 0$.

[9] A Cobb-Douglas technology implies that input shares remain constant, which limits input substitutability. While sales reallocation, non-linearities, and second-order effects can be relevant in a frictional production network (Hulten, 1978; Baqaee and Farhi, 2020), low values of the elasticity of substitution are appropriate given the estimates available in the literature (Atalay, 2017).

expression for the marginal cost, $mc_{ik}$, follows from the specific production function assumed in Equation (9). Given the restrictions in Equation (7), the markup charged by monopolistically competitive firms increases in firm sales and becomes more sensitive to cost shocks, implying a lower pass through rate.

Lastly, I assume that monopolistically competitive producers are subject to nominal rigidities. Producers set the price of their variety based on their marginal cost before the realization of shocks. I use a one-period version of Calvo (1983) pricing, assuming that producers can update their price ex post with a sector-specific probability $\delta_i$ (Mukhin, 2022; Rubbo, 2020). Thus, a fraction $\delta_i$ of firms in sector $i$ can adjust their prices to changes in their marginal costs following exchange rate fluctuations.

**Imported Goods.** The production and pricing decisions of imported goods are deliberately simplified given the focus on the role of domestic wedges on the domestic transmission of exchange rate fluctuations.

I assume that imported sectoral goods ($i \in n_F$) are produced abroad and purchased by a local distributor, which then combines them with local distribution services. Therefore, as shown in Equation (8), the domestic retail price of imported goods, $p_i$, is given by:

$$p_i = \left(\widetilde{p}_i(e)\right)^{\phi_i} w^{1-\phi_i} \qquad \text{with } \phi_i \leqslant 1, \tag{11}$$

where $i \in n_F$ and $\widetilde{p}_i$ is the local-currency, producer price of the imported good, which is determined by the foreign producer and depends on the exchange rate. I abstract from any micro-foundation of the foreign production process of imported goods and treat $\widetilde{p}_i$, along with its response to exchange rate fluctuations, as exogenous.[10] The small open economy assumption rules out international input-output linkages, so changes in the price of domestic goods do not affect the foreign production costs of imported goods, excluding roundabout effects.

## 1.2 Theoretical Results

This section develops intuition for the response of domestic prices to exchange rate fluctuations, considering sectoral heterogeneity in wedges and exposure, within-sector firm-level heterogeneity, and input-output linkages. Further details are reported in the Appendix A.1.

**Marginal Cost and Sectoral Prices.** The behavior of marginal costs is crucial for understanding the response of domestic prices to exchange rate fluctuations. I focus on the direct effect of exchange rate, excluding changes in the wage rate or the response of firms to changes in sectoral price indices and quantities (Burstein and Gopinath, 2014).

[10] The implicit assumption is the separability between domestic and foreign suppliers. While the interaction between domestic and foreign suppliers is important for markup and concentration dynamics (Amiti and Heise, 2024), the available data do not permit an assessment of the competition between them. Nevertheless, the granularity of the transaction-level customs data used in the quantitative analysis allows the direct measurement of the response of import prices to exchange rate fluctuations.

At the firm level, the change in the price of variety $k$ in a domestic sector $i$ can be written:

$$\partial \log \widetilde{p_{ik}} = \delta_i \kappa_{ik} \partial \log mc_{ik}, \tag{12}$$

where $\kappa_{ik} \equiv \frac{1}{1+\Gamma_{ik}}$, $\Gamma_{ik} \equiv -\frac{\partial \log \mu_{ik}}{\partial \log \widetilde{p_{ik}}}$ is the markup elasticity, and $\delta_i$ the sector-specific Calvo probability. Equation (12) illustrates how two wedges - variable markup and nominal rigidities - reduce the response of prices to changes in marginal costs. While nominal rigidities hinder the adjustment of prices, variable markups make firms less inclined to adjust their prices relative to other firms' prices, leading them to absorb a portion of the cost changes instead.[11]

Given the production technology in Equations (23) and (24), the change in the marginal cost of producer $k$ in domestic sector $i$ following a change in input prices is as follows:

$$\partial \log mc_{ik} = \sum_{j=1}^{N} \alpha_{ik,j} \partial \log p_j = \sum_{j=1}^{n_D} \alpha_{ik,j} \partial \log p_j + \sum_{j=1}^{n_F} \alpha_{ik,j} \partial \log p_j(e), \tag{13}$$

where $\alpha_{ik,j}$ is the exposure of firm $k$ in sector $i$ to input $j$, and $p_j$ represents the retail price of input $j$. The second part of the equation highlights how a firm's marginal cost can be influenced directly by exchange rate fluctuations through the use of imported inputs, as well as indirectly through the use of domestic inputs. This emphasizes the role of input-output linkages in shaping marginal costs, and consequently, in affecting the transmission of exchange rate fluctuations to domestic prices.

We are interested in characterizing the response of sectoral prices to exchange rate fluctuations, aggregating up the price responses of individual firms, as derived in Equation (12):

$$\partial \log \widetilde{p_i} \equiv \sum_{k \in N_i} S_{ik} \partial \log \widetilde{p_{ik}} = \sum_{k \in N_i} S_{ik} \delta_i \kappa_{ik} \partial \log mc_{ik} = \delta_i [\bar{\kappa}_i \partial \overline{\log mc}_i + cov_{S_{ik}} (\kappa_{ik}, \partial \log mc_{ik})], \tag{14}$$

where $S_{ik}$ is the revenues share of firm $k$ in sector $i$; $\bar{x}$ is the revenues-weighted average of variable $x$, i.e. $\bar{x} = \sum_{k \in N_i} S_{ik} x_{ik}$; and $cov_{z_{ik}} (x_{ik}, y_{ik})$ is the $z$-weighted covariance between two variables $x$ and $y$, i.e. $cov_{z_{ik}} (x_{ik}, y_{ik}) = \sum_{k \in N_i} z_{ik} (x_{ik} - \bar{x})(y_{ik} - \bar{y})$.

The last part of Equation (14) shows that the aggregate sectoral response to exchange rate fluctuations can be decomposed into two components: an average effect and a heterogeneous effect. The average effect is captured by the revenue-weighted average response across firms, measured by the average change in the marginal cost muted by the average incomplete pass-through due to variable markups ($\overline{\kappa_i}$). The heterogeneous effect, on the other hand, depends on the within-sector revenue-weighted correlation between markup elasticity and marginal cost fluctuations, highlighting the importance of within-sector systematic heterogeneity in markup elasticity and exposure (Amiti et al., 2019).

Moreover, by leveraging the definition of marginal cost and the economy's production struc-

[11] $\kappa_{ik}$ formally measures the incomplete degree of pass-through of cost shocks into prices. The pass-through rate inversely depends on how much the markup is sensitive, i.e. on the markup elasticity.

ture, I can further specialize Equation (14) in terms of input exposure:

$$\partial \overline{\log mc_i} = \sum_{j=1}^{N} \overline{\alpha_{ij}} \partial \log p_j, \qquad cov_{S_{ik}}\left(\kappa_{ik}, \partial \log mc_{ik}\right) = \sum_{j}^{N} \partial \log p_j cov_{S_{ik}}\left(\kappa_{ik}, \alpha_{ik,j}\right), \tag{15}$$

where $\overline{\alpha_{ij}} = \sum_{k \in N_i} S_{ik}\alpha_{ik,j}$ is the revenue-weighted average input share of product $j$ in sector $i$. Thus, the response of sectoral prices depends on the average exposure of the sector to imported and domestic inputs ($\overline{\alpha_{ij}}$), muted by the presence of variable markups and nominal rigidities.

Within-sector heterogeneity can either dampen or amplify the response of sectoral prices, depending on the correlation between exposure and size at the firm level. Under the assumptions of the distributor's Kimball aggregator in Equation (7), markup elasticity increases with firm size, while pass-through decreases. If larger firms are also more exposed—either directly or indirectly—to exchange rate fluctuations, the covariance is negative. Consequently, the response of sectoral prices is smaller than the average effects, as larger firms exhibit lower pass-through. However, I do not impose any ex-ante correlation between exposure and firm size, leaving this relationship to be determined during the calibration in Section 2.

**Aggregate Exchange Rate Pass-through in Retail Prices.** I present closed-form expressions for the response of inflation to exchange rate fluctuations. Under the assumptions regarding the distribution sector in Equation (8), the change in the retail price of good $i$ can be expressed as follows:

$$\partial \log p_i = \phi_i \partial \log \widetilde{p}_i, \tag{16}$$

where the presence of distribution costs further dampens the response of retail prices to changes in production costs (e.g. due exchange rate fluctuations), as production costs account for only a fraction $\phi_i$ of the retail price.

Combining these equations across all sectors with Equations (14) and (15), the $n_D \times 1$ vector of pass-through rates into the retail prices of domestic goods, $\boldsymbol{\eta^D} = \left[\frac{\partial \log p_1}{\partial \log e}, \cdots, \frac{\partial \log p_H}{\partial \log e}\right]^T$ is:

$$\boldsymbol{\eta^D} = \underbrace{\left[\mathbf{I} - \underbrace{\mathbf{\Phi^D \Delta^D}\left(\mathbf{\Gamma^D S^D} + \mathbf{\Lambda^D}\right)}_{\text{Adjusted Leontief}}\right]^{-1}}_{\text{IO network}} \mathbf{\Phi^D \Delta^D} \underbrace{\left(\underbrace{\mathbf{\Gamma^D S^F}}_{\text{Average}} + \underbrace{\mathbf{\Lambda^F}}_{\text{Heterogeneous}}\right)}_{\text{Import Exposure}} \underbrace{\mathbf{\Phi^F \Psi^F}}_{\boldsymbol{\eta^F}}, \tag{17}$$

where $\boldsymbol{\eta^F}$ and $\boldsymbol{\Psi^F}$ are $n_F \times 1$ vectors of pass-through rate into the retail price and the producer price of imported goods, respectively; $\boldsymbol{\Phi^F}$ and $\boldsymbol{\Phi^D}$ are the $n_F \times n_F$ and $n_D \times n_D$ diagonal matrices of sectoral distribution margins; $\boldsymbol{\Delta^D}$ is the $n_D \times n_D$ diagonal matrix of sectoral Calvo parameters; $\boldsymbol{\Gamma^D}$ is a $n_D \times n_D$ matrix of sectoral average markup elasticities $\overline{\kappa i}$; $\boldsymbol{\Lambda^F}$ and $\boldsymbol{\Lambda^D}$ are the $n_D \times n_F$ and $n_D \times n_D$ matrices collecting the within-sector correlations between markup elasticities and the use of imported and domestic inputs in the production of domestic goods, respectively; $\boldsymbol{S^F}$ and $\boldsymbol{S^D}$ are $n_D \times n_F$ and $n_D \times n_D$ matrices collecting the expenditure share of sector $i$ on each imported and domestic goods, respectively. The vectors of pass-through rates into the retail price of domestic and imported goods ($\boldsymbol{\eta^D}$ and $\boldsymbol{\eta^F}$, respectively) fully characterize the elements determining the transmission of exchange rate fluctuations into the CPI, as outlined in Equation (6). Additional details on the derivations in Appendix A.1.

The final term in Equation (17) illustrates that the pass-through of exchange rate fluctuations into the retail price of domestically produced goods, $\boldsymbol{\eta^D}$, depends on the pass-through of exchange rate fluctuations into the domestic price of imported inputs, $\boldsymbol{\eta^F}$. This, in turn, is determined by the sensitivity of the local-currency producer price of the imported good to exchange rate fluctuations, $\boldsymbol{\Psi^F}$, weighted by the share of local distribution services, $\boldsymbol{\Phi^F}$, as specified in Equation (11).

$\boldsymbol{\eta^D}$ depends not only on changes in the price of imported inputs but also on domestic firms' exposure to these inputs and the presence of domestic wedges. As shown in Equation (15), the second-to-last term consists of two components: an average effect - representing the average use of imported inputs, moderated by the variable markup wedge - and a heterogeneity effect, which captures the correlation between the use of imported inputs and markup elasticity within a sector. Similarly, the impact of the other two wedges, nominal rigidities and distribution services, in dampening overall pass-through is captured by the multiplicative term $\mathbf{\Phi^D \Delta^D}$.

The presence of input-output linkages amplifies the pass-through of exchange rate fluctuations on domestic prices, although domestic wedges dampen these amplification effects. Input-output linkages are captured by the first term, the adjusted Leontief inverse matrix, which depends on the input-output matrix of domestic inputs $\boldsymbol{S^D}$. However, this form of indirect exposure is adjusted to account for the presence of domestic wedges, as the actual response of domestic prices is dampened by nominal rigidities, variable markups, and distribution services.

**On Heterogeneity.** Equations (17) and (6) highlight the potential importance of within- and across-sector heterogeneity, as well as their interactions, in the transmission of exchange rate fluctuations to the CPI. Equation (14) illustrates how variations in input mixes at the firm level - and their correlation with firm size and markup elasticity within each sector - can amplify or dampen the transmission, depending on the sign of these correlations. Beyond this, the contribution of each sector and good to the aggregate transmission of exchange rate fluctuations into the CPI also depends on the interplay of heterogeneities in exposure, wedges, and consumption shares across sectors.

For example, Equation (6) shows that the correlation between consumption shares and pass-through rates at the sector level can either amplify or dampen the aggregate transmission. If final consumers allocate larger shares of their consumption basket onto goods that are more sensitive to exchange rate fluctuations (i.e. goods with higher pass-through rates), the aggregate pass-through rate to the CPI will be higher.

The contribution of a sector to the aggregate transmission of exchange rate fluctuations into the CPI also depends on the interaction between the intensity of imported input usage and the strength of domestic wedges. Stronger domestic wedges — such as higher distribution costs, more rigid nominal prices, or greater markup elasticities—exert a larger dampening effect on the aggregate transmission when they are positively correlated with sectors that heavily rely on imported inputs. These sectors are typically the most significant channels through which exchange rate fluctuations affect the CPI.

The contribution of a sector to the aggregate transmission into the CPI also depends on the interaction between the intensity of imported input usage and the strength of domestic wedges. Stronger domestic wedges - such as higher distribution costs, more rigid nominal prices, or greater markup elasticities - exert a larger dampening effect on the aggregate transmission when they are positively correlated with sectors that heavily rely on imported inputs.

Similarly, a sector's contribution depends on its centrality in the domestic input-output network, adjusted for the presence of domestic wedges. Sectors producing goods that are extensively used as inputs in the production of other goods contribute more to the aggregate transmission of exchange rate fluctuations into the CPI. However, the aggregate dampening effects of domestic wedges are amplified when these central sectors face stronger wedges.

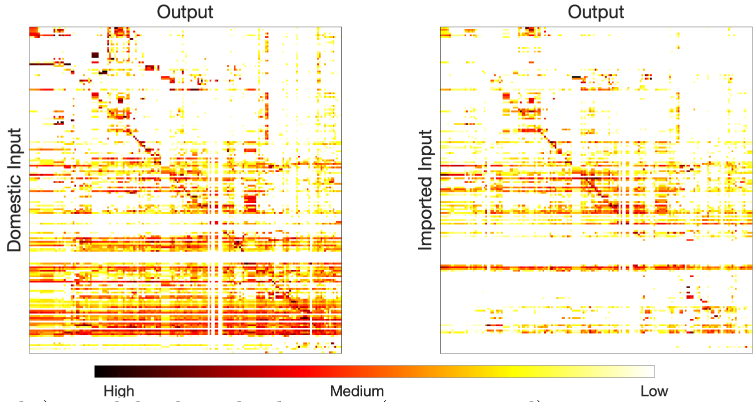
The presence and interaction of these various sources of heterogeneity represent an example of the identity effect (Pasten et al., 2020). The degree to which a sector transmits exchange rate fluctuations to the CPI depends on the precise interaction of these heterogeneities. I impose no restrictions on the joint distribution of these factors, leaving the quantitative effect to the empirical section below. The ranking of importance across sectors may shift significantly when one or more sources of heterogeneity are abstracted away, underscoring the need for a comprehensive analysis. From a policy perspective, the identity effect is key, as optimal targeting or redistribution policies require precise knowledge of the most relevant sectors.

# 2 Calibration

Each element in the key Equation (17), along with their heterogeneity across products, is carefully calibrated using a variety of micro-level datasets. The primary inputs include the granular "make" and "use" tables from the Central Bank of Chile (2008–2019), data from the Annual Survey of Manufacturing (ENIA, Encuesta Nacional Industrial Anual) compiled by the Chilean National Statistical Agency (INE, Instituto Nacional de Estadísticas) for the period 1995–2015, and the universe of Chilean import transactions (2007–2019) from the Chilean Customs Agency (Aduanas). Below, I detail the strategy employed to calibrate each component of the main measurement equations. Additional information is provided in Appendix B.

**Leontief Matrices and Consumption Shares** I construct the input-output matrices for the Chilean economy from 2008 to 2019 by combining the "make" and "use" tables provided by the the Central Bank of Chile. These tables consist of two basic national accounting components: the "make" table, which shows the production of goods by sector, and the "use" table, which shows the use of goods by sectors and final users. The Central Bank of Chile also provides information on international flows, allowing the construction of international "make" (for imports) and "use" (for exports) tables. The tables are highly disaggregated and include

Figure 2: Domestic and International Leontief Matrices




**Note:** The left (right) panel displays the domestic (international) input-output matrix of the Chilean economy, with shares averaged over the period 2013-2019. The matrices are computed using the "make" and "use" tables under the industry technology assumption. Each row (column) represents an input (output). The intensity of the coloring indicates the extent to which one product is used as an input in the production of other products. Darker colors correspond to higher input shares, while lighter colors indicate lower input shares. The log of input shares below -10 are censored.

110 industries and 175 products before 2013, and 180 products starting on 2013.[12]

I combine the "make" and "use" tables under the industry technology assumption to construct a product-by-product input-output matrix of dimension $175\times175$ or $180\times180$.[13] Each matrix quantifies how much of each product (row) is used in the production of other products (column), allowing me to calibrate the domestic and international Leontief matrices, $\mathbf{S^D}$ and $\mathbf{S^F}$ respectively. Figure 2 displays the average Leontief matrices over the period 2013-2019, where darker colors indicate a higher share of a given input in the production of a specific product. Domestic network and trade exposure are highly sparse and heterogeneous across products, characteristics that play a crucial role in shaping the response of aggregate variables (Pasten et al., 2020).[14] Lastly, I use the "use" tables to compute the share of each product in final consumption, calibrating the vector $\boldsymbol{\beta}$.

**Distribution Margin** Following Goldberg and Campa (2010), I compute the product-level distribution margin $1-\phi_i$ as the ratio of the value of trade and transport margins to the value of total supply of that product at purchasers' prices:

$$1-\phi_i \equiv \frac{\text{Retail + wholesale + transportation costs}}{\text{Value at purchaser prices}} \equiv \frac{\text{Value at purchaser prices - value at basic prices}}{\text{Value at purchaser prices}}. \quad (18)$$

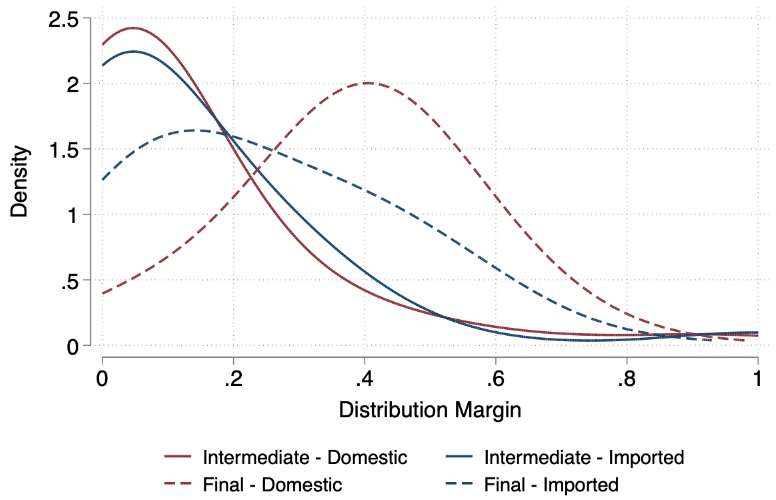
I use the input-output matrices for the Chilean economy to compute the value of trade and transport margins as the difference between the cost of supply (basic price) and the purchaser price. The data allows me to calculate time-varying, heterogeneous margins across products,

[12] For comparison, commonly used input-output tables, such as the WIOD or the OECD tables, typically contain around 30 to 40 sectors. Pasten et al. (2020) shows that the granularity of the input-output table plays a central role in quantifying the real effects of monetary policy, as less granular input-output tables tend to underestimate these effects.

[13] Appendix B provides details on the technical assumptions used in the construction of the input-output matrices.

[14] Figure 16 in Appendix B shows the average Leontief matrices over the period 2008-2012, with qualitatively similar patterns.

Figure 3: Distribution Margins




**Note:** The figure plots the density distribution of the distribution margins across products with positive use shares. The distribution margins are computed using Equation (18) and input-output tables from 2008 to 2019. Products are differentiated based on their use (final vs. intermediate use), with solid lines representing final goods and dashed lines representing intermediate goods. Additionally, products are classified by their origin, with blue lines for imported goods and red lines for domestically produced goods.

as well as variations across use (final vs. intermediate consumption) and origin (imported vs. domestic).

Figure 3 reports the density distribution of distribution margins across different product categories (domestic vs. imported, intermediate vs. final). The distribution margin is found to be large and highly heterogeneous across products, origins, and uses. On average, domestically produced goods have lower distribution margins compared to imported goods (18% vs 26%, respectively), which is consistent with the the higher transportation costs associated with internationally sourced products. Moreover, intermediate goods generally have lower distribution margins than final goods (13% vs 31%, respectively).[15] This suggests that lower pass-through due to distribution costs may arise primarily at the end of the production chain, when goods reach final consumers. Panel B of Table 4 in Appendix B highlights considerable heterogeneity across sectors: distribution margins in manufacturing sectors such as food and textiles are approximately 25%-30%, while in non-tradable sectors such as communication, health care and education are around 8% (Burstein et al., 2003; Berger et al., 2012).

**Markup Elasticity** Operationalizing the theoretical framework in Equation (17) requires additional assumptions on the functional form of the Kimball aggregator in Equation (7). These assumptions enable the parameterization of markup elasticities $\Gamma_{ik}$ and, ultimately, the firm-level pass-through rates $\kappa_{ik}$ used to construct $\Gamma$ and $\Lambda$ in Equation (17). I assume that the Kimball aggregator in Equation (7) takes the form of a sector-specific Klenow and Willis (2016) aggregator and calibrate it following Edmond et al. (2018). Under the Klenow and Willis (2016) specification, the markup elasticity of firm $k$ in sector $i$, $\Gamma_{ki} = -\frac{\partial \log \mu_{ki}}{\partial \log p_{ki}}$, takes the

[15] Values are reported in Panel A of Table 4 in Appendix B.

following function form:

$$\Gamma_{ki} = \frac{\epsilon_i}{\sigma_i}\mu_{ki}, \tag{19}$$

where $\sigma_i > 1$ and $\epsilon_i$ represent the sector-specific demand elasticity and the demand superelasticity, respectively. Thus, the markup elasticity can be computed using $\sigma_i$, $\epsilon_i$, and firm-level markups $\mu_{ki}$.

Firm-level pass-through rates are estimated in two steps. First, I use firm-level balance sheet data from the Annual Survey of Manufacturing (ENIA), administered by the Chilean National Institute of Statistics (INE), spanning the years 1995 to 2015, to compute firm-level markups following Autor et al. (2020). Under the assumption of constant returns to scale, markups are measured as the ratio of firm sales to total costs:

$$\mu_{kit} = \frac{\alpha^v_{kit}}{S^v_{kit}} = \frac{\texttt{Sales}_{kit}}{\texttt{Total Cost}_{kit}}, \tag{20}$$

where $\alpha^v_{kit}$ and $S^v_{kit}$ denote the output elasticity and the factor share of input $v$, respectively ($S^v_{kit} = \frac{\texttt{Expenditure on } v}{\texttt{Sales}_{kit}}$). The second equality arises from the CRS assumption, which implies $\alpha^v_{kit} = \frac{\texttt{Expenditure on } v}{\texttt{Total Cost}_{kit}}$. I assume that total costs are the sum of wage bill, materials expenditure, and capital costs. In the second step, I jointly estimate the elasticity and super-elasticity of demand following Edmond et al. (2018). The Klenow and Willis (2016) specification allows to specify the following within-industry relationship between markups and market shares:

$$\frac{1}{\mu_{kit}} + \log\left(1 - \frac{1}{\mu_{kit}}\right) = \texttt{constant} + \gamma \log s_{kit} + \nu_{kit} \tag{21}$$

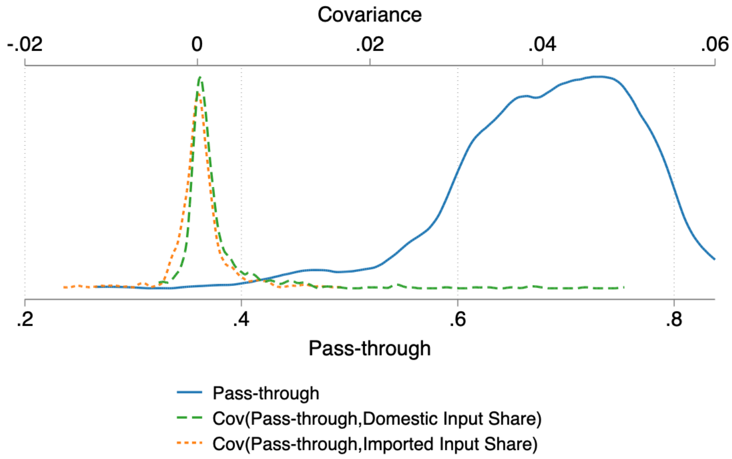
where $\gamma = \frac{\epsilon_i}{\sigma_i}$ and $s_{kit}$ is the market share of firm $k$ in sector $i$. I estimate this specification for each sector in the economy (CIIU industry), introducing firm and year fixed effects to control for unobserved productivity, quality differences, and aggregate dynamics.

Figure 4 displays the distribution of the revenue-weighted average pass-through rate ($\overline{\kappa_i}$) and the covariance between pass-through rates and the shares of domestic and imported inputs across sectors. There is substantial heterogeneity in the average pass-through rate, which ranges from 0.3 to 0.85. The covariance terms exhibit both positive and negative values, ranging from–0.01 to 0.01, suggesting qualitative differences in the relationship between pass-through and the intensity of domestic and imported input use across sectors.[16]

The sectoral estimates are then mapped to the input-output product categories to construct the matrices $\mathbf{\Gamma^D}$, $\mathbf{\Lambda^D}$, and $\mathbf{\Lambda^F}$ in Equation (17). The balance sheet data from ENIA distinguishes only between total domestic and imported input use, without specifying the intensity of each input $j$. Therefore, I assume that the covariance terms are equal across $j$ within a given sector $i$, i.e. $cov_{S_{ik}}(\kappa_{ik}, \alpha_{ik,j}) \equiv cov_{S_{ik}}(\kappa_{ik}, \alpha_{ik,j'}) \quad \forall j, j'$. This assumption allows me to calibrate the common covariance term by rescaling the empirical covariances based on the number

[16] Table 3 in Appendix B reports key moments of the estimated markup elasticities and pass-through rates at the firm-level. The estimated values are in line with previous work (Amiti et al., 2019; Baqaee and Farhi, 2020). On average, firms with higher pass-through rates exhibit a larger share of domestic inputs (Figure 13 in Appendix B).

Figure 4: Markup Elasticy and Pass-Through Rates




**Note:** The blue solid line plots the distribution of revenue-weighted average pass-through rate $\overline{\kappa_i}$ across sectors. The green and orange dash lines represent the covariance between pass-through rates and the aggregate share of domestic and imported inputs, respectively. Firm-level pass-through rates and input shares are estimated using firm-level balance sheet data from the Annual Survey of Manufacturing (ENIA), administered by the Chilean National Institute of Statistics (INE), spanning the years 1995 to 2015. Appendix B provides additional details on data and estimation.

of domestic and imported inputs, which is observed in the input-output tables.[17] Appendix B provides additional details on data construction, estimation, and robustness exercises.

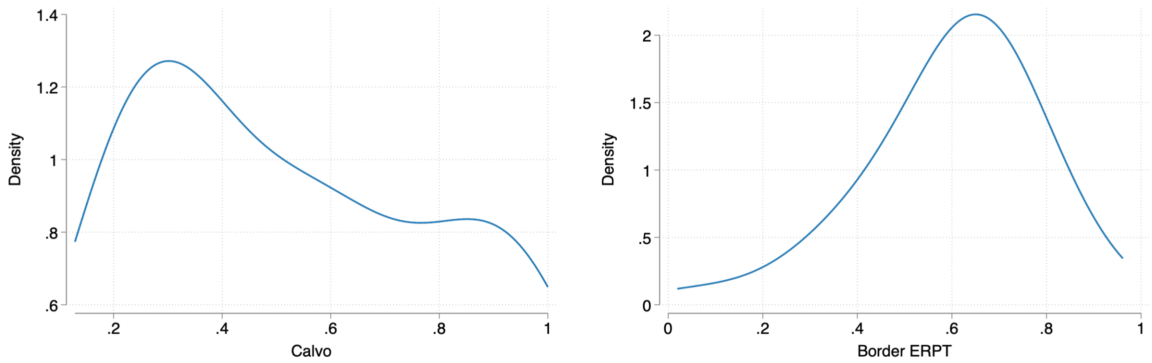
**Nominal Rigidities** I calibrate the product specific Calvo frequency of price adjustment using information available from Pasten et al. (2024). They use the confidential microdata underlying the PPI of the BLS to calculate the frequency of price adjustment at the Naics level, defined as the ratio of the number of price changes to the number of sample months. I construct a concordance table between Naics and the Chilean input-output product classification and then rescale the original monthly frequency of price adjustment to the quarterly level. The average duration is of 2.04 quarters (6.13 months), implying an average frequency of price adjustment of 0.53. Substantial heterogeneity is present in the frequency across products, with raw materials and farming product exhibiting durations lower than 0.3 quarters and many service industries showing durations above 4.5 quarters (left panel of Figure 5).[18]

**Import Price Sensitivities** I use Chilean Custom records from 2007 to 2019 to calibrate product-level pass-through rates of exchange rate fluctuations into import prices at the border.

[17] I leverage the linearity of covariances. The covariance between pass-through rates and the aggregate share of domestic inputs is equal to the sum of the covariances between pass-through rates and the share of individual domestic inputs, $cov_{S_{ik}}(\kappa_{ik}, \textit{Aggregate share of domestic inputs}_{ik}) = \sum_{j \in D} cov_{S_{ik}}(\kappa_{ik}, \alpha_{ik,j})$. Assuming that the covariances are the same across $j$, I calibrate this as $\frac{1}{J_{iD}} cov_{S_{ik}}(\kappa_{ik}, \textit{Aggregate share of domestic inputs}_{ik})$, where $J_{iD}$ is the number of domestic inputs used in sector $i$. A similar reasoning applies to the covariance for imported inputs.

[18] As a robustness, I rescale the distribution of the frequency of price adjustments to match the average monthly frequency of price adjustment of 30%, as estimated by Aruoba et al. (2022) from confidential daily transaction data from the Chilean Tax Authority. This implies an average quarterly probability of adjustment of 0.65, slightly reducing the effect of nominal rigidities on the exchange rate pass-through into CPI.

Figure 5: Calvo Adjustment and Border ERPT




**Note:** The left panel plots the distribution of the Calvo frequencies of price adjustment at quarterly level across product categories in the Chilean input-output tables. These are constructed from the PPI BLS data (Pasten et al., 2024). The right panel plots the distribution of exchange rate pass-through rates on border prices at quarterly frequency across product categories in the Chilean input-output tables. These are estimated using Chilean customs records from 2007 to 2019 and the specification in Equation (22) at the HS2 level.

The customs data records, for each import transaction, information such as the importer's unique identifier, the 8-digit HS product code, the transaction date, the country of origin, the value, and the quantity shipped. Appendix B provides additional details on cleaning and summary statistics.

I estimate a standard reduced-form exchange rate pass-through regression to measure the transmission of exchange rate fluctuations into import prices at the border (Burstein and Gopinath, 2014). The pass-through is estimated at quarterly frequency to be consistent with the Calvo frequency of adjustment $\mathbf{\Delta^D}$, also calibrated at the quarterly level. Let $f$ index an importing firm, $p$ an HS8 product category, $o$ the country of origin, and $t$ the quarter. The baseline specification is:

$$\Delta \log p_{fpot} = \alpha \Delta \log e_{ot} + \beta X_{fpot} + \varepsilon_{fpot}, \tag{22}$$

where $\Delta \log e_{ot}$ is the quarterly change in bilateral exchange rates, $X_{fpot}$ includes a variety of fixed effects, and $\alpha$ is the parameter of interest, capturing exchange rate pass-through on import prices at the border.

In line with estimates from the literature, Table 6 in Appendix B shows that the average pass-through rate in the whole sample ranges between 66 to 81 percentage points, depending on the variation used in the estimation. I estimate Equation (22) at the HS2 level and calibrate the vector $\boldsymbol{\Psi^F}$ in Equation (17) after creating a cross-walk between HS2 and product categories in the input-output tables.[19] Substantial heterogeneity is present across product categories, with the bulk of the distribution ranging from 0.3 to 0.8 (right panel of Figure 5).

[19] I calibrate the entries in $\boldsymbol{\Psi^F}$ corresponding to product categories without a match in the HS classification (e.g., services) to the average pass-through rate estimate obtained from the customs data.

# 3 Quantitative Results

I show that all domestic wedges are individually significant and collectively more important than border price sensitivity in shaping the response of domestic prices and the CPI to exchange rate fluctuations. When accounting for domestic wedges, imported final consumption goods emerge as the primary driver of the CPI's response to exchange rate fluctuations, contrary to previous findings in the literature. Moreover, heterogeneity in frictions, import exposure, and consumption share generates substantial identity effects, which tend to dampen the overall response of the CPI to exchange rate fluctuations.

## 3.1 The role of domestic wedges

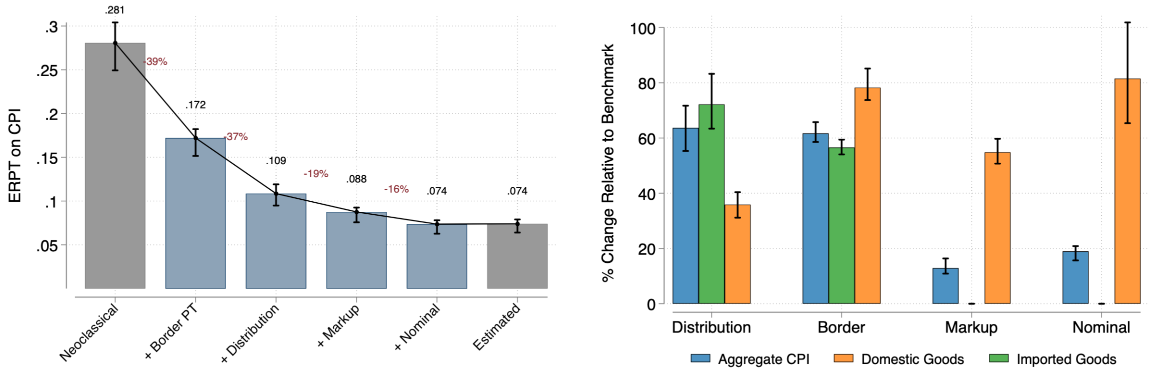
The left panel of Figure 6 shows that the calibrated benchmark model predicts a CPI sensitivity closely aligned with to its empirical counterpart. Using standard econometric frameworks (Burstein and Gopinath, 2014), I estimate an average CPI sensitivity to a 1 p.p. depreciation of the Chilean peso of approximately 0.07 p.p. in the period 1990-2019, in line with previous estimates from the literature.[20] The benchmark model, which includes all domestic wedges and incomplete pass-through into import prices at the border, closely replicates the estimated CPI sensitivity. This result underscores the validity of the measurement equations introduced in Section 1, showing that their simplicity does not come at the expense of quantitative performance.

Figure 5 further reveals that the low CPI sensitivity is primarily driven by domestic wedges – mechanisms that operate independently of border prices. To quantify the relative contributions of domestic wedges and border price dynamics, I first compute CPI sensitivity under a counterfactual, frictionless neoclassical economy. This scenario, where pass-through is complete and domestic wedges are absent, predicts a CPI sensitivity four times larger than the observed estimate (0.28 percentage points versus 0.07 percentage points). As expected, removing all mechanisms that dampen the transmission of cost shocks increases domestic price sensitivity.

Figure 6 further documents that the low sensitivity of CPI is primarily driven by domestic wedge - mechanisms that operate independently of border prices response. To quantify the relative contributions of domestic wedges and border price sensitivity, I first compute the CPI sensitivity under a counterfactual frictionless, neoclassical economy. This scenario, where pass-through is complete and domestic wedges are absent, predicts a CPI sensitivity four times larger than the estimated one (0.28 p.p. vs 0.07 p.p.). As expected, removing all mechanisms that dampen the transmission of costs shocks substantially increases domestic price sensitivity. Accounting for incomplete pass-through into import prices at the border reduces CPI sensitivity by 40% relative to the neoclassical framework, from 0.28 p.p. to 0.17 p.p.. However, border price sensitivity alone cannot account for the observed low sensitivity. Domestic wedges further reduce CPI sensitivity by an additional 57%, from 0.17 p.p. to 0.074 p.p., indicating that domestic factors play a dominant role in moderating CPI sensitivity relative to border price

[20] See Appendix B.4 for details on the estimation of the CPI sensitivity over the period 2009-2020.

Figure 6: Domestic Wedges vs Border Price Dynamics




**Note:** The left panel plots the aggregate CPI sensitivity to a one percent depreciation in the exchange rate across different scenarios. The first bar on the left represents the average CPI sensitivity in a counterfactual frictionless, neoclassical economy where pass-through is complete and domestic wedges are absent. The blue bars in the middle sequentially incorporate incomplete pass-through into import prices at the border, distribution costs, variable markups, and nominal rigidities to the neoclassical scenario. The red numbers between the bars indicate the percentage reduction in CPI sensitivity attributable to each additional element. The bands represent the range of estimated CPI sensitivities for the years 2008 - 2019. The final bar on the right, labeled "Estimated", displays the CPI sensitivity to exchange rate fluctuations estimated at the quarterly level over the period 1990–2019 (see Appendix B.4 for estimation details). The bands represent the range of estimated CPI sensitivities across various specifications of lags and controls. The right panel's blue bars depict the percentage change in CPI sensitivity relative to the benchmark economy when excluding one element - distribution costs, variable markups, nominal rigidities, or border price responses - at a time. Orange and green bars show the percentage change in the sensitivity of domestic and imported final goods, respectively, relative to the benchmark economy. The bands represent the range of estimated CPI sensitivities for the years 2008 - 2019.

sensitivity. These results indicate how the sensitivity of border prices and the presence of domestic wedges need to go hand in hand to fully characterize the sensitivity of CPI to exchange rate fluctuations.

The right panel of Figure 6 shows that all domestic wedges significantly contribute to the low sensitivity of CPI, mainly through their effects on domestically produced goods. I quantify the impact of each wedge by computing the change in CPI sensitivity when one wedge is removed relative to the fully calibrated benchmark economy. CPI sensitivity increases by 60% when distribution costs are excluded, while the increases are more moderate when variable markups and nominal rigidities are removed (15% and 20%, respectively), resonating the evidence in Nakamura and Zerom (2010). This difference arises because variable markups and nominal rigidities primarily affect the sensitivity of domestically produced goods exposed to imported intermediate inputs. In contrast, distribution costs influence the sensitivity of all goods in the final consumption basket, including imported final consumption goods. However, when focusing on the relative changes for domestic and imported final goods separately (orange and green bars, respectively), nominal rigidities and variable markups contribute more to reducing CPI sensitivity than distribution costs. Finally, removing incomplete pass-through in import prices at the border increases CPI sensitivity by approximately 60%, with comparable effects on both domestic and imported consumption goods.

## 3.2 Heterogeneity and composition effects

Focusing solely on the aggregate sensitivity of CPI may masquerade substantial heterogeneity across products. This heterogeneity arises from various dimensions, such as domestic wedges, exposure to import and consumption shares, which interact with one another.

The left panel of Figure 18 documents the significant dispersion in product-level sensitivities to exchange rate fluctuations. For domestic final consumption goods, sensitivities range from 0 to 0.3, while for imported final consumption goods, they span from 0 to 0.85. Figure 17 in Appendix C shows that sectoral heterogeneity aligns with economic intuition. For instance, domestic goods in the service sectors exhibit low sensitivity to exchange rates due to their relatively low exposure to imported inputs. In contrast, domestic products in sectors such as chemical and metal products exhibit higher sensitivities, reflecting their greater dependence on imported inputs. This pronounced heterogeneity shapes the aggregate CPI sensitivity by interacting with the consumption shares of individual products. Simultaneously, it reflects the interplay of product-level border price dynamics, import exposure in production, and domestic wedges.

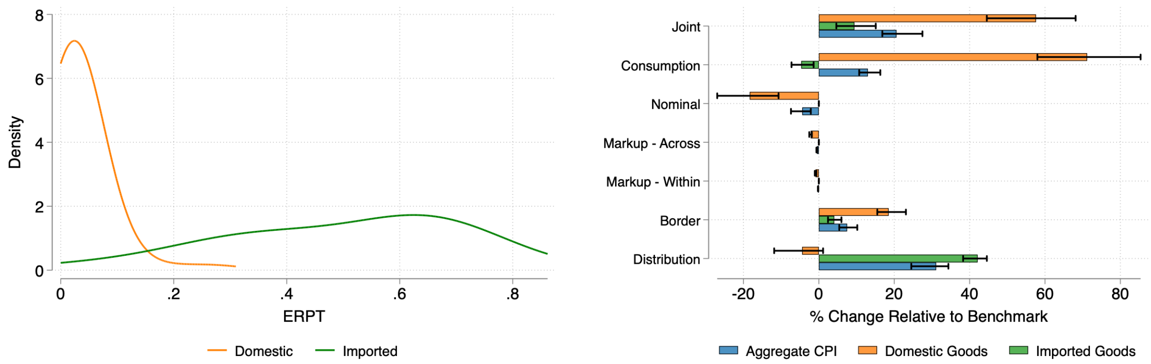
**Composition Effects** The right panel of Figure 18 shows that the heterogeneity in the primitives of the economy – such as domestic wedges, border price sensitivity, import exposure, and consumption shares – dampens the sensitivity of CPI relative to the fully calibrated benchmark model. To quantify the role of heterogeneity, I set each dimension of interest equal to its average value across products and compare the resulting sensitivities to the benchmark model.[21] In a scenario without heterogeneity in domestic wedges, border price sensitivity, and consumption shares, the CPI sensitivity increases by 20% relative to the benchmark model, primarily driven by a 60% increase in the sensitivity of domestic goods.

While joint heterogeneity across all primitives dampens CPI sensitivity, heterogeneity in individual primitives may amplify CPI sensitivity. For each characteristic – domestic wedges, border price sensitivity, and consumption shares – I assess the impact of its heterogeneity by setting it equal to its average value across products while holding all other factors at benchmark levels. Abstracting from heterogeneity in consumption shares, distribution costs, and border price dynamics reduces CPI sensitivity by approximately 13%, 31%, and 7%, respectively, consistent with the effects of joint heterogeneity. In contrast, heterogeneity in nominal rigidities and variable markups amplifies CPI sensitivity by 4% and 1%, respectively. For variable markups, sectoral differences play a more significant role than within-sector differences, amplifying CPI sensitivity by 0.65% and 0.3%, respectively.

The effects of heterogeneity in individual primitives differ in magnitude and direction between domestic and imported final consumption goods. For consumption shares, heterogeneity dampens CPI sensitivity for domestic goods but amplifies it for imported goods. Conversely,

[21] Consumption shares are set equal to the average consumption share across product without affecting the extensive margin, i.e. without altering the set of products consumed. The absence of heterogeneity in variable markups implies i) no within-sector heterogeneity (covariance terms set to zero) and ii) the same average markup elasticity across products, which is set equal to the average across products.

Figure 7: On Heterogeneity




**Note:** The left panel displays the distribution of product-level sensitivities for final goods in the consumption basket. The orange line represents domestically produced goods, while the green line represents imported final goods. The analysis uses data from 2008 to 2019. The right panel presents the percentage change in CPI sensitivity relative to the benchmark economy under various scenarios. The blue bars show the change when omitting heterogeneity in consumption shares, domestic wedges, and border price sensitivity collectively ("Joint") or individually. Orange and green bars show the percentage change in the sensitivity of domestic and imported final goods, respectively, relative to the benchmark economy. The bands represent the range of estimated CPI sensitivities for the years 2008 - 2019.

heterogeneity in distribution costs amplifies CPI sensitivity for domestic goods while dampening it for imported goods. Heterogeneity in border price sensitivity has a qualitatively similar effect on both domestic and imported goods but is quantitatively stronger for domestic goods, increasing CPI sensitivity by 18% compared to 5% for imported goods. By definition, nominal rigidities and variable markups affect only the sensitivity of domestic goods.

**Correlation in Primitives of the Economy** The effects of cross-product heterogeneity on the sensitivity of the CPI ultimately depend on the correlation between domestic wedges and the use of imported goods in production and consumption. Panel A of Table 1 shows that the share of imported inputs used in the production of domestic goods, which measures the exposure of domestic goods to exchange rate fluctuations, is positively correlated with the frequency of price adjustment and the pass-through due to variable markups in the sector. Consequently, sectors that are more influential for the overall sensitivity are also those that transmit cost shocks more strongly into their prices, explaining why removing heterogeneity in these two domestic wedges reduces the aggregate sensitivity of the CPI. Moreover, the share of imported inputs is negatively correlated with border price sensitivity of imported inputs. This finding aligns with the observation that abstracting from heterogeneity in border price sensitivity amplifies the CPI sensitivity, as the most relevant imported inputs are also those with lower sensitivity to exchange rate changes.

Panel B of Table 1 shows that the share of imported inputs used in the production of domestic goods is positively correlated with the share of distribution cost in retail prices. Therefore, sectors that are more critical for the overall sensitivity also pass cost shocks less strongly into their prices, explaining why removing heterogeneity in distribution costs increases the aggregate CPI sensitivity. Moreover, domestic products with larger consumption shares

Table 1: Correlation between Dimensions of Heterogeneity

| **Panel A:** | Nominal | Border ERPT | Average Pass-through | Covariance Pass-through Domestic Goods | Covariance Pass-through Imported Goods |
|---|---|---|---|---|---|
| Share Imported Inputs | 0.155 | -0.081 | 0.054 | 0.117 | -0.061 |
| | (0.0419) | (0.0262) | (0.0097) | (0.0003) | (0.0008) |
| $N$ | 2135 | 2135 | 2135 | 2135 | 2135 |

| **Panel B:** | Consumption Share Domestic Goods | Consumption Share Imported Goods | Distribution Domestic Goods | Distribution Imported Goods | Consumption Share Domestic Goods | Consumption Share Imported Goods |
|---|---|---|---|---|---|---|
| Share Imported Inputs | -0.0142 | | -0.1636 | -0.2546 | | |
| | (0.0020) | | (0.0295) | (0.0302) | | |
| Border ERPT | | 0.0013 | | | | |
| | | (0.0003) | | | | |
| Distribution | | | | | 0.0039 | -0.0039 |
| | | | | | (0.0014) | (0.0002) |
| $N$ | 2135 | 2135 | 2135 | 2135 | 2135 | 2135 |

**Note:** Panel A reports the regression coefficients of the aggregate share of imported inputs used in production on various sector-level primitives. These include the frequency of price adjustment (labeled "Nominal"), the average border price sensitivity of imported inputs, the average pass-through rate, and the covariance between pass-through rates and domestic or imported goods. Panel B presents the regression coefficients of the aggregate share of imported inputs used in production on the consumption share of domestic goods in the final consumption basket and the distribution margin. Additionally, it includes the regression coefficient of border price sensitivity on the consumption share of imported final goods. The last two columns display the regression coefficients of the distribution margin on the consumption shares of domestic and imported goods, respectively. Standard errors are reported in parentheses, and all coefficients are standardized to allow for comparison of the variance explained.

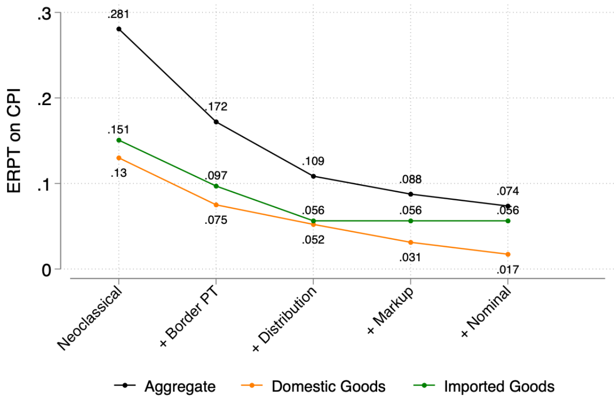
are less exposed to imported inputs in production, accounting for the rise in CPI sensitivity when heterogeneity in consumption shares is removed. The mild positive correlation between the share of imported final goods and the border price sensitivity aligns with the increased sensitivity of imported final goods when heterogeneity in consumption shares is removed.

## 3.3 Identity effect

Accounting for the presence of domestic wedges and their heterogeneity has significant implications for identifying the products or groups of products most relevant to the overall sensitivity of the CPI, a phenomenon often referred to as the identity effect.

**Direct and Indirect Exposure** The fully calibrated economy predicts that the majority of CPI sensitivity arises from the consumption of imported final goods, corresponding to the direct exposure in Equation (6). This finding contrasts with previous studies, which typically attribute equal importance to direct and indirect exposure (Goldberg and Campa, 2010; Burstein et al., 2003; Gopinath, 2015). The overestimation of the importance of domestic final goods, i.e., indirect exposure, is primarily driven by the omission of domestic wedges, which significantly affect the response of domestically produced goods. Figure 8 shows that, in a frictionless neoclassical economy, direct and indirect import exposure contribute almost equally to overall price changes (15% and 13%, respectively). Introducing border prices dynamics does not alter the relative importance of the two types of exposure. However, the relative importance shifts markedly when domestic wedges are incorporated – particularly nominal rigidities and variable markups – as these factors exclusively influence the sensitivity of domestically produced goods. Standard practices, which often fail to account for domestic wedges, quantify direct exposure

Figure 8: Macro Identity Effects




**Note:** The figure plots the CPI sensitivity to a one percent depreciation in the exchange rate across different scenarios. The first point on the left represents the average sensitivity in a counterfactual frictionless, neoclassical economy where pass-through is complete and domestic wedges are absent. Each subsequent point sequentially incorporates incomplete pass-through into import prices at the border, distribution costs, variable markups, and nominal rigidities to the neoclassical scenario. The black line represents the aggregate CPI sensitivity to a one percent depreciation in the exchange rate. The green and orange lines represent the decomposition into imported final consumption ("Imported Goods"), i.e. direct exposure, and domestic final consumption ("Domestic Goods"), i.e. indirect exposure, respectively. Values represent the average for the years 2008-2019.

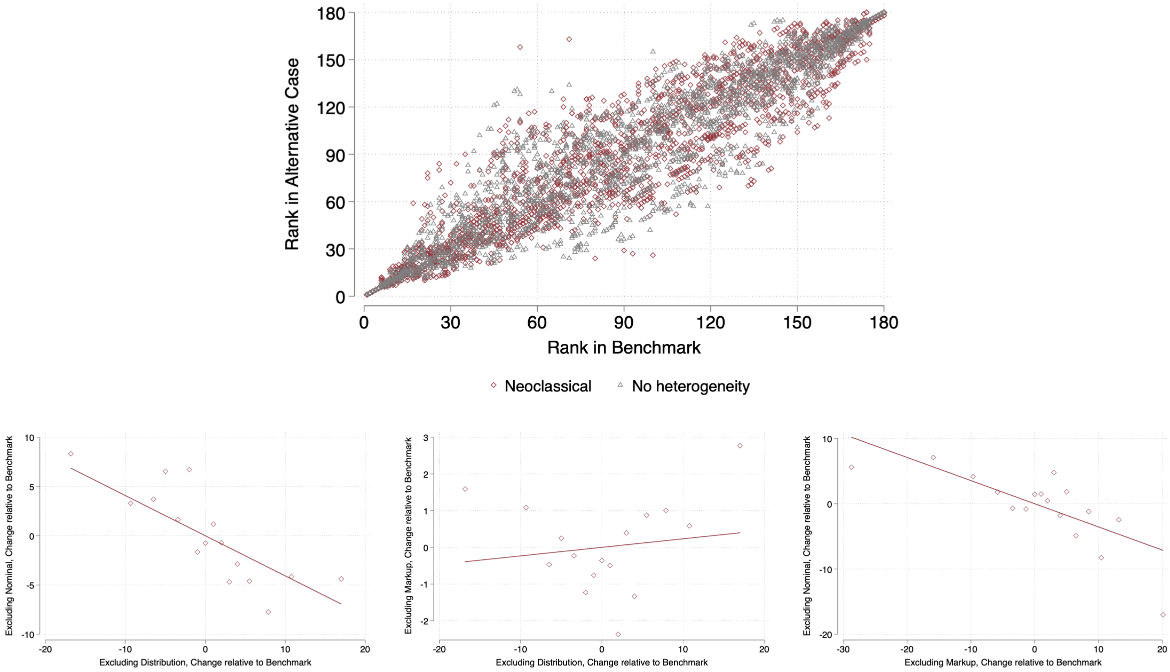
using frameworks akin to the frictionless economy, leading to potential mischaracterizations of CPI sensitivity.

**Identity Effect at the Product Level** The identity of the products most relevant for the overall CPI sensitivity shifts when different (heterogeneous) wedges are considered. The top panel of Figure 9 shows how the ranking of the products contributing most to overall CPI sensitivity changes depending on the inclusion of domestic wedges in the economy. Relative to a frictionless neoclassical benchmark or an economy without wedge heterogeneity, product rankings shift significantly, with some products moving as many as 80 positions. The three bottom panels in Figure 9 show that these changes in rankings are specific to the domestic wedge being omitted. In three separate scenarios, I exclude one domestic wedge at a time and calculate the change in product rankings relative to the benchmark economy. Omitting nominal rigidities generates identity effects that contrast sharply with those observed when distribution costs or variable markups are omitted. The identity effects arising from distribution costs and variable markups show no correlation. These findings underscore the importance of carefully considering the specific heterogeneities at play when identifying the products most critical to the transmission of exchange rate fluctuations.

## 3.4 On the Role of Input-Output linkages

The sensitivity of domestically produced goods arises not only from the direct use of imported inputs in production but also from domestic input-output linkages. Even if a domestically produced good does not directly use imported intermediate inputs, the domestic inputs in its production process might themselves be exposed to imports.

Figure 9: Micro Identity Effects




**Note:** The top panel compares the ranking of products contributing the most to CPI sensitivity in the fully calibrated benchmark model (x-axis) to their ranking in alternative scenarios (y-axis). The alternative scenarios include: a frictionless neoclassical economy that excludes all domestic wedges and border price sensitivity (red diamonds) and an economy that omits the heterogeneity in domestic wedges and border price sensitivity (gray triangles). The three bottom panels compare the changes in rankings relative to the benchmark economy when omitting specific combinations of domestic wedges: nominal rigidities and distribution costs (left panel), variable markups and distribution costs (middle panel), and nominal rigidities and variable markups (right panel). Solid lines indicate a linear fit within the binscatter plot.

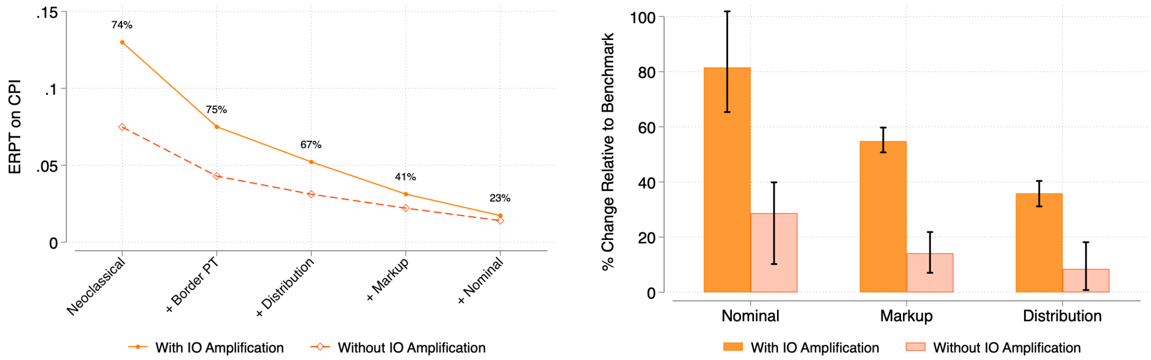
I show that, because of the presence of domestic wedges, the presence of input-output linkages amplifies the sensitivity of CPI only modestly. The left panel of Figure 10 compares the CPI sensitivity under two scenarios: one with roundabout production (solid line) and one without it (dashed line). In a frictionless neoclassical economy, input-output linkages amplify CPI sensitivity by 74%. When domestic wedges are incorporated, the amplification effect of input-output linkages diminishes to just 24% in the full benchmark model (Basu, 1994; Pasten et al., 2020).[22] This reduction occurs because domestic wedges dampen price sensitivity and limit downstream propagation at each stage of the production network (Carvalho and Tahbaz-Salehi, 2019).[23]

The inclusion of domestic wedges also alters the centrality of products within the domestic input-output network and their correlation with the use of imported inputs. To assess this, I use the PageRank centrality measure, which evaluates the relative importance of each product

[22] Incomplete pass-through at border does not affect the role of input-output linkages because it does not directly interact with the domestic Leontief matrix. The right panel of Figure 10 shows that omitting a domestic wedge from the fully calibrated model increases the sensitivity of CPI by approximately three times more when input-output linkages are present in the economy. This effect is quantitatively similar across the three domestic wedges considered – distribution costs, nominal rigidities, and variable markups.

[23] Formally, the adjusted Leontief inverse matrix captures both direct and indirect downstream propagation. Abstracting from domestic wedges involves using the Leontief inverse matrix instead of the adjusted one in Equation (17), with the former leading to stronger amplification.

Figure 10: Effects of Input-Output Linkages




**Note:** The figure plots the CPI sensitivity to a one percent depreciation in the exchange rate across different scenarios. The first point on the left represents the average sensitivity in a counterfactual frictionless, neoclassical economy where pass-through is complete and domestic wedges are absent. Each subsequent point sequentially incorporates incomplete pass-through into import prices at the border, distribution costs, variable markups, and nominal rigidities to the neoclassical scenario. The solid line depicts the aggregate CPI sensitivity to a one percent depreciation in the exchange rate, accounting for the amplification effects of domestic input-output linkages. In contrast, the dashed line represents the CPI sensitivity when the amplification from domestic input-output linkages is omitted. The right panel bars depict the percentage change in CPI sensitivity relative to the benchmark economy when excluding one element - distribution costs, variable markups, nominal rigidities - at a time. The darker bars depicts the effect accounting for the amplification effects of domestic input-output linkages. In contrast, the lighter bars represents the effect when the amplification from domestic input-output linkages is omitted. The bands represent the range of estimated CPI sensitivities for the years 2008 - 2019.

in the network. Figure 11 shows how product centrality changes when edge weights are based solely on input shares from input-output tables versus when these weights account for the presence of domestic wedges. Accounting for wedges flattens the relationship between product centrality and exposure to imported inputs, thereby reducing the overall sensitivity of CPI to exchange rate fluctuations.[24]

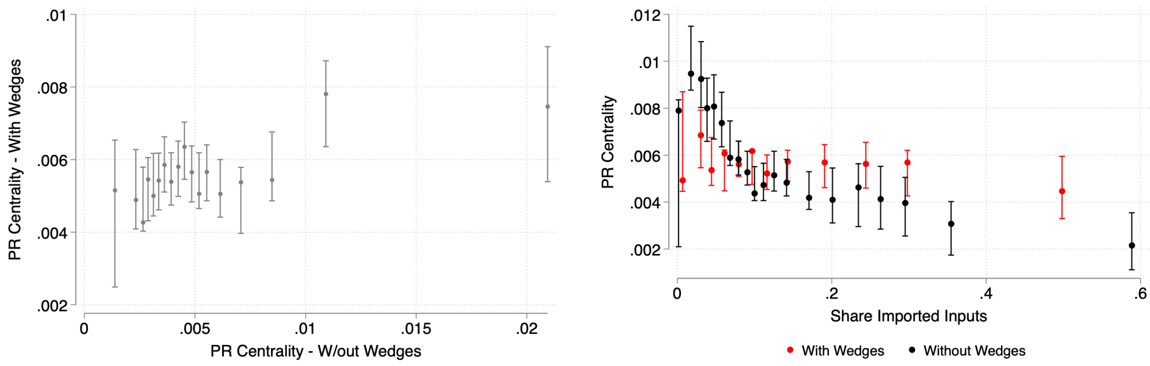
## 3.5 Robustness

Figure 19 illustrates the stability of CPI sensitivity over the period 2008–2019, suggesting that the average effect reported in Figure 6 does not obscure significant time variation. The only notable deviation occurs in 2009, where the sensitivity of the CPI decreases by 0.015. The decomposition into domestic and imported final goods reveals that this decline is entirely attributable to imported goods, consistent with the effects of the great trade collapse during the global financial crisis.

Table 8 evaluates the robustness of the benchmark economy's calibration. Following Edmond et al. (2018), I construct the average pass-through rate and the covariance terms arising from variable markups ($\mathbf{\Gamma^D}$, $\mathbf{\Lambda^D}$, and $\mathbf{\Lambda^F}$) using cost shares instead of revenue shares. Figure 15 in Appendix B demonstrates that these terms, constructed using cost shares, exhibit near-perfect correlation with their benchmark counterparts based on revenue shares. As expected,

[24] igure 20 in Appendix C shows that these qualitatively patterns holds when product centrality is constructed using the average between indegree and outdegree centrality of each product in the domestic input-output network.

Figure 11: Product Centrality and Imported Inputs




**Note:** The left panel illustrates the relationship between the PageRank centrality of a product in the input-output network when the edges are constructed based on input-output tables that include domestic wedges (y-axis) versus those that omit domestic wedges (x-axis). The right panel depicts the relationship between a product's centrality in the domestic production network and the share of imported inputs used in its production. Centrality is measured using the PageRank centrality measure, with edges weighted by input-output linkages that either include domestic wedges (red dots) or omit domestic wedges (black dots). Both panels use data spanning the years 2008 to 2019. Both panels use binscatters constructed while absorbing product and year fixed effects. The figures include 95% confidence intervals.

the sensitivities of CPI, domestic goods, and imported final goods remain consistent with those in the benchmark model.

The frequency of price adjustment is calibrated using data from the BLS. To account for potential differences between the US and Chile, I rescale the frequency distribution to match an average monthly frequency of price adjustment of 30%, as estimated by Aruoba et al. (2022) using confidential daily transaction data from the Chilean Tax Authority. This adjustment implies an average quarterly adjustment probability of 0.65, slightly higher than the benchmark calibration. Consequently, the effect of nominal rigidities on exchange rate pass-through into CPI increases marginally from 0.074 to 0.077. Nevertheless, the benchmark model's overall performance is robust to this calibration adjustment.

The customs data used to calibrate border import price sensitivity exclude service imports. For unmatched product categories in the HS classification, I assume their sensitivity equals the average pass-through rate estimated from the customs data. To test this assumption, I explore two extreme cases: full pass-through for imported services at the border and zero pass-through. Table 8 shows that complete pass-through increases CPI sensitivity marginally, from 0.074 to 0.078, while zero pass-through reduces it by nearly 0.01. Most of the impact occurs through the sensitivity of domestic final goods, indicating that imported services are primarily used as intermediate inputs rather than final goods. Overall, the benchmark model's performance remains largely unaffected by this assumption.

# 4 Conclusion

In this paper, I have examined the role of domestic wedges and their heterogeneity in the (in)sensitivity of domestic prices to exchange rate fluctuations. I find that domestic wedges

– distribution costs, variable markups, and nominal rigidities – account for most of the low sensitivity of the CPI to exchange rate movements. Additionally, I show that accounting for the presence and heterogeneity of domestic wedges has important implications for identifying the products or product groups most relevant to overall CPI sensitivity. Contrary to previous literature, I find that most of the sensitivity arises from direct exposure (imported final consumption), as domestic wedges dampen the response of domestically produced goods (indirect exposure) to a greater extent. Furthermore, the identity of the products contributing most to the transmission of exchange rate fluctuations depends on the specific sources of heterogeneity considered. This underscores the importance of jointly accounting for the wedges and mechanisms included in the analysis. In this regard, the model and calibration strategy used in this paper can help guide future research on the relationship between domestic prices and exchange rates.

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# A Appendix - Theory

## A.1 Derivations of key pass-through equations

**Producers of sectoral varieties.** Consider a domestic sector $i$. The $N_i$ firms indexed by $k$ within the sector employ a CRS technology to produce a variety of the same product:

$$y_{ik} = F_i(l_{i,k}, x_{i1,k}, \cdot, x_{iN,k}) = \zeta_{ik} l_{i,k}^{\alpha_{ik,l}} \prod_{j=1}^{N} x_{ij,k}^{\alpha_{ik,j}} \qquad \text{with } \alpha_{ik,l} + \sum_{j=1}^{N} \alpha_{ik,j} = 1 \quad \forall k, \tag{23}$$

where each firm $k$ potentially uses a different mix of inputs (i.e. exponents are $k$-specific).

Given the assumption on the distributor's aggregating technology, producers charge a variable markup over the marginal cost:

$$\widetilde{p_{ik}} = \mu_{i_k} mc_{ik} \qquad \text{with } mc_{ik} \propto w^{\alpha_{ik,l}} \prod_{j=1}^{N} p_j^{\alpha_{ik,j}}, \tag{24}$$

where $\widetilde{p_{ik}}$ is the price paid by the distributor for variety $k$, $\mu_{ik} = \frac{\varepsilon_{ik}}{\varepsilon_{ik}-1}$ is the markup charged, that depends on the perceived demand elasticity $\varepsilon_{ik}$, and the expression for the marginal cost, $mc_{ik}$, comes from the specific production function assumed.

**Derivation of sectoral price inflation** We focus on the direct effect of a change in the marginal cost on the producer price at fixed aggregate price (Burstein and Gopinath, 2014). Consider a domestic sector $i \in H$. At the firm level, the change in the price of variety $k$ in sector $i$ is given by:

$$\partial \log \widetilde{p_{ik}} = \kappa_{ik} \partial \log mc_{ik},$$

where $\kappa_{ik} \equiv \frac{1}{1+\Gamma_{ik}}$, and $\Gamma_{ik} \equiv -\frac{\partial \log \mu_{ik}}{\partial \log \widetilde{p_{ik}}}$ is the markup elasticity.

It follows that the sectoral price inflation is:

$$\partial \log \widetilde{p_i} \equiv \sum_{k \in N_i} S_{ik} \partial \log \widetilde{p_{ik}} = \sum_{k \in N_i} S_{ik} \kappa_{ik} \partial \log mc_{ik} = \bar{\kappa}_i \partial \overline{\log mc}_i + cov_{S_{ik}} \left( \kappa_{ik}, \partial \log mc_{ik} \right), \tag{25}$$

where $S_{ik}$ is the revenues share of firm $k$ in sector $i$; $\bar{x}$ is the revenues-weighted average of variable $x$, i.e. $\bar{x} = \sum_{k \in N_i} S_{ik} x_{ik}$; and $cov_{z_{ik}}(x_{ik}, y_{ik})$ is the $z$-weighted covariance between two variables $x$ and $y$, i.e. $cov_{z_{ik}}(x_{ik}, y_{ik}) = \sum_{k \in N_i} z_{ik}(x_{ik} - \bar{x})(y_{ik} - \bar{y})$.

**Derivation of marginal cost changes** Given the production technology in Equations (23) and (24), the change in the marginal cost of producer $k$ in domestic sector $i$ following a change in input prices is as follows:

$$\partial \log mc_{ik} = \sum_{j=1}^{N} \alpha_{ik,j} \partial \log p_j, \tag{26}$$

where $\alpha_{ik,j}$ is the exposure of firm $k$ in sector $i$ to input $j$, and $p_j$ is the retail price of input $j$. It follows that we can write:

$$\partial \overline{\log mc}_i = \sum_{k \in N_i} S_{ik} \sum_{j=1}^{N} \alpha_{ik,j} \partial \log p_j = \sum_{j=1}^{N} \overline{\alpha_{ij}} \partial \log p_j, \tag{27}$$

where $\overline{\alpha_{ij}} = \sum_{k \in N_i} S_{ik}\alpha_{ik,j}$ is the revenue-weighted average input share of product $j$ in sector $i$. Moreover, we can rewrite the covariance term in Equation (25) as follows:

$$cov_{S_{ik}}\left(\kappa_{ik}, \partial \log mc_{ik}\right) = \sum_{j}^{N} \partial \log p_j cov_{S_{ik}}\left(\kappa_{ik}, \alpha_{ik,j}\right). \tag{28}$$

**Derivation of retail price inflation** Given the assumption of the distribution sector and the Calvo-style nominal rigidities, we can write the change in the retail price of a *domestic* good $i$ as follow:

$$\partial \log p_i = \phi_i \delta_i \partial \log \widetilde{p}_i. \tag{29}$$

Substituting Equations (25), (27), and (28), we obtain:

$$\partial \log p_i = \phi_i \delta_i \sum_{j}^{N} \partial \log p_j \left[\overline{\alpha_{ij}} \bar{\kappa}_i + cov_{S_{ik}}\left(\kappa_{ik}, \alpha_{ik,j}\right)\right]. \tag{30}$$

Part of the inputs used in the production of domestic goods are imported, i.e. $N$ can be partitioned into domestic ($n_D$) and imported inputs ($n_F$), i.e. $N = n_D + n_F$. We can therefore rewrite Equation (30) highlighting this difference:

$$\begin{aligned} \partial \log p_i =& \phi_i \delta_i \sum_{j}^{n_D} \partial \log p_j \left[\overline{\alpha_{ij}} \bar{\kappa}_i + cov_{S_{ik}}\left(\kappa_{ik}, \alpha_{ik,j}\right)\right] + \\ & \phi_i \delta_i \sum_{j}^{n_F} \partial \log p_j \left[\overline{\alpha_{ij}} \bar{\kappa}_i + cov_{S_{ik}}\left(\kappa_{ik}, \alpha_{ik,j}\right)\right]. \end{aligned}$$

We can therefore solve for the change in the retail price of a domestic good $i \in n_D$. In matrix form, we can write:

$$\mathbf{\Pi^D} = \left[\mathbf{I} - \mathbf{\Phi^D \Delta^D}\left(\mathbf{\Gamma^D S^D} + \mathbf{\Lambda^D}\right)\right]^{-1} \mathbf{\Phi^D \Delta^D}\left(\mathbf{\Gamma^D S^F} + \mathbf{\Lambda^F}\right) \mathbf{\Pi^F}, \tag{31}$$

with:

$$\mathbf{\Phi^D}=\begin{bmatrix}\phi_1 & 0 & 0\\ \vdots & \ddots & \vdots\\ 0 & 0 & \phi_{n_D}\end{bmatrix},\qquad \mathbf{\Delta^D}=\begin{bmatrix}\delta_1 & 0 & 0\\ \vdots & \ddots & \vdots\\ 0 & 0 & \delta_{n_D}\end{bmatrix},\qquad \mathbf{\Gamma^D}=\begin{bmatrix}\bar{\kappa}_1 & \cdots & \bar{\kappa}_{n_D}\\ \vdots & \ddots & \vdots\\ \bar{\kappa}_1 & \cdots & \bar{\kappa}_{n_D}\end{bmatrix},$$

$$\mathbf{\Lambda^F}=\begin{bmatrix}cov_{S_{1k}}\left(\kappa_{1k},\alpha_{1k,1}\right) & \cdots & cov_{S_{1k}}\left(\kappa_{1k},\alpha_{1k,n_F}\right)\\ \vdots & \ddots & \vdots\\ cov_{S_{n_Dk}}\left(\kappa_{n_Dk},\alpha_{n_Dk,1}\right) & \cdots & cov_{S_{n_Dk}}\left(\kappa_{n_Dk},\alpha_{n_Dk,n_F}\right)\end{bmatrix},\qquad \mathbf{S^F}=\begin{bmatrix}\overline{\alpha_{11}} & \cdots & \overline{\alpha_{1n_F}}\\ \vdots & \ddots & \vdots\\ \overline{\alpha_{n_D1}} & \cdots & \overline{\alpha_{n_Dn_F}}\end{bmatrix},$$

$$\mathbf{\Lambda^D}=\begin{bmatrix}cov_{S_{1k}}\left(\kappa_{1k},\alpha_{1k,1}\right) & \cdots & cov_{S_{1k}}\left(\kappa_{1k},\alpha_{1k,n_D}\right)\\ \vdots & \ddots & \vdots\\ cov_{S_{n_Dk}}\left(\kappa_{n_Dk},\alpha_{n_Dk,1}\right) & \cdots & cov_{S_{n_Dk}}\left(\kappa_{n_Dk},\alpha_{n_Dk,n_D}\right)\end{bmatrix},\qquad \mathbf{S^D}=\begin{bmatrix}\overline{\alpha_{11}} & \cdots & \overline{\alpha_{1n_D}}\\ \vdots & \ddots & \vdots\\ \overline{\alpha_{n_D1}} & \cdots & \overline{\alpha_{n_Dn_D}}\end{bmatrix},$$

$$\mathbf{\Pi^D}=\left[\partial\log p_1,\cdots,\partial\log p_{n_D}\right]^T,\qquad \mathbf{\Pi^F}=\left[\partial\log p_1,\cdots,\partial\log p_{n_F}\right]^T.$$

where $\mathbf{\Pi^D}$ and $\mathbf{\Pi^F}$ are the $n_D\times 1$ and $n_F\times 1$ vectors of changes in domestic and foreign prices, respectively; $\mathbf{\Phi^D}$ and $\mathbf{\Delta^D}$ are the $n_D\times n_D$ diagonal matrices of sectoral distribution margins and Calvo parameters, respectively; $\mathbf{S^D}$ ($\mathbf{S^F}$) is the $n_D\times n_D$ ($n_D\times n_F$) matrix of average use of domestic (foreign) inputs in the production of domestic goods; $\mathbf{\Gamma^D}$ is the $n_D\times n_D$ matrix of sectoral revenue-weighted average pass-through; $\mathbf{\Lambda^D}$ ($\mathbf{\Lambda^F}$) is the $n_D\times n_D$ ($n_D\times n_F$) matrix of sectoral covariances between firm-level markup elasticity and the use of domestic (imported) inputs in the production of domestic goods.

**Derivation of exchange rate pass-through into domestic inflation** Equation (17) in the main text follows from Equation (31). The pass-through into the retail price of domestic goods, $\boldsymbol{\eta^D}=\left[\frac{\partial\log p_1}{\partial\log e},\cdots,\frac{\partial\log p_H}{\partial\log e}\right]^T$ can be written as:

$$\begin{aligned}\boldsymbol{\eta^D}&=\left[\mathbf{I}-\mathbf{\Phi^D\Delta^D}\left(\mathbf{\Gamma^D S^D}+\mathbf{\Lambda^D}\right)\right]^{-1}\mathbf{\Phi^D\Delta^D}\left(\mathbf{\Gamma^D S^F}+\mathbf{\Lambda^F}\right)\boldsymbol{\eta^F}\\ &=\left[\mathbf{I}-\mathbf{\Phi^D\Delta^D}\left(\mathbf{\Gamma^D S^D}+\mathbf{\Lambda^D}\right)\right]^{-1}\mathbf{\Phi^D\Delta^D}\left(\mathbf{\Gamma^D S^F}+\mathbf{\Lambda^F}\right)\mathbf{\Phi^F\Psi^F},\end{aligned}$$

where $\boldsymbol{\eta^F}=\left[\frac{\partial\log p_1}{\partial\log e},\cdots,\frac{\partial\log p_F}{\partial\log e}\right]^T$ is the vector of exchange rate pass-through rates in the retail price of imported goods. In the second equation, we rewrite $\mathbf{\Omega^F}$ as the product of sectoral distribution margins, $\mathbf{\Phi^F}$, and the sensitivity of the local-currency producer price of the imported good to exchange rates, $\mathbf{\Psi^F}$.

Lastly, given the assumption on the aggregate consumption bundle and the model-based measure of inflation and pass-through, Equation (6) in the main text follows immediately:

$$\eta\equiv\frac{\partial\log\pi}{\partial\log e}=\boldsymbol{\beta^D}*\boldsymbol{\eta^D}+\boldsymbol{\beta^F}*\boldsymbol{\eta^F}. \tag{32}$$

# B Appendix - Data and Empirics

## B.1 Markup and Markup Elasticity Estimation

The following section provides a detailed description of the estimation of markups and markup elasticities.

**Data construction** I use data from the Annual Survey of Manufacturing (ENIA), administrated by the Chilean National Institute of Statistics (INE), covering the years 1995 - 2015. The data is at the establishment-year level and includes approximately 30 manufacturing industries, with roughly 4,000 observations per year. For each observation, the dataset contains information on capital stock, labor, wage bill, domestic and imported materials, revenues, and electricity consumption.[25] Capital stock data are unavailable after 2015. As a robustness check, we extend the sample to 2019 by constructing the capital stock using investment and depreciation data via a perpetual inventory method. Industries are defined at the three-digit CIIU Rev. 3 level (Chilean industry classification).

Observations with zero or negative values for capital, materials, revenues, or wage bill are excluded. Additionally, I drop observations with a labor share or materials share of revenue exceeding one. To remove outliers, I exclude observations in the bottom and top 5% of labor and materials shares of revenue for each industry.

A firm-level measure of capital costs is constructed as the product of capital stock and the rental rate net of depreciation. The average real interest rate for Chile during the sample period, reported in the World Bank World Development Indicators, serves as a proxy for the rental rate of capital (Raval, 2023).[26] The rental rate is combined with sectoral depreciation rates from Oberfield and Raval (2021), after creating a concordance between NAICS and CIIU classifications.

Table 2 reports the mean, the median, and the standard deviation of the key variables used in the dataset.

**Measuring Markup** Under the assumption of constant return to scale, as in the theoretical framework in Section 1, Autor et al. (2020) shows that markup can be measured as the ratio of firm sales to total costs:

$$\mu_{it} = \frac{\alpha_{it}^v}{S_{it}^v} = \frac{\texttt{Sales}_{it}}{\texttt{Total Cost}_{it}}, \tag{33}$$

where $\alpha_{it}^v$ and $S_{it}^v$ represent the output elasticity and the factor share of input $v$ ($S_{it}^v = \frac{\texttt{Expenditure on } v}{\texttt{Sales}_{it}}$), respectively. The second equality follows from the CRS assumption, i.e. $\alpha_{it}^v = \frac{\texttt{Expenditure on } v}{\texttt{Total Cost}_{it}}$. In mapping Equation (33) to the data, I assume that total costs are equal to the sum of wage bill, materials expenditure, and capital costs.

[25] The INE applies a small amount of noise to all variables to ensure statistical privacy. For integer variables, such as labor, I use the floor of the value reported by INE.

[26] The real interest rate represents the private sector lending rate, adjusted for the domestic inflation rate as measured by the GDP deflator.

Table 2: Summary Statistics - Firms Level Data

| | Mean | Median | Sd |
|---|---|---|---|
| Revenues | 4844162.47 | 483788.12 | 34550569.32 |
| Wage Bill | 507305.73 | 101679.23 | 2899456.52 |
| Capital Stock | 3856994.72 | 133303.42 | 80629588.68 |
| Materials | 2130928.83 | 223607.36 | 18598449.48 |
| Imported Materials | 412995.46 | 0.00 | 7524363.83 |
| Observations | 69389 | | |

**Note:** The table reports the mean, median, and standard deviation of key firm-level variables from the ENIA manufacturing survey, covering the period 1995–2015. All values are expressed in nominal Chilean pesos. Observations with zero or negative values for capital, materials, revenues, or wage bill are excluded. Additionally, observations with a labor share or materials share of revenue exceeding one are removed. The data are trimmed at the 5% within each industry.

Table 3: Summary Statistics - Markup and Markup Elasticity

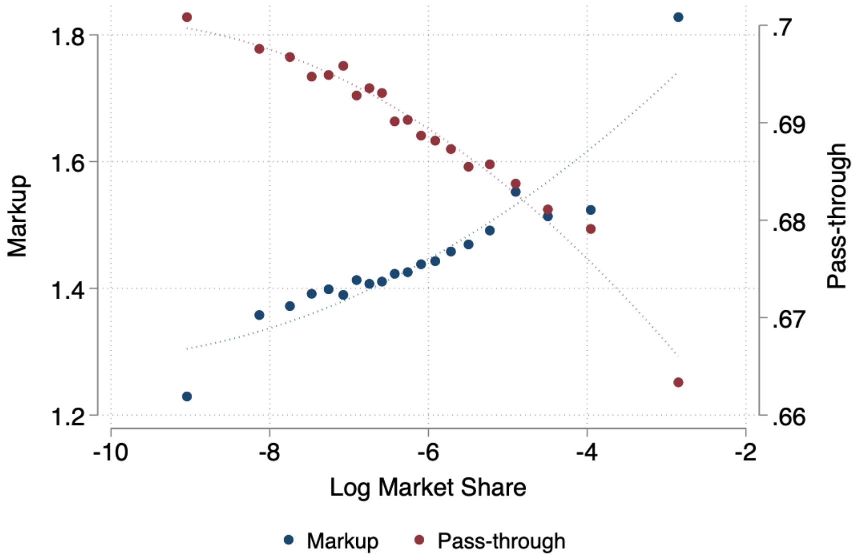
| | Mean | Median | Sd | P10 | P90 |
|---|---|---|---|---|---|
| Markup | 1.39 | 1.28 | 0.94 | 1.00 | 1.77 |
| $\frac{\epsilon}{\sigma}$ | 0.34 | 0.29 | 0.11 | 0.19 | 0.51 |
| Markup Elasticity | 0.48 | 0.44 | 0.25 | 0.27 | 0.71 |
| Pass-through | 0.69 | 0.69 | 0.08 | 0.58 | 0.79 |
| Revenue Share | 0.01 | 0.00 | 0.03 | 0.00 | 0.02 |
| Cost Share | 0.01 | 0.00 | 0.03 | 0.00 | 0.02 |
| Share Domestic Inputs | 0.63 | 0.64 | 0.16 | 0.41 | 0.82 |
| Share Imported Inputs | 0.05 | 0.00 | 0.14 | 0.00 | 0.22 |
| Observations | 69389 | | | | |

**Note:** The table reports the mean, the median, the standard deviation, the 10th and 90th percentile of the distribution of markups, estimated $\frac{\epsilon}{\sigma}$, markup elasticities and implied pass-through rates, revenue and cost shares, domestic and imported input shares. Markups are computed as the ratio of firm sales to total costs (Autor et al., 2020). The ratio $\frac{\epsilon}{\sigma}$ is estimated using the estimated markups and Equation (36). Markup elasticities and implied pass-through rates are computed from Equation (35) using the estimated coefficients and markups. The revenue (cost) shares represent the share of each firm in the total revenues (costs) of the CIIU sector. The share of domestic input is computed as the share of imported materials over total costs. The share of imported input is computed as one minus the share of domestic materials over total costs. Data are from the ENIA manufacturing survey, covering the period 1995–2015.

Table 3 shows that the estimated average and median markups are 40% and 30%, respectively, consistent with previous estimate using similar data. Furthermore, Figure 12 shows that markups increase with a firm's market share, aligning with extensive previous literature and supporting the Marshall's weak second law assumed in the theoretical framework presented Section 1 (Equation (7) ).

**Markup Elasticity and Pass-Through** Measuring markups allows the estimation of the markup elasticity. To make progress, I assume that the Kimball aggregator in the distributor's technology in Equation (7) follows the function form proposed by Klenow and Willis (2016).

Figure 12: Relationship Market Share, Markup and Pass-through Rate




**Note:** The figure plots the binscatter plot between the log market share and the markup (left axis) and the pass-through (right axis) after absorbing for industry fixed effects. The market share is compute as the share of each firm in the total revenues of the CIIU sector. Markups are constructed as the ratio of firm sales to total costs (Autor et al., 2020). Pass-through rates are computed under the Kimball aggregator assumption, using the estimated markups.

Thus, the inverse demand for each variety $k$ can be written as follows:

$$\mathcal{K}_i' = \frac{\sigma}{\sigma - 1} \exp\left(\frac{1 - \left(\frac{y_{ki}}{y_i}\right)^{\frac{\epsilon}{\sigma}}}{\epsilon}\right). \tag{34}$$

This formulation depends on two parameters: the demand elasticity, $\sigma > 1$, and the demand superelasticity, $\epsilon$. Importantly, the markup elasticity of firm $k$ in sector $i$, $\Gamma_{ki} = -\frac{\partial \log \mu_{ki}}{\partial \log p_{ki}}$, takes the following function form:

$$\Gamma_{ki} = \frac{\epsilon}{\sigma} \mu_{ki}, \tag{35}$$

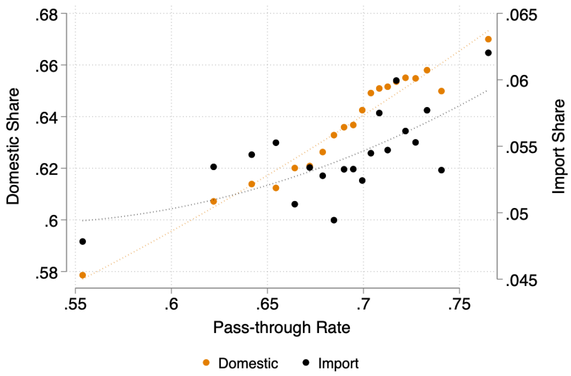
which can be computed given $\sigma$, $\epsilon$, and firm-level markups $\mu_{ki}$.

I follow Edmond et al. (2018) and estimate the elasticity and superelasticity of demand ($\sigma$ and $\epsilon$) to calibrate the Kimball aggregator and compute firms' markup elasticity. The Klenow and Willis (2016) specification for the Kimball aggregator in Equation (34) allows to specify the following within-industry relationship between markups and market shares:

$$\frac{1}{\mu_{ki}} + \log\left(1 - \frac{1}{\mu_{ki}}\right) = \texttt{constant} + \gamma \log s_{ki} + \nu_{ki} \tag{36}$$

where $\gamma = \frac{\epsilon}{\sigma}$ and $s_{ki}$ is the market share of firm $k$ in sector $i$. I estimate this specification for each sector in the economy (CIIU industry), introducing firm and year fixed effects to control for unobserved productivity and/or quality differences as well as aggregate dynamics. I also exclude observations with market shares lower (larger) than the 5th (95th) percentile within each industry.

Figure 13: Correlation Pass-through - Domestic and Imported Inputs




**Note:** The figure plots the relationship between firm-level pass-through rates and the share of domestic (left axis) and imported inputs (right axis), after absorbing industry fixed effects. Pass-through rates are computed under the Kimball aggregator assumption, using the estimated markups. The share of domestic input is computed as the share of imported materials over total costs. The share of imported input is computed as one minus the share of domestic materials over total costs. Data are from the ENIA manufacturing survey, covering the period 1995–2015.

Table 3 reports moments of the estimated $\frac{\epsilon}{\sigma}$, the implied markup elasticities, and the pass-through rates (where the pass-through rate is $\kappa_{ki} = \frac{1}{1+\Gamma_{ki}}$). The average estimated value for $\frac{\epsilon}{\sigma}$ is 0.34, consistent with the calibrated value used in Amiti et al. (2019) and in macroeconomic studies of exchange rate pass-through more broadly.[27] The average implied markup elasticity is 0.48, which in turn implies a pass-through rate of 69%.

Importantly, there is substantial heterogeneity in markup elasticity and pass-through rate across firms. Given the estimated demand elasticities and the distribution of markups, the pass-through rate ranges from 0.58 to 0.8 between the 10th and 90th percentiles of the distribution. This dispersion is pass-through rates is comparable to that estimated in Amiti et al. (2019) using Belgian data.[28]

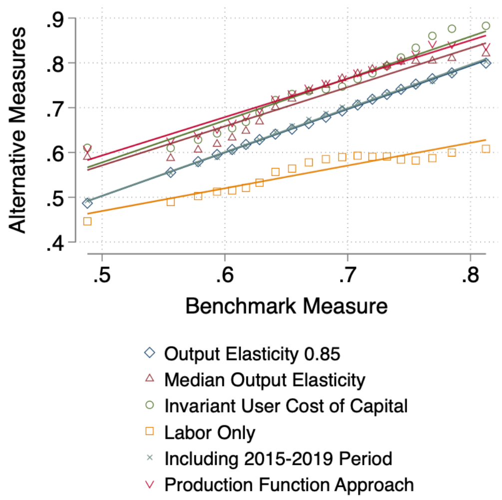
**Robustness** I show that the distribution of markups used to estimate markup elasticities and pass-through rates is robust to variations in how markups are constructed. Figure 14 show that markup values remain consistent under several key assumptions: i) using a constant output elasticity for the composite input $v$, $\alpha^v_{it}$, equal to the sectoral median as in Raval (2023); ii) adopting a time-invariant user cost of capital of 0.14, as in De Loecker et al. (2020); iii) applying a common constant output elasticity of 0.85, as in De Loecker et al. (2020); iv) extending the sample to include data from 2015–2019, where a proxy for capital stock is constructed.[29] Moreover, state-of-the-art production function estimation techniques provides very similar markup values. I construct consistent measures of inputs and outputs over time

[27] Amiti et al. (2019) calibrates $\sigma$ equal to 5 and $\epsilon$ to 1.6, implying a value of 0.32 for the ratio. A value of 0.34 is however higher than the micro-level estimates of 0.16 in Edmond et al. (2018).

[28] Amiti et al. (2019) estimate pass-through rates of 0.9 for small firms and 0.4 for large firms. The Chilean data used in this study replicate similar patterns, though large firms exhibit relatively higher sensitivity, with pass-through rates exceeding those found in Amiti et al. (2019).

[29] In line with previous literature (e.g. Raval (2023)), markups are sensitive to the choice of the variable input $v$. Using only labor as variable input, markups are lower than in the benchmark case.

Figure 14: Alternative Measures of Markup




**Note:** The figure displays a binscatter plot between the benchmark measure of markups and the alternative measures constructed as robustness. The benchmark measure is constructed as the ratio of firm sales to total costs (Autor et al., 2020). Alternative markups are constructed: i) applying a common constant output elasticity of 0.85 (blue diamonds); ii) using a constant output elasticity for the composite input equal to the sectoral median (maroon triangles); iii) adopting a time-invariant user cost of capital of 0.14 (green circles); iv) using only labor as variable input (yellow squares); v) extending the sample to include data from 2015–2019 (gray crosses); vi) applying state-of-the-art production function estimation techniques (Levinsohn and Petrin, 2003; Ackerberg et al., 2015) (red check marks). Straight lines represent a linear fit between the benchmark and the alternative markup measures. Data are from the ENIA manufacturing survey, covering the period 1995–2015.

using capital, imported and domestic materials, and output deflators.[30] I estimate production function applying the Ackerberg et al. (2015) correction to the Levinsohn and Petrin (2003) approach, using electricity consumption as a control variable and the sum of labor and material expenditure as the variable input.

The key measures of interest for the pass-through equations, the weighted average pass-through rate ($\mathbf{\Gamma^D}$) and the covariance terms ($\mathbf{\Lambda^D}$ and $\mathbf{\Lambda^F}$), are robust to the weighting. Figure 15 shows that the terms $\mathbf{\Gamma^D}$, $\mathbf{\Lambda^D}$ and $\mathbf{\Lambda^F}$ constructed using cost shares exhibit a near-perfect correlation with benchmark measures constructed using revenue shares.

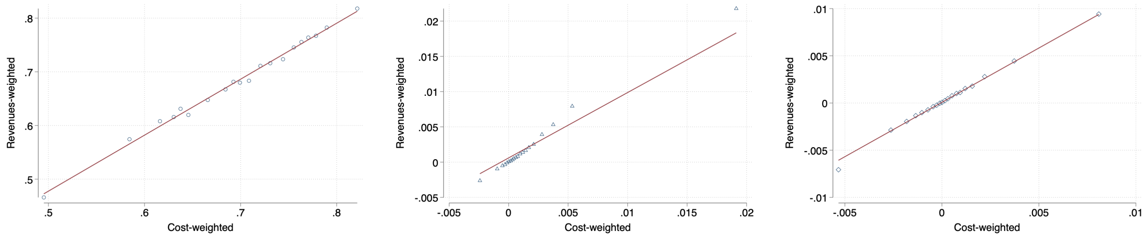
## B.2 Input-Output Tables

I construct the yearly input-output matrix for the Chilean economy by combining the "make" and "use" tables provided by the Central Bank of Chile (*Banco Central de Chile*) for the period 2008 to 2019.[31] I combine these tables to create a product-by-product input-

[30] For output and domestic materials, deflators are industry specific. Deflators are downloaded from the Central Bank of Chile: https://si3.bcentral.cl/siete/ES/Siete/Cuadro/CAP_CCNN/MN_CCNN76/CCNN2018_G3_A?idSerie=F033.FKF.DEF.Z.CLP.EP18.0.A for capital; https://si3.bcentral.cl/Siete/ES/Siete/Cuadro/CAP_CCNN/MN_CCNN76/CCNN1996_P3_A/CCNN1996_P3_A for output and domestic materials; https://si3.bcentral.cl/Siete/ES/Siete/Cuadro/CAP_BDP/MN_BDP42/BP6M_IND_EXPORT_A_96_11/BP6M_IND_EXPORT_A_96_11?cbFechaInicio=1996&cbFechaTermino=2011&cbFrecuencia=ANNUAL&cbCalculo=NONE&cbFechaBase= for imports and exports.

[31] Data are available at the following website: https://www.bcentral.cl/web/banco-central/cuentas-nacionales-anuales-excel. Data before 2008 do not have the same granularity in terms of

Figure 15: Revenue vs Cost Weighting




**Note:** The three panels plot the revenue-weighted $\mathbf{\Gamma^D}$, $\mathbf{\Lambda^D}$ and $\mathbf{\Lambda^F}$ against the cost-weighted counterparts. The left panel plots the average pass-through, $\mathbf{\Gamma^D}$, constructed under the Kimball aggregator assumption with markups constructed as the ratio of firm sales to total costs (Autor et al., 2020). The middle and right panels plot the covariance between pass-through rates and the aggregate share of domestic and imported inputs, respectively. The revenue (cost) shares represent the share of each firm in the total revenues (costs) of the CIIU sector. Firm-level pass-through rates and input shares are estimated using firm-level balance sheet data from the Annual Survey of Manufacturing (ENIA), administered by the Chilean National Institute of Statistics (INE), spanning the years 1995 to 2015.

output matrix that quantifies the extent to which each product is used in the production of other products. I opt to construct a product-by-product matrix, rather than an industry-by-industry one, in order to leverage the larger product dimension available in the make and use tables.

Following standard best practices outlined in Mahajan (2018) and Miller and Blair (2009), I construct the input-output table under the industry technology assumption. Consider the product-by-industry make matrix, $V^T$, and the product-by-industry use matrices for domestic and imported products, $U_d$ and $U_m$, respectively. Let $g^T$ represent the row vector of industry output, i.e. the column sum of $V^T$. I then construct the product-mix matrix $C$,

$$C = V^T \left[\mathtt{diag}(g^T)\right]^{-1},$$

which collects the share of each product in the output of an industry. Under the industry technology assumption, each industry has its own specific production process, irrespective of its product mix.[32] I create the domestic and international Leontief matrices by multiplying the product-mix matrix $C$ to the use matrices $U_d$ and $U_m$:

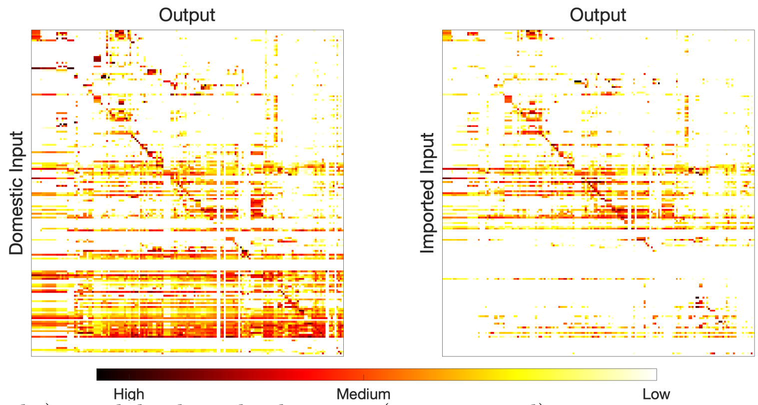
$$\mathbf{S^D} = U_d C^T \qquad \mathbf{S^F} = U_m C^T,$$

where $\mathbf{S^D}$ and $\mathbf{S^F}$ represent the domestic and international product-by-product Leontief matrices, respectively.

product classification.

32 Compared to the more commonly used product technology assumption, the key advantage of the industry technology assumption is that it prevents the occurrence of negative elements in the input-output table.

Figure 16: Domestic and International Leontief Matrices




**Note:** The left (right) panel displays the domestic (international) input-output matrix of the Chilean economy, with the shares averaged over the period 2008-2012. The matrices are constructed using the make and use table under the industry technology assumption. Each row (column) represents an input (output). The color intensity indicates the extent to which one product is used as an input in the production of other products: darker (lighter) colors correspond to higher (lower) input share. Log input shares smaller than -10 are censored.

## B.3 ERPT into Border Prices

For each import transaction, the Chilean Customs dataset includes standard information such as the importer's unique identifier (*importer*), the 8-digit HS product code (*product*), the transaction date, the country of origin (*origin*), the FOB and CIF values, and the quantity shipped. This dataset covers the period from 2007 to 2019. I compute import prices as unit values by dividing the shipment value by the quantity shipped. I aggregate the data at the importer-product-origin level at quarterly frequency. ransactions with missing information, such as missing quantity, value, or weight, are excluded from the dataset. Panel A of Table 5 provides summary statistics of the main variables while Panel B reports information on industry and origin composition of the data. For the estimation of exchange rate pass-through rates, I use bilateral exchange rates between the Chilean peso and the currency of the origin country at quarterly frequency. These exchange rates are sourced at a quarterly frequency from Bloomberg/Datastream.

## B.4 Empirical CPI Sensitivity to Exchange Rates

Following Goldberg and Campa (2010) and Burstein and Gopinath (2014), I estimate the aggregate CPI sensitivity for the period 1990-2019 at the quarterly level using the following specification:

$$\Delta \log CPI_t = \sum_{\tau=0}^{6} \beta_\tau \Delta \log e_{t-\tau} + \sum_{\tau=0}^{6} \gamma_\tau X_{t-\tau} + \varepsilon_t, \tag{37}$$

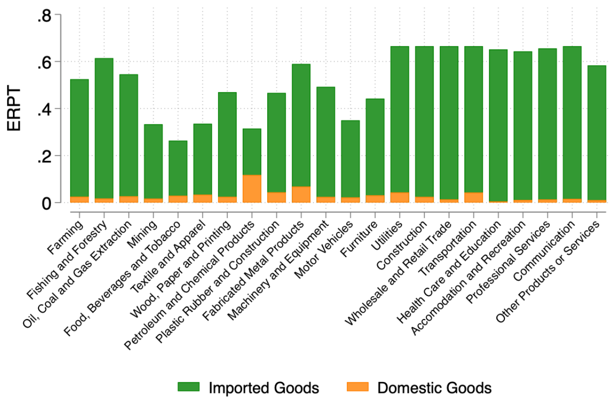
where $CPI$ is the Chilean consumer price index at the quarterly frequency, $e$ is the nominal exchange rate between the Chilean peso and the US dollar, and $X$ is a vector of controls that includes i) the inflation rate in the exporting country as proxy for trading partners' costs (Campa and Goldberg, 2005; Burstein and Gopinath, 2014) and ii) Chile's real GDP growth rate.[33] I include up to six lags to control for gradual adjustments and auto-correlation in inflation and exchange rates. Data are sourced from IMF and Datastream.

The estimated contemporaneous CPI sensitivity from Equation (37) is 7.4%, in line with estimates in the literature (Goldberg and Campa, 2010). Table 7 shows that the coefficient is robust to different specifications. Column (2) replaces the USD-Peso bilateral exchange rate with the trade-weighted nominal exchange rate between the Chilean peso and the exporting country's currency. In this case, trading partners' costs are proxied by the difference between the nominal and the real effective exchange rate sourced from the IMF as in Campa and Goldberg (2005). The coefficient remains robust to including four or eight lags (Columns (3) and (4), respectively). Column (5) shows that omitting additional controls does not affect the point estimate.

[33] I consider the US-Chile bilateral exchange rate because the majority of Chilean imports are denominated in US dollar (Gopinath et al., 2020).

# C Appendix - Additional Results

Figure 17: Sectoral Heterogeneity




**Note:** The figure presents the average sensitivity of final goods across 2-digit CIUU industries, as computed in the fully calibrated benchmark economy. For each industry, the bars represent the average sensitivity of domestically produced final goods (orange) and imported final goods (green).

Table 4: Distribution Margin - Summary Statistics

| **Panel A:** | Mean | Median | St Dev |
|---|---|---|---|
| Intermediate - Domestic | 0.122 | 0.047 | 0.195 |
| Intermediate - Imported | 0.133 | 0.043 | 0.203 |
| Final - Domestic | 0.244 | 0.199 | 0.200 |
| Final - Imported | 0.384 | 0.398 | 0.172 |

| **Panel B:** | Intermediate Goods | | Final Goods | |
|---|---|---|---|---|
| | Domestic | Imported | Domestic | Imported |
| Farming | 0.197 | 0.112 | 0.112 | 0.341 |
| Fishing and Forestry | 0.0146 | 0.0163 | 0.0163 | 0.127 |
| Oil, Coal and Gas Extraction | 0.0641 | 0.0212 | 0.0212 | . |
| Mining | 0.0252 | 0.0518 | 0.0518 | 0.0724 |
| Food, Beverages and Tobacco | 0.210 | 0.176 | 0.176 | 0.421 |
| Textile and Apparel | 0.174 | 0.278 | 0.278 | 0.538 |
| Wood, Paper and Printing | 0.139 | 0.136 | 0.136 | 0.332 |
| Petroleum and Chemical Products | 0.219 | 0.219 | 0.219 | 0.441 |
| Plastic Rubber and Construction | 0.0919 | 0.171 | 0.171 | 0.469 |
| Fabricated Metal Products | 0.0882 | 0.132 | 0.132 | 0.403 |
| Machinery and Equipment | 0.116 | 0.255 | 0.255 | 0.405 |
| Motor Vehicles | 0.0733 | 0.418 | 0.418 | 0.379 |
| Furniture | 0.114 | 0.167 | 0.167 | 0.433 |
| Utilities | 0.118 | 0.120 | 0.120 | . |
| Construction | 0.0122 | 0.0476 | 0.0476 | . |
| Wholesale and Retail Trade | 0.0293 | 0.000522 | 0.000522 | 0 |
| Transportation | 0.0425 | 0.174 | 0.174 | 0 |
| Health Care and Education | 0.0986 | 0.0833 | 0.0833 | . |
| Accomodation and Recreation | 0.0913 | 0.0646 | 0.0646 | . |
| Professional Services | 0.0636 | 0.0562 | 0.0562 | 0.163 |
| Communication | 0.0991 | 0.0860 | 0.0860 | 0 |
| Other Products or Services | 0.0983 | 0.0904 | 0.0904 | 0.727 |

**Note:** Panel A reports the mean, the median, and the standard deviation of the distribution margin across all products with non-zero use share. Panel B reports the average distribution margin for each industry (2-digit CIIU classification). I distinguish across products depending on their use, final vs intermediate use, and on their origin, imported vs domestically produced. The distribution margin is computed according Equation (18) using the input-output tables of Chile from 2008 to 2019.

Table 5: Summary Statistics

| **Panel A: Summary Statistics** | Whole Sample | | | | |
|---|---|---|---|---|---|
| | Mean | Median | StD | p5 | p95 |
| Importers | 41,186 | . | . | . | . |
| Products | 7,518 | . | . | . | . |
| Origin Countries | 168 | . | . | . | . |
| Products per importer | 10.66 | 3 | 27.28 | 1 | 43 |
| Origins per importer | 2.227 | 1 | 2.931 | 1 | 7 |
| Unit value (USD/quantity) | 1,732.7 | 21.35 | 76,930.6 | 0.934 | 1,569.2 |
| % $\Delta$ log unit value | 0.446 | 0.417 | 0.690 | -116.6 | 118.1 |
| Transaction value (USD) | 130,817.5 | 7,214.3 | 2,659,917.9 | 239.5 | 286,991.7 |
| Observations (N) | 3,044,931 | . | . | . | . |

| **Panel B: Breakdown by Industry and Origin** | Numbers of Transactions (%) | Import Value (%) |
|---|---|---|
| **Industry (SITC):** | | |
| Food & Animals | 3.871 | 8.238 |
| Beverages, Tobacco | 0.291 | 0.613 |
| Crude Materials | 1.589 | 2.392 |
| Mineral fuels | 0.503 | 24.34 |
| Animal & Vegetable Oils | 0.192 | 0.524 |
| Chemicals | 11.55 | 13.23 |
| Manufactured Goods | 18.57 | 9.466 |
| Machinery | 36.52 | 33.02 |
| Mix Manufacturing | 26.91 | 8.160 |
| **Country:** | | |
| China | 14.02 | 6.208 |
| USA | 25.01 | 30.00 |
| EU15 | 25.41 | 17.41 |
| Other Americas | 18.42 | 25.03 |
| Others | 17.14 | 21.35 |

**Note:** Panel A presents summary statistics for the cleaned sample of import transactions from Chilean Customs data covering the period 2007-2019. Transaction values and unit values are reported in USD. Panel B provides a breakdown of the cleaned universe of import transactions by industry (2-digit SITC level) and country of origin. The breakdown is computed in terms of: i) the number of transactions and ii) import values.

Table 6: Exchange Rate Pass-Through on Import Prices at the Border

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| $\Delta \log e\_ot$ | 0.76 | 0.81 | 0.81 | 0.77 | 0.66 | 0.67 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| Year FEs | No | No | No | No | Yes | Yes |
| Origin - Product - Importer FEs | No | Yes | No | No | Yes | No |
| Origin - Sector - Importer FEs | No | No | Yes | No | No | Yes |
| Origin - Sector - Year FEs | No | No | No | Yes | No | No |
| $N$ | 3946868 | 3652480 | 3862118 | 3943332 | 3652480 | 3862118 |

**Note:** The table reports the estimated coefficients from the specifications based on Equation (22) using the cleaned sample of import transactions from Chilean Customs data covering the period 2007-2019. In all specifications the dependent variable is the quarterly log change in the price of imports at the firm-HS8-origin level. Column (1) does not include any additional control or fixed effect. Column (2) introduces origin-product-importer fixed effects, where products are defined as a 8-digit HS category. Column (3) introduces origin-sector-importer fixed effects, where sectors are defined as a 2-digit HS category. Column (4) introduces origin-sector-year fixed effects. Column (5) introduces origin-product-importer and year fixed effects. Column (6) introduces origin-sector-importer and year fixed effects. Standard errors clustered at origin-HS8 level.

Table 7: CPI Sensitivity to Exchange Rates

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| $\Delta\log$(US-CLP ER) | 0.074 | | 0.079 | 0.064 | 0.069 |
| | (0.025) | | (0.026) | (0.028) | (0.031) |
| $\Delta\log$(Weighted ER) | | 0.079 | | | |
| | | (0.019) | | | |
| Controls | Yes | Yes | Yes | Yes | No |
| 6 Lags | Yes | Yes | No | No | Yes |
| 4 Lags | No | No | Yes | No | No |
| 8 Lags | No | No | No | Yes | No |
| $N$ | 120 | 120 | 120 | 120 | 120 |

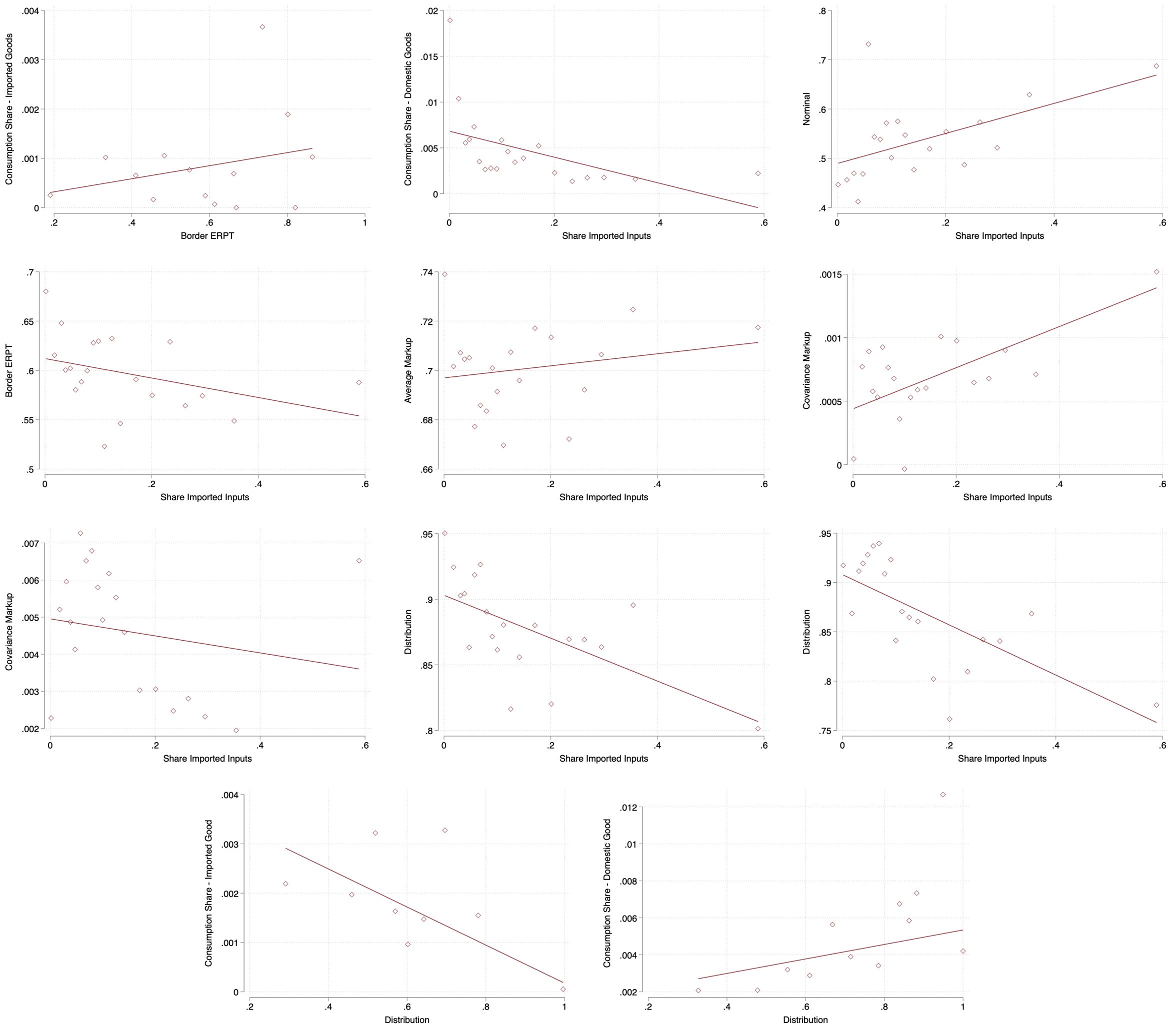
**Note:** The table reports the contemporaneous coefficient of $\Delta\log e$ from Equation (37). All columns use the nominal exchange rate between the Chilean peso and the US dollar, except for Column (2), which uses the trade-weighted nominal exchange rate between the Chilean peso and the exporting country's currency. Controls include Chile's real GDP growth rate and proxies for trading partners' costs. Coefficients for additional variables and their lags are omitted for brevity. Newey-West standard errors are used to account for autocorrelation. Inflation and exchange rate data are sourced from IMF and Datastream, respectively.

Table 8: Alternative Calibrations

| | Aggregate | Domestic Goods | Imported Goods |
|---|---|---|---|
| Benchmark | 0.074 | 0.017 | 0.056 |
| | (0.0042) | (0.0020) | (0.0034) |
| Complete Border ERPT Service | 0.078 | 0.020 | 0.058 |
| | (0.0047) | (0.0020) | (0.0036) |
| Zero Border ERPT Service | 0.065 | 0.012 | 0.052 |
| | (0.0043) | (0.0029) | (0.0032) |
| Cost-weighted Markup Measures | 0.074 | 0.018 | 0.056 |
| | (0.0042) | (0.0021) | (0.0034) |
| Rescaled Nominal Rigidities | 0.077 | 0.020 | 0.056 |
| | (0.0043) | (0.0021) | (0.0034) |

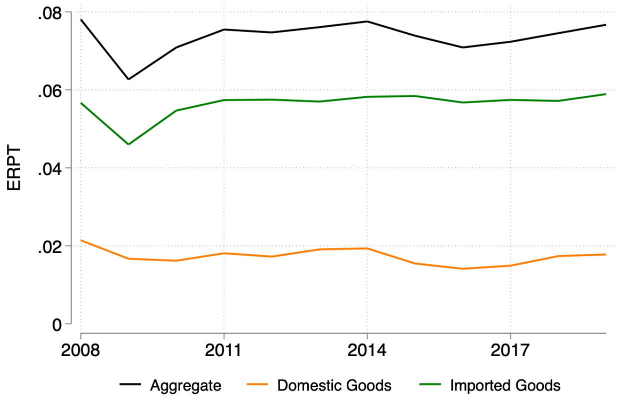
**Note:** The table presents the sensitivity of the CPI, domestic, and imported final goods in the fully calibrated benchmark economy (top row) and across various alternative calibrations (remaining rows). The second and third rows calculate sensitivities by setting the sensitivity of import prices for service products at the border to one and zero, respectively, instead of using the average sensitivity across manufacturing products. The fourth row computes sensitivities using cost shares rather than revenue shares to weight the average pass-through and covariance terms arising from variable markups. The final row calculates sensitivities by rescaling the frequencies of price adjustment to align with the average Calvo probability reported in Aruoba et al. (2022). Standard deviations of sensitivities over the 2008–2019 period are reported in parentheses.

Figure 18: Correlation in Primitives



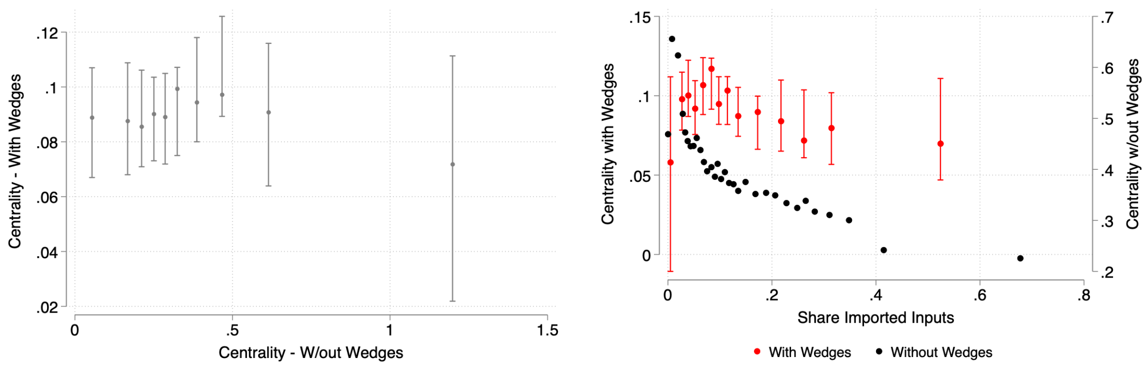

**Note:** Each panel depicts a binscatter plot between two primitive characteristics of the economy, with a solid line indicating a linear fit. Correlation coefficients corresponding to these relationships are reported in Table 1. Top row: The left panel shows the relationship between border price sensitivity and the consumption share of imported final goods. The middle and right panels plot the aggregate share of imported inputs used in production against the consumption share of domestic goods in the final consumption basket and the frequency of price adjustment, respectively. Second row: The left, middle, and right panels display the relationship between the aggregate share of imported inputs used in production and the average border price sensitivity of imported inputs, the average pass-through rate, and the covariance between pass-through rates and domestic goods, respectively. Third row: The left, middle, and right panels show the relationship between the aggregate share of imported inputs used in production and the covariance between pass-through rates and imported goods, the distribution margins of domestic inputs, and the distribution margins of imported inputs, respectively. Bottom row: The left and right panels illustrate the relationship between the distribution margin and the consumption share of domestic and imported goods in the final consumption basket, respectively.

Figure 19: Stability Over Time




**Note:** The figure illustrates the sensitivity in the fully calibrated benchmark economy over time, spanning from 2008 to 2019. The black line represents the sensitivity of the CPI, while the orange and green lines represent the sensitivity of domestic and imported final consumption goods, respectively.

Figure 20: Product Centrality and Imported Inputs




**Note:** The left panel illustrates the relationship between the centrality of a product in the input-output network when the edges are constructed based on input-output tables that include domestic wedges (y-axis) versus those that omit domestic wedges (x-axis). The right panel depicts the relationship between a product's centrality in the domestic production network and the share of imported inputs used in its production. Centrality is measured using the centrality measure, with edges weighted by input-output linkages that either include domestic wedges (red dots) or omit domestic wedges (black dots). Centrality of a product is measured as the average between its indegree and outdegree centrality of node in the input-output network. Both panels use data spanning the years 2008 to 2019. Both panels use binscatters constructed while absorbing product and year fixed effects. The figures include 95% confidence intervals.