From Dominant to Producer Currency Pricing: Dynamics of Chilean Exports*

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Abstract

We revisit a central question for international macroeconomics: The response of export prices and quantities to movements in the exchange rate (ER). We use a comprehensive dataset for Chile and study how the effects vary over time with the currency of invoicing and the destination of exports. For prices, we find that the short-run effects of bilateral ER movements vanish when we control for U.S. dollar ER, which supports the dominant currency paradigm. The longer the horizon, the larger the role is played by bilateral ER movements, which lends support to producer currency pricing. The dynamics do not depend on the invoicing currency. We find consistent results for quantities, supporting the view that bilateral exchange rate movements contribute to macroeconomic adjustment through exports. We also find that U.S. dollar fluctuations, holding bilateral exchange rates constant, show results suggestive of relevant supply and demand effects.

Keywords: Currency of invoicing, emerging markets, dominant currency pricing, producer currency pricing
JEL codes: F14, F31, F41.

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1 Introduction

External adjustment is a central topic in international finance for academics and practitioners alike. To a large extent, the appropriateness of flexible versus fixed exchange rates depends on how fluctuations in the nominal exchange rate affect relative prices and resource reallocation. If exporters fix their prices using their home currency, a depreciation of the exporter's currency to the currency at the destination reduces the price of goods at the destination market. Hence, it increases the volume of exports due to the downward slope of export demand, everything else is constant. This pricing paradigm, named Producer Currency Pricing (PCP), forms part of the building block in the Mundell-Fleming open economy workhorse. However, noting a low pass-through from the exchange rate to prices, an alternative pricing mechanism was proposed in which prices are set in the (local) currency of the destination market.[1] This has been dubbed Local Currency Pricing (LCP). A major implication of LCP is that exchange rate fluctuations do not promote external adjustment. As export prices in the destination market and import prices in the domestic market remain fixed, neither production nor expenditure switching occurs from exchange rate movements, and thus external adjustment is impaired.

More recently, it has been noted that a large fraction of international transactions are fixed in U.S. dollars (USD), a fraction much larger than the role of the U.S. and dollarized countries in global trade.[2] This led to the Dominant Currency Pricing Paradigm (DCP), where firms carry out their trade in a handful of currencies and where the USD is the most salient example. Under DCP, a bilateral depreciation of an exporter country's currency against any currency other than the USD does not induce changes in prices at the destination because they are fixed in USD. Consequently, neither a bilateral depreciation generates production switching effects through changes in demand. Nor does it generate expenditure switching effects, as import prices are set in USD, and the currency is only depreciating against currencies different from the USD. Only changes in the value of the exporters' or importers' currency against the USD produces nominal and real effects.

In this paper, we quantify the degree of PCP, LCP, and DCP over different time horizons and assess whether movements in the USD and bilateral exchange rates have allocating implications by examining the impact on quantities. To this end, we use customs data from Chile, where roughly 90% of its exports are set in USD. We characterize the degree of exchange rate pass-through using detailed information about the currency in which

[1]This has been abundantly documented in Takhtamanova (2010); McCarthy (2007); Campa and Goldberg (2005); Gopinath and Rigobon (2008); Goldberg and Knetter (1997); Goldberg and Campa (2010).

[2]See Goldberg and Tille (2008), Gopinath (2016), and Gopinath et al. (2020).

transactions are set. The extent of USD and bilateral exchange rate pass-through (ERPT) is informative of the degree of PCP, LCP, and DCP. In addition, we study whether these effects depend on the currency of invoicing that exporters report when selling abroad.

Most Chilean exporters invoice their foreign sales in USD, yet it is not apparent that the prevalence of USD invoicing is borne out of optimal currency choice considerations. Chile is a small open economy with several free trade agreements across the globe, and thus it is natural that the currency for conducting foreign trade should be the most readily used, and that is the USD. Therefore, Chile can be considered a *currency taker* as most firms invoice in USD; with only a small fraction invoicing in a different currency. We show that these firms differ in size, number of products, and diversification compared to firms invoicing in USD. They have more than double the number of employees, export more in value, export around three times more distinct goods, and double the number of different destinations they sell.

The USD predominance in invoicing suggests price stickiness in the said currency, which implies complete pass-through from USD exchange rate variations into prices in the short-run. However, this characteristic of the Chilean economy needs to be more conclusive about the implication in the medium-run as firms are likely to reset their prices and may not consider the USD exchange rate for their reset pricing decision.

To assess the short- and medium-run pricing strategies firms follow, we estimate the destination prices' sensitivity to bilateral exchange rates at different horizons. Under PCP, we should expect a complete pass-through from the local currency's bilateral exchange rate depreciation to the Chilean peso (CLP) into the destination prices. We find a high pass-through into prices of around 0.50 in the short-run, which grows to around 0.65 after eight quarters. So on average, a 10 percent appreciation today of the CLP to the destination's currency leads to a 6.5 percent rise in the price. As we expect quantities not to react immediately, slow drops start to occur, declining by around 8 percent after eight quarters.

We expand the analysis and include variations of the USD exchange rate to the local currency but keeping the original bilateral exchange rate. In this setup, the bilateral ERPT is conditional on a given variation of the USD exchange rate, which implies that both CLP and the local currency have moved, if any, equal to the USD. Therefore, the effect now fully reflects changes in bilateral exchange rates. The results cast stark differences depending on the exchange rate and horizon. In the short-run, the incomplete bilateral effect mentioned above entirely vanishes, whereas the pass-through into prices from the USD exchange rate is very close to complete. These two results are consistent with the

DCP paradigm. They have been noted before (Gopinath et al., 2020), forming the basis for the argument that DCP is an essential factor in shaping external adjustment. However, after eight quarters, these levels of pass-through revert. The bilateral ERPT rises to 0.83, and the USD ERPT drops to 0.31. This result has been documented in previous research, but we appropriately highlight it in this article. Indeed, the evidence for Chilean exports shows that the proper pricing mechanism would be DCP in the short-term and PCP in the long-term.

The price elasticity of exports depends on what type of exchange rate we consider and supports the idea that PCP is still an appropriate paradigm for macroeconomic adjustment. As expected, quantities do not react contemporaneously with either exchange rate movement. Nevertheless, in the medium-run, bilateral exchange rate movements have allocating effects with an export elasticity of -1.34. On the other hand, USD exchange rate movements do not significantly affect quantities, despite the increase in prices in destination countries. The lack of significance could result from a small elasticity of demand or supply-side effects; after a global appreciation of the USD, Chilean exporters enjoy higher profitability because of the depreciation of the CLP, hence boosting supply. We explore this mechanism and find that a supply channel plays a role in offsetting demand to leave quantities unaffected.

Finally, our work answers whether the previous results depend on the invoice currency. Despite the overwhelming prevalence of the USD, there is a non-trivial share of Chilean exports invoiced in the destination's currency, mainly to some European and Asian countries. To examine the role of the currency of invoicing, we consider exports set in USD or the destination currency and assess the differential effect the currency of invoicing may bring for ERPT to prices and the elasticity of quantities to the exchanges rates. We conclude that the dynamic and magnitude of the bilateral ERPT to prices and adjustment on quantities is independent of the currency of invoice. However, when transactions are set in the destination currency, there is a zero USD pass-through into prices and a non-significant response of quantities to the USD.

Related literature. This paper builds upon the empirical contributions that document the overwhelming role of the USD in settling transactions in international trade (Goldberg and Tille, 2008; Boz et al., 2022), and the literature that documents that ERPT into import prices is high but incomplete.[3]

[3] See Campa and Goldberg (2005) and Burstein and Gopinath (2014) for a review.

We contribute to the literature that estimates different ERPTs according to the currency of invoice. Gopinath (2016) is the first article that empirically quantifies the role of the currency of invoice for ERPT. Giuliano and Luttini (2020) and Gopinath et al. (2020) extend standard ERPT regressions, as in Burstein and Gopinath (2014), to account for the role of the currency of invoice. We use this empirical framework to show how the correlation of export price changes with bilateral and USD exchange rates variations is informative of the degree of DCP, LCP, and PCP.

Our results for the USD ERPT are high in the short-run and lower in the medium-term, in line with those of Giuliano and Luttini (2020), Gopinath et al. (2020), Chen et al. (2021), and Amiti et al. (2022). Empirical studies focusing on exogenous events such as the 2015 Swiss Franc appreciation (Auer et al., 2021), and the significant and persistent Sterling Pound depreciation after the Brexit referendum (Corsetti et al., 2022) find results like ours. For transactions invoiced in the same currencies as in their destinations, we find that prices are sticky in the currency of invoice. Thus, a local currency depreciation against the CLP or USD does not affect prices in the short-run. This result has also been noticed in articles using data from advanced economies (Chen et al., 2021; Corsetti et al., 2022; Amiti et al., 2022). However, our article is the first one to point this out for emerging economies.

In the medium-run, we find evidence of PCP; that is, prices adjust gradually to changes in the bilateral exchange rate, regardless of the currency of invoice. In addition, we estimate the effect of an exchange rate depreciation on quantities using granular data. Except for Amiti et al. (2022), which collects similar results for Belgium, evidence circumventing temporal and composition effects of aggregate data is virtually nonexistent. To the best of our knowledge, we are the first to estimate demand and supply effects when analyzing the effects of a change in the USD against the local currency or the CLP. For example, when the USD multilaterally appreciates and exports are invoiced in USD, prices at destination increase; however, quantities remain stable. The stability suggests that a supply effect compensates for the fall in demand, as Chilean exporters find more profitable to export. We estimate the supply and demand forces behind the stability result.

Our paper contributes to understanding whether invoicing is an equilibrium outcome in which vehicle currencies eliminate the transaction cost of bilateral exchange in small currency markets. We provide evidence that the PCP benchmark is consistent with how export prices are set in the medium-term. However, for most Chilean exporters, prices are sticky in vehicle currencies. Krugman (1980) and Devereux and Shi (2013) establish that a vehicle currency emerges because of the lower transaction cost associated with settling transactions in currencies with more liquid markets. Thus, even if CLP would be the convenient currency for exporters to set their transactions, the costs associated to the lack of liquid exchange rate markets for the CLP and non-vehicle currencies prevent the use of CLP in international trade. For large firms, we find evidence that they invoice their transactions in more than one currency; this evidence supports theories, such as Engel (2006) and Gopinath et al. (2010), in which the currency of invoice is an active firm-level decision.

Except for Gopinath et al. (2020), which focuses on data from Colombia, the empirical literature has used chiefly data from advanced economies such as Belgium, France, Switzerland, the United Kingdom, and the United States. As documented in Boz et al. (2022), the USD widely dominates the invoicing patterns of Emerging Economies. For Advanced Economies invoicing in producer currency units is more likely to occur. Thus, the relevance of this study for countries with a similar invoicing pattern as Chile is likely to be more critical.

The rest of the paper is organized as follows. Section 2 provides a theoretical discussion to benchmark our empirical results. Section 3 discusses the methodology of our empirical exercises. Section 4 describes the data used in the analysis and present descriptive statistics about the currency of invoice in Chile. Section 5 presents the empirical results about the impact of different exchange rates changes on firms' export prices and quantities. Section 6 concludes.

2 Exports pricing and ERPT

In this Section, we provide the conceptual framework for the empirical approach below. We first describe the problem the firm faces and its optimal price. Then, we focus on cases that depend on the different currencies of invoicing and pricing strategies.

2.1 Pricing in international markets

Consider the case in which the exporter wants to set the optimal price maximizing the domestic currency profits. We denote the optimal log price of firm f, expressed in the Chilean pesos (CLP), exported to country j, at time t as $\tilde{p}_{f,j,CLP,t}$.[4] This price solves the

[4] Alternatively, it can can also be expressed in an arbitrary currency c.

following problem:

$$\tilde{p}_{f,j,CLP,t}\left(\Omega_t\right) = \arg\max_{p_{f,j,CLP,t}} \Pi\left(p_{f,j,CLP,t} | \Omega_t\right),$$

where Ω_t represents all the states of the world. This can be called the "optimal PCP price."

We denote by $\mathcal{E}_{i,j,t}$ the price of currency i in terms of currency j at time t. We also define $e_{i,j,t} = \log \mathcal{E}_{i,j,t}$. Ignoring the t subindex we have that when $e_{i,j}$ increases, currency j depreciates with respect to i, that is, the price of currency i increases with respect to currency j. For most of the discussion we will have the following three exchange rates:

- $e_{USD,CLP}$ is the log value of USD in terms of CLP, and an increase represents a CLP depreciation with respect to the USD.
- $e_{USD,j}$ is the log value of USD in terms of currency j. Country j will be, in most of the discussion, the country of destination of Chilean exports. An increase in this exchange rate is a depreciation of currency j with respect to the US Dollar.
- $e_{CLP,j}$ is the bilateral exchange rate of currency j with respect to the Chilean peso, and an increase is an appreciation of the Chilean peso with respect to currency j.

In absence of strategic complementarities, and when firms face an isoelastic demand function, the desired flexible price of the firm is:

$$\tilde{p}_{f,j,CLP,t}\left(\Omega_t\right) = \mu + (1-\alpha)w_t + \alpha\left(m_t + e_{USD,CLP,t}\right) - a_{ft}, \tag{1}$$

where μ is a markup, a_f is productivity of the firm, w are wages, and m is the value of imported inputs which are denominated in USD. Parameter α is the share of imported inputs in total costs. This is a general set-up, but we will leave imported inputs aside for the initial exercise, retaking them in following sections. Note that in this setup we exclude the effect of imported inputs, which we consider in following sections.

In what follows we propose some simple cases which distinguish the currency under which prices are sticky, and the currency in which optimal prices are calculated when firms can reset them. The idea is that prices are fixed in the invoicing currency, despite this may not be the currency in which firms set optimal prices. We will consider 6 cases, as the combination of two assumptions for price rigidity, in local currency or USD, and three optimal prices, DCP, LCP and PCP. After that we discuss some extensions to the basic analysis.

2.2 Fixed prices vs. optimal prices

In the following discussion we analyze different pricing strategies for exports to destination j. Thus, $p_{f,j,t}$ represents price of exports from firm f to destination j at time t.

(A) PRICE STICKINESS IN THE DOMINANT CURRENCY AND PCP

We consider the case in which exports are invoiced in USD. The local price, in the domestic currency of destination j, of good produced by firm f at time t is:

$$p_{f,j,t} = \tilde{p}_{f,CLP,t} + e_{CLP,USD,t} + e_{USD,j,t},$$

where $e_{CLP,USD,t}$ transforms the price of exports in CLP to USD, the currency of invoicing and in which prices are sticky. On the other hand, $e_{USD,j,t}$ transforms the price in USD to local currency. This is equivalent to transforming the price from pesos to local currency at a bilateral exchange rate $e_{CLP,j,t}$. That is, $p_{ft} = \tilde{p}_{ft} + e_{USD,j,t}$, since $e_{CLP,USD,t} + e_{USD,j,t} = e_{CLP,j,t}$.

We can assume that over k periods a fraction $\theta(k)$ of firms, which we index by f', do not change prices in USD, and thus local prices in local currency vary according to the changes in the value of local currency j with respect to the USD:

$$p_{f',j,t+k} - p_{f',j,t} = e_{USD,j,t+k} - e_{USD,j,t}. \tag{2}$$

As expected, a depreciation of the local currency with respect to the USD will lead to a 1 to 1 increase in prices in the local currency, since prices are fixed in USD in the short-run.

Over the same k periods, the remaining $(1 - \theta(k))$ share of firms, indexed by f'', reset their prices to their optimal PCP price, in which case, absent other shocks, they return to $p_{f'',j,t+k} - e_{CLP,j,t+k}$, and therefore:

$$p_{f'',j,t+k} - p_{f'',j,t} = e_{CLP,j,t+k} - e_{CLP,j,t}$$

Over time the evolution of the local price in local currency of all firms f will be given by:

$$p_{f,j,t+k} - p_{f,j,t} = \theta(k)(e_{USD,j,t+k} - e_{USD,j,t}) + (1 - \theta(k))(e_{CLP,j,t+k} - e_{CLP,j,t}). \tag{3}$$

Given that $\theta(0) = 1$, $\lim_{k\to\infty} \theta(k) = 0$, and $\theta'(k) < 0$, we have that in the short-run the ERPT of the USD exchange rate is one. As time passes by its impact vanishes to zero, whereas the ERPT of the bilateral exchange rate goes to one, starting from zero.

(B) Price stickiness in the dominant currency and LCP

As in the previous case the sticky price is in USD. This implies that for the fraction of firms that do not adjust prices they will have a 1 to 1 ERPT from a depreciation with respect to the USD, and changes in the bilateral exchange rate will have no effects at all. For these firms $p_{f,j,t+k} - p_{f,j,t} = e_{USD,j,t+k} - e_{USD,j,t}$, just as equation (2). Since firms want to keep their prices constant in the local currency, firms that change their price will return to the original local currency price, that is, $p_{f,j,t+k} - p_{f,t,j} = 0$. Since a fraction $\theta(k)$ keep their prices fixed during k periods, we have that:

$$p_{f,j,t+k} - p_{f,j,t} = \theta(k)(e_{USD,j,t+k} - e_{USD,j,t}). \tag{4}$$

Since all firms start with fixed price ($\theta = 1$) we have that the ERPT is 1 in the short-run and declines to zero over time. Although this assumption sounds unrealistic, we consider it for completeness.

(C) Price stickiness in the dominant currency and DCP

This case is simple to analyze, in the short-run prices will absorb completely a change in the USD exchange rate, and since it is also the currency to set the optimal price, the optimal is to let this adjustment to take place and remain there. The bilateral exchange rate has no effect on prices. Hence:

$$p_{f,j,t+k} - p_{f,j,t} = e_{USD,j,t+k} - e_{USD,j,t}. \tag{5}$$

(D) Price stickiness in local currency and PCP

At $t + k$ a fraction $\theta(k)$ of firms will have $p_{f,j,t+k} = p_{f,j,t}$, while firms that are changing prices will make it to keep $p_{f,j,t} - e_{CLP,j,t}$ constant, and hence they reset their local price to $p_{f,j,t+k} - p_{f,j,t} = e_{CLP,j,t+k} - e_{CLP,j,t}$. The evolution of prices will be,

$$p_{f,j,t+k} - p_{f,j,t} = (1 - \theta(k))(e_{CLP,j,t+k} - e_{CLP,j,t}). \tag{6}$$

Only the bilateral exchange rate is relevant. The bilateral ERPT starts from zero and converges to 1 over the long-run, while the USD ERPT is always zero..

(E) Price stickiness in local currency and DCP

This case is analogous to the previous one, but instead of the bilateral exchange rate, the USD exchange rate of the destination country is the relevant one. In this case the ERPT for the USD starts from zero and converges to 1:

$$p_{f,j,t+k} - p_{f,j,t} = (1 - \theta(k))(e_{USD,j,t+k} - e_{USD,j,t}). \tag{7}$$

(F) PRICE STICKINESS IN LOCAL CURRENCY AND LCP

In this case, the optimal price as well as short-run fixed prices are denominated in local currency and therefore the bilateral as well as USD ERPT are both zero in the short- and long-run.

3 Empirical strategy

In this Section we provide the empirical approach to understanding the pricing strategies Chilean exporters carry out.

3.1 Bilateral exchange rates

We begin by estimating the sensitivity of prices to bilateral exchange rates, controlling for other relevant variables. To examine the impact of the bilateral exchange rate on local prices, we regress quarterly changes in export prices in destination currencies on changes in contemporaneous and lagged bilateral exchange rates:

$$\Delta p_{fgjct} = \lambda^P_{fgjc} + \sum_{k=0}^{8} \beta^P_k \Delta e_{CLP,j,t-k} + \theta^{P\prime} X^P_{jt} + \varepsilon^P_{fgjct}, \tag{8}$$

where p_{fgjct} is the log price (in destination currency) of product g, from firm f to destination j, invoiced in currency c, at quarter t. X^P_{jt} controls for variations in the Consumer Price Index at destination j and the Chilean Producer Price Index, respectively. Δ is the first difference quarterly operator, $\Delta x_t = x_t - x_{t-1}$. The term $\sum_{k=0}^{S} \beta^P_k$ captures the S-periods cumulative ERPT of an exchange rate movement that took place at time 0. Including fixed effects in the regression implies that variation of prices at the firm, good, destination, and currency of invoicing level identifies the S-periods cumulative ERPT.

We perform reduced form estimates of the effects of bilateral exchange rates on quantities; we consider the same dynamic-lag regression model as in Equation (8):

$$\Delta q_{fgjct} = \lambda^{Q}_{fgjc} + \sum_{k=0}^{8} \beta^{Q}_{k} \Delta e_{CLP,j,t-k} + \theta^{Q\prime} X^{Q}_{jt} + \varepsilon^{Q}_{fgjct}, \tag{9}$$

where q_{fgjct} is the log of exported quantities, X^{Q} includes GDP and Consumer Price Index a the Chilean Producer Price Index. Because of the reduced form nature of these estimates, β^{Q}_{k} captures the equilibrium response of quantities to supply and demand factors. We label this response as the allocating effects of exchange rates, the S-periods allocating effects of exchange rates is $\sum_{k=0}^{S} \beta^{Q}_{k}$, and the ratio $\frac{\sum_{k=0}^{S} \beta^{Q}_{k}}{\sum_{k=0}^{S} \beta^{P}_{k}}$ is the export elasticity. Leveraging from implications of invoicing in different currencies, in Section 5.4, we isolate supply-side effects out of movements in exchange rates.

The prediction of the PCP framework in Mundell-Flemming is $\sum_{k=0}^{S} \beta^{P}_{k} = 1$, for any time horizon S. In the short-run, this happens because prices are fixed in the exporter's currency. In the long-run, the bilateral exchange rate variation does not affect anything other than changes in the optimal price chosen by the firms. The first deviation from PCP comes from observing the low ERPT from exchange rate movements into inflation. The presumption then is that prices are set in the importer's currency, LCP. Betts and Devereux (2000) or Chari et al. (2002) advanced the idea that exporters set their prices in the importer's currency. Therefore exchange rate variations should have a *null* effect on prices and both parameters (for quantities and prices) should be equal to zero at all horizons. The zero effect at any horizon gives rise to an idea of exchange rate irrelevance in terms of its ability to induce current account adjustment.

3.2 Bilateral and dominant currency exchange rates

International trade prices settle in a vehicle currency (Gopinath and Rigobon, 2008; Goldberg and Tille, 2008; Gopinath et al., 2020). That is, the currency used is neither the origin nor the destination. In this context, the USD appeared to be the *dominant* currency in international trade, referred to as the dollar or dominant currency paradigm (DCP).

To jointly test the different pricing mechanisms, we extend specifications (8) and (9) to include the USD exchange rate. With this, we can assess how the parameters change concerning the initial specifications and how they compare when they are both included.

In particular, we run:

$$\Delta p_{fgjct} = \lambda^P_{fgjc} + \sum_{k=0}^{8} \beta_k^{P,USD} \Delta e_{USD,j,t-k} + \sum_{k=0}^{8} \beta_k^{P,BER} \Delta e_{CLP,j,t-k} + \theta^{P\prime} X^P_{jt} + \varepsilon^P_{fgjct}, \quad (10)$$

$$\Delta q_{fgjct} = \lambda^Q_{fgjc} + \sum_{k=0}^{8} \beta_k^{Q,USD} \Delta e_{USD,j,t-k} + \sum_{k=0}^{8} \beta_k^{Q,BER} \Delta e_{CLP,j,t-k} + \theta^{Q\prime} X^Q_{jt} + \varepsilon^Q_{fgjct}. \quad (11)$$

In this equation, we have two pass-through coefficients; one from bilateral exchange rate movements and another from USD exchange rate movements. We label them with superindices BER and USD, respectively.

As discussed in Section 2.2, if firms have local prices fixed in the short-run in USD, we should expect $\sum_k \beta_k^{P,BER}$ in (10) to play a significantly less important role than $\sum_k \beta_k^P$ in (8). In addition, if their optimal prices are in DCP, we should expect $\beta_0^{P,USD} = 1$ in the short-run, given that prices are settled in USD. If prices are settled in local currency, we should have that both $\beta^{P,USD}$ and $\beta^{P,BER}$ are equal zero.

What should we expect in the long-run? The answer to this depends on the currency choice and the effects of exchange rate movements on the optimal price chosen by the firm. It also depends on the economy's structure, competition, and cost structure, among others. For instance, if there are no strategic complementarities and all costs are in USD, then the pass-through, in the long-run, should be equal to the one in the short-run. If some costs are domestic, then the long-run pass-through should be smaller. Table 3 summarizes the implications of the discussion in Section 2.2. The effects on quantities depend on demand and supply responses to price changes. This issue is relevant for the empirical results we present in the following sections.

3.3 Dominant and destination currency invoicing

We extend the analysis to assess the adjustment process of prices and quantities when transactions are set in the local currency of destination. We modify our baseline specifications to include transactions that are invoiced in local currency. We consider the following regression models:

$$\Delta p_{fgjct} = \sum_{k=0}^{8} \left(\beta_k^{P,USD} + \gamma_k^{P,USD} D_{fgjct}^{LC}\right) \Delta e_{USD,j,t-k} + \sum_{k=0}^{8} \left(\beta_k^{P,BER} + \gamma_k^{P,BER} D_{fgjct}^{LC}\right) \Delta e_{CLP,j,t-k} + \alpha D_{fgjct}^{LC} + \theta^{P\prime} X_{jt}^{P} + \lambda_{fg}^{P} + \varepsilon_{fgjct}^{P}, \tag{12}$$

$$\Delta q_{fgjct} = \sum_{k=0}^{8} \left(\beta_k^{Q,USD} + \gamma_k^{Q,USD} D_{fgjct}^{LC}\right) \Delta e_{USD,j,t-k} + \sum_{k=0}^{8} \left(\beta_k^{Q,BER} + \gamma_k^{Q,BER} D_{fgjct}^{LC}\right) \Delta e_{CLP,j,t-k} + \alpha D_{fgjct}^{LC} + \theta^{Q\prime} X_{jt}^{Q} + \lambda_{fg}^{Q} + \varepsilon_{fgjct}^{Q}, \tag{13}$$

where D_{fgjct}^{LC} is 1 if the export is invoiced in local currency and 0 if in USD. This means that we exclude exports in CLP and in other vehicle currencies different to the USD (e.g., exports to the Republic of Ireland in British Pounds).

The β parameters have the same interpretations as the previous section above when exports are invoiced in USD. The γ parameters instead denote the differential effects on prices and quantities, from USD and bilateral exchange rate movements, respectively, of an export invoiced in local currency. Therefore, $\beta^{P,USD}$ ($\beta^{P,BER}$) represents the ERPT of the USD (bilateral) exchange rate to local prices of exports when they are invoiced in USD. In contrast, $\beta^{P,USD} + \gamma^{P,USD}$ ($\beta^{P,BER} + \gamma^{P,BER}$) represents the ERPT of the USD (bilateral) exchange rate to local prices of exports when they are invoiced in local currency. Likewise for the effects of exchange rate movements on export quantities.

This setup implies that, for instance, if $\gamma_k^{P,USD} < 0$, the pass-through into local prices from a depreciation of the local currency with respect to the USD is smaller when invoiced in local currency than when invoiced in USD. Similarly, if $\gamma_k^{P,BER} > 0$, the pass-through into local prices from a depreciation of the local currency with respect to the CLP is larger when invoiced in local currency than when invoiced in USD.

4 Data and descriptive statistics

We describe the data sources we employ, and present descriptive statistics that characterize our data. They replicate the overwhelming presence of invoicing in USD for Chilean exports as it has been reported extensively in the literature.

4.1 Data source

The core of our data is drawn from Customs Export Declaration collected by Chile's National Customs Service. The data covers the relevant universe of Chilean non-mining exports at transaction level.[5] [6] From the Customs Export Declaration we use information on FOB value, quantity, exporting firm, product code, invoicing currency, and destination country. Our study focuses on the 2010-2019 period. The database classifies goods according to an 8-digit Harmonized System (HS8) classification system, equivalent to the U.S. 10-digit Harmonized System.

We add employment characteristics of the exporting firms using data from the Unemployment Insurance Administrator (AFC).[7] We obtain the economic sector of firms using data from the Internal Revenue Service of Chile.

A common limitation of customs declarations is that they do not contain information on prices. Our dataset is not an exception. To solve this we collapse for firm f, product g, invoiced in currency j, to destination country c, in period t as in Amiti et al. (2022). Thus, for each tuple (f,g,j,c) the price in the period t is the unit value across all the relevant transactions i,

$$P_{fgjct} = \frac{\sum_i \mathrm{FOB}_{ifgjct}}{\sum_i Q_{ifgjct}}.$$

We exclude items exported by firms that have less than 5 employees. We also drop items that contain obvious errors such as missing values in quantities or values, and remove items exported by firms that do not reported economic sector. Additionally, we consider tuples observed for at least 8 quarters consecutively. Finally, we remove observations with quarter-to-quarter FOB values growth rate above 200% or below −66%. Our final sample covers 1,441 Chilean exporting firms, 1,839 different goods, 12 distinct invoicing currencies, and 24 different destinations.

The Chilean Producer Price Index (PPI) data is from National Statistics Institute of Chile, trade partners' Consumer Price Index (CPI) and Gross Domestic Product (GDP)

[5] Sample of considerate countries are the top 30 trading partners excluding those without macro data, ending with 24 countries, which represent on average 81% and 73% of the value and transactions respectively of the universe of non-mining exports.

[6] We do not cover mining data because of reverse causality bias. For example, a change in Chinese copper demand affects copper price and exchange rate at the same time.

[7] AFC data consider full-time or part-time employees with permanent or fixed contract who work in the private sector. We exclude home contracts as employees.

are from IMF data.

4.2 Descriptive statistics

Table 1 displays the main descriptive statistics in our sample at annual level. The first two columns show that the average firm has around 480 employees, while the median has 144. This difference between mean and median happens for the number of destinations, products and total exports. The former one being the more acute. This is consistent with the right skewness observed for exporters, and firms in general.

In the next two set of columns we separate firms depending on whether they invoice in USD or not.[8] We can observe that Non USD firms are on average larger than USD firms, whether we measure that by the number of employees or total exports. Similarly, Non USD firms export to more destinations and more products. Finally, Table 1 also shows that around 90% of exporters heavily invoice in USD.

Figure 1a shows the export share of our sample by destination. Exports to the U.S. and Latin America (LATAM) each represent about a quarter of total exports in our sample. The export share to China growth considerably between 2010 and 2019, whereas the share to the Eurozone almost halves in the same period. Despite this, Figure 1b shows that the invoicing currency composition share is around 90 percent for the USD, which is more than three times the corresponding share of exports going to the U.S. The currency composition share in the Euro is a mere 5 percent, which is considerably less than the share to the Eurozone. The CLP is contained in the "Other" category. These facts are at odds with theories where international trade is either invoiced in the currency of the origin country or the destination country, and lends support to the dominant currency paradigm.

To complement the description of the data, Table 2 displays the export share distribution by currency for each major destination. In Asia, the Yen plays a small role, compared to the overwhelming use of the USD for currency invoicing. In the Eurozone, the Euro plays a greater role relative to other regions, but only is used to invoice about a quarter of exports to that zone, while the USD is again the most important currency of invoicing. A similar pattern emerges for other destinations except for Europe no Eurozone where the GBP plays an important role caused by exports to Great Britian, but also in this case the USD participation is considerably. In the case of LATAM, as no country has a currency

[8]Firms that export at least 95% invoiced in USD are labeled as "USD" in Table 1. If not, they are labelled as "Non USD".

used massively in international trade, most exports are invoiced in USD. This evidence, though scant, portrays a picture similar to that already observed in papers like Boz et al. (2022) for Colombia where exports invoiced in the USD are even more prevalent. Finally, we summarize this findings in Figure 1c. We classify the currency of invoice, according to whether transactions are set in vehicle, destination or producer currency units; the USD is overwhelmingly used as a vehicle currency, and for transactions going to the U.S. and the Euro zone there is a non-negligible role for their currencies to fix prices.

5 Results

In this section we follow the approach outlined in Section 3, and report evidence on the ERPT from the bilateral exchange rate and USD exchange rate into prices and the exchange rate effect on quantities.

5.1 Adjustment of prices and quantities to the bilateral exchange rate

We begin our analysis by considering standard ERPT regressions at firm-product-destination-currency level as in equation (8). Figure 2 plots the sum of β_k^P, and each panel presents results for the different samples used in the paper. Short-run ERPT estimates range between 0.50 and 0.60; they are highly significant. Over time, ERPT becomes higher reaching a maximum in the range of 0.65 to 0.75. However, we cannot statistically reject that these magnitudes are different to those in the short-run. Our results are consistent with earlier findings in the literature: ERPT to border prices is high but incomplete.[9]

As for the effects on quantities, we find that movements in the bilateral exchange rates have real effects. Figure 3 plots the sum of β_k^Q from estimating equation (9). This is the impact over time of a depreciation of the domestic currency (appreciation of exporter's currency). Exploiting within variation at the firm-product-currency-destination level, we observe that a depreciation of the destination's currency with respect to the CLP is associated with a decline in imported quantities. The effect of a nominal depreciation takes time to have allocating implications. Two quarters after the depreciation, there are small effects. They become significant from the third quarter onward and keep gradually increasing, reaching a demand elasticity of close to 1.

[9]See, for example, Campa and Goldberg (2005) and Burstein and Gopinath (2014) .

5.2 Adjustment of prices and quantities to the bilateral and USD exchange rates

The separate identification of the pass-through to prices from both bilateral exchange rates and USD exchange rates can shed light on the pricing behavior of firms. We therefore shift our attention to ERPT regressions that include both the USD and the bilateral exchange rate, and analyze its effects on quantities. In particular, we focus on transactions invoiced in USD to non-dollarized destinations, in order to not confound the effect of currency of invoicing with those of the exchange rate movements.

Figure 4 and Table 4 show the results of estimating (10) and (11). Panel 4a plots the sum of $\beta_k^{P,USD}$ and $\beta_k^{P,BER}$. In the short-run, we can see that the ERPT of USD to border prices is almost complete and nil for the bilateral exchange rate. However, the results show a relevant reversion as time progresses. In addition to this, we observe that once the USD is taken into account in the regression, the short-run bilateral ERPT is quantitatively small and does not statistically differ from zero. This pass-through is significantly smaller than without conditioning for the currency of invoicing. Indeed, when the USD is not included, the bilateral ERPT was about 0.55, as reported in Figure 2. Despite this, long-run bilateral ERPT is of the same order as in Figure 2, which is about 0.8. In contrast, the short-run USD ERPT is almost complete rising to 0.89, but after four quarters falls to 0.41.[10]

This result implies that in the short-run DCP is a good characterization, but in the long-run PCP dominates. As we discussed in Section 2.2, this is consistent with the case where prices are fixed in the short-run in USD, but the optimal price for exporters is determined in their own currency. This is one of the main findings of this paper that we examine further and provide robustness checks below.

In terms of the effects on quantities, Figure 4b plots the sum of estimates of $\beta_k^{Q,USD}$ and $\beta_k^{Q,BER}$. Consistent with the bilateral ERPT above, we can observe that quantities fall after a bilateral depreciation of the destination's currency with respect to CLP. This result points to the real adjustment implied by the Mundell-Flemming framework, which highlights the allocating effects still prevail even when controlling for USD exchange rate fluctuations.

For the USD exports' price elasticity, we see that movements in the exchange rate do

[10] For completeness we report in the Appendix the results for the sample that employs information from all currencies to all destinations and the sample that employs all currencies to non-dollarized destinations. This is shown in Appendix Figure A.1 and Appendix Figure A.2 respectively.

not have a significant effect on exports. Even though the ERPT into prices is not complete in the eighth quarter, it starts high, remains always positive and is consistently above 0.30. Then, we would expect some negative effect on demand, which is not verified in the data. There are two potential explanations for this. First, the average demand faced by Chilean exporters is not elastic enough to react for price changes that are not sufficiently large. A second alternative may come from the increased profitability exporters enjoy when the USD appreciates. Below, we explore this ”supply” channel further.

The results of this section suggest that over short horizons the USD fluctuations appear to have measurable effects on export prices. The lack of evidence of a significant effect on quantities is suggestive of counterbalancing allocating implications on supply and demand for exports. Yet, the large and precisely estimated effects on quantities and prices resulting from bilateral exchange fluctuations, shows that over longer periods Mundell-Fleming and PCP remain relevant for the macroeconomic adjustment process. Finally, this result contrast to Gopinath et al. (2020) where they find that USD exchange rate has allocating effects, but not the bilateral one.[11]

5.3 Adjustment of prices and quantities when prices are set in destination currency or USD

The descriptive section of our data showed that even though the USD is by far the most prevalent currency of invoicing, a small fraction of exports are invoiced in other currencies. We proceed to evaluate the importance of different invoicing patterns to the adjustment process to exchange rates shocks; we do that by estimating equations 12 and 13 that incorporate the different invoicing practices. The sample contains USD invoicing, which is DCP when exported to non-dollarized economies, and local currency invoicing, in which case would be short-term LCP.

Figure 5 and the first two columns of Table 5 present the results. As Figure 5a shows, for the case of transactions invoiced in local currency, the dynamics of bilateral exchange rate movements into prices and quantities are similar to the results presented in Section 5.2. In the short-run, the effects on export prices is close to zero, it becomes statistically different from zero after a few quarters, and then increases steadily over eight quarters. Export quantities initially do not change, but then steadily reflect changes that can be associated with shifts along the demand curve in the export destination. As the price of

[11] See Table 24 in the Appendix of Gopinath et al. (2020).

exports in local currency increases its demand declines.

The response of local prices to a change in the BER is the same for dollar and local currency invoice. That is, whether the invoicing of exports is in USD or in local currency, a bilateral movement of the exchange rate does not change the export prices at destination on impact, they are fixed in local currency or USD, but over time it does adjust in a consistent way with PCP, although the ERPT does not reach one. The adjustment in quantities to a change in the BER is the same regardless the currency of invoicing. In consequence, the Mundell-Fleming or PCP export adjustment to bilateral exchange rate movements is present irrespective of the currency of invoicing.

The previous results are for bilateral exchange rate movements, keeping the USD exchange rate constant. Figure 5b displays also the dynamics of prices and quantities associated with USD movements, keeping the bilateral exchange rate constant. In this case, there are differential effects on export prices depending on the invoicing currency. When exports are invoiced in USD, we obtain the same results as for the previous sections. The short-run ERPT into prices is close to 1, since prices are fixed in USD and a depreciation of the local currency with respect to the USD increases the domestic price one-to-one. In contrast, when exports are invoiced in the local currency, the pass-through into prices is not statistically different from zero at any horizon. This is suggestive that price stickiness is associated with the invoicing currency. Hence, when faced with movements in the USD exchange rate, price stickiness depends on the currency of invoicing.

The price elasticity of exports also depends on the exchange rate movement we consider and the currency of invoicing. The elasticity with respect to the BER starts in zero in the short-run, and declines to -1, as in the previous section and regardless the currency of invoicing. This result is the the decline in demand as a consequence of the increase in local prices.

For the elasticity with respect to the USD exchange rate, the effect is nil when invoiced in either currency. When invoiced in USD, it replicates the result in the previous subsection as prices do react, but not quantities. Here again, there are potential supply-side effects taking place that may explain why quantities do not move, and we discuss in greater detail in the next subsection. When invoiced in local currency, the quantities have a positive effect, but it is statistically insignificant. In this case, this is consistent since the ERPT into prices is also absent.

We perform two additional exercises to assess the robustness of our findings. First, we repeat (12) and (13) but exclude the U.S. as a destination. The results for this are in columns 3 and 4 of Table 5 and in Figure 6. For both exchange rate movements and both currencies of invoicing, the pass-through and their dynamics are the same as the ones observed in Figure 5.

Second, we consider only exports invoiced USD, and analyze the pass-through when the destination is the U.S. and when it is not. This allows to test the USD as local currency and as vehicle currency, respectively. For this, we estimate:

$$\begin{aligned}\Delta p_{fgjt} =& \lambda^P_{fg} + \sum_{k=0}^{8} \left(\beta_k^{P,BER} + \gamma_k^{P,BER} D^{US}_{fgjt}\right) \Delta e_{CLP,j,t-k} + \sum_{k=0}^{8} \beta_k^{P,USD} \Delta e_{USD,j,t-k} \\ &+ \alpha D^{US}_{fgjt} + \theta^{P\prime} X^P_{jt} + \varepsilon^P_{fgjt},\end{aligned} \tag{14}$$

$$\begin{aligned}\Delta q_{fgjt} =& \lambda^Q_{fg} + \sum_{k=0}^{8} \left(\beta_k^{Q,BER} + \gamma_k^{Q,BER} D^{US}_{fgjt}\right) \Delta e_{CLP,j,t-k} + \sum_{k=0}^{8} \beta_k^{Q,USD} \Delta e_{USD,j,t-k} \\ &+ \alpha D^{US}_{fgjt} + \theta^{Q\prime} X^Q_{jt} + \varepsilon^Q_{fgjt},\end{aligned} \tag{15}$$

where D^{US}_{fgjt} is 1 if the destination is the U.S., and 0 otherwise.

The results for this are in columns 5 and 6 in Table 5 and in Figure 7. The results show that prices are sticky in USD regardless of the currency of destination, and then they adjust to the higher value of the Chilean peso over time, regardless the destination country's currency is the USD (panels (a) and (c)). Panels (b) and (d) consider a depreciation of the local currency respect to the dollar, excluding obviously the US. There is an ERPT close to one in the short-run and in eight quarters prices revert partially to its original value since the bilateral exchange rate has remained constant.

Put together, these last two exercises confirm the baseline. The adjustment of prices and quantities to the bilateral exchange rate is mostly independent of the currency of invoicing, prices are fixed in the currency of invoice, and in the medium-term they converge to PCP.

5.4 Supply and demand effects

Appealing to export demand effects when there is a depreciation of the local currency is insufficient since, despite the increase in prices, there is no quantity response. Indeed, for exports invoiced in USD, Figures 4 and 5 show that under a global appreciation of the USD, even if there is an increase in export prices in destination currency, there is a null effect on quantities. This may happen because the appreciation of the USD increases the return of exports measured in the producer currency, i.e. the CLP. Then, the increase in supply offsets the fall in demand. Here, we explore this issue further.

The differential response of prices to the bilateral exchange rate and USD permits us to isolate supply and demand forces. Upon a multilateral depreciation of the destination country currency, when exports are set in USD, prices increase in the destination, whereas for the Chilean exporter, prices remain the same. Because of a downward-sloping demand curve, quantities should react accordingly. When exports are set in USD or destination currency, a global depreciation of the CLP triggers an increase in the price for Chilean exporters without affecting prices at the destination. Because of an upward-sloping supply curve, movements in quantities reflect supply-side effects.

To estimate the supply and demand components, we use equations (12) and (13). For transactions invoiced in USD, the coefficients $\beta^{\cdot,USD}+\beta^{\cdot,BER}$ identify movements along the demand curve. When currency j depreciates against the CLP and USD, prices increase in the destination but not in the origin country, so the demand curve accounts for these movements. Implications are different for transactions invoiced in destination currency. A multilateral depreciation of currency j is neutral to prices and the returns of the Chilean exporter, as is to quantities. The coefficients $\beta^{\cdot,USD} + \gamma^{\cdot,USD} + \beta^{\cdot,BER} + \gamma^{\cdot,BER}$ capture the neutrality result. Going back to transactions invoice in USD, the coefficients $-\beta^{\cdot,BER}$ identify movements along the supply curve. A depreciation of the CLP against currency j, holding the parity USD-j constant, increases prices in pesos faced by Chilean exporters, while the effects are muted in the destination currency. For transactions invoiced in the destination currency, a multilateral depreciation of the CLP captures a reduction in the returns of the Chilean exporter, holding constant prices in the country j, and hence holding demand constant. The coefficients $-\beta^{\cdot,BER} - \gamma^{\cdot,BER}$ capture the negative supply shock.

Panels (a) and (b) of Figure 8 report the results of a multilateral depreciation in the importer country, i.e., a depreciation against the CLP and USD currencies holding constant the CLP-USD parity. For transactions invoiced in USD, the red line in panel (a) shows a persistent increase in prices in the destination currency. However, the adjustment in quantities is more sluggish, and there is a negligible decrease upon impact that starts to accumulate over time. Four to seven quarters after the initial shock, the response of quantities reaches its long-term value. We cannot reject that demand falls one-to-one with the shock. The blue line shows that prices and quantities remain unaffected by the exchange rate shock at all horizons for transactions invoiced in destination currency.

Panels (c) and (d) in Figure 8 report the results of a multilateral CLP depreciation, i.e., a depreciation against the country's j and USD currencies holding constant currency j-USD parities. We express prices in CLP to interpret the results more easily (the results are a reinterpretation of Figures 5a and 5c). Given that prices in local currency should not change since the local currency parity to the USD remains constant. When there is a multilateral depreciation of the CLP, prices in CLP increase on impact, and they monotonically decrease to a final ERPT between 0.20 and 0.50 for transactions invoiced in USD and destination currency, respectively. The price in the destination currency remains constant in the short-run and then gradually declines. As for quantities, there is a positive response to output. Given constant demand in the short-run, exports' expansion results from higher profitability of exporters and a supply increase. For given prices, the increase in supply depresses prices. Therefore, panels (c) and (d) isolate and show the effect of supply effects. For given local prices, deprecation of the CLP stimulates the supply of exports.

In sum, the evolution of prices and quantities is consistent with standard demand and supply forces. When prices are set in USD, and the USD multilaterally appreciates, there is an immediate increase in local prices, with an ERPT of about 1, but no relevant drop in exports, despite the rise in prices. In this case, both negative demand and positive supply effects offset each other. Multilateral changes in the CLP generate movements along the supply curve, and multilateral changes in the importer currency generate movements along the demand curve. For transactions invoiced in local currency, multilateral changes in the CLP exchange rate generate allocating implications by boosting exports. There are no demand effects for multilateral changes in the country's currency j.

5.5 Robustness exercises

To make sure our results are not driven by a particular specification, we extend the analysis carried out in (10) and (11) for different samples, data cleaning or variables definition. To start, we carry out the same exercises but do it by sectors. We do this to understand whether our results might be explained by specific sectors driving the results.

Table 6 and Table 7 present such results. We can see that for most sectors, the estimates are in line with the aggregate results. For prices in the short-run, there is small or zero ERPT for bilateral exchange rate, which then increases in the medium- to long-term to levels of around 0.60-0.70. The ERPT of the USD instead is very high, above 0.8, for most industries, and then falling over the medium-term. Regarding quantities, we only obtain significant results for bilateral exchange rates pass-through, which is consistent with certain degree of medium-term PCP. The only two subsectors that have somewhat different results are “Fishing industry” and “Other beverages and tobacco products”. In the former case, the bilateral ERPT starts high in the short-term, even larger than the USD ERPT. Regarding quantities, exports are quite insensitive to exchange rates. In latter case, the short-term bilateral ERPT is about 0.3 and declining in the medium-run. Quantities are sensitive to the bilateral exchange rate, although not with a precise estimate. Overall, these results support our baseline estimates, although quantity estimates lack significance in most cases.

In addition, we perform other robustness exercises. First, we consider a different definition of prices, which instead of being the unit values as computed in Section 3, they are median or mean prices. Second, we use standard errors clustered at the time-destination level instead of firm level, which is the clusterization used in Amiti et al. (2022). Third, we change the control variables. We omit either destination’s GDP, destination’s CPI, Chile’s PPI, or a combination of those. Fourth, we improve the definition of a product by combining the HS8 together with the units of measure of the export.[12] Finally, we proceed to clean the data in a less strict way to allow for more observations to be included in our regression. For all the cases mentioned above, the results do not change substantially and are available upon request.

6 Conclusions

In this paper, we showed that the USD has a relevant role in Chilean exports over short horizons, even if the U.S. is not directly involved in the transactions. The result is strong evidence for the DCP. However, it is less so in the medium-term, where bilateral exchange rates play the traditional role implied by the Mundell-Fleming open economy workhorse. To gauge the role the USD and bilateral exchange rates play in the macroeconomic external adjustment process, we consider different variations of standard ERPT regressions. In all cases, price stickiness in the currency of invoicing seems a significant friction in the short-run. For Chile, where transactions mostly settle in USD or local currency, this implies that global changes in the USD are likely to impact international trade. Over the medium-term, however, PCP becomes a better description of the macroeconomic exter-

[12] These can be meters, square meters, litres, metric ton, carat, dozen, hundred, among others.

nal adjustment process; remarkably, the dynamics of the bilateral ERPT and its allocating implications are independent of the invoice currency.

In summary, we obtain the following results:

- Prices are sticky in the short-run in the currency of invoicing. Therefore, when exports are set in USD, a depreciation of the local currency against the USD increases destination prices in local currency. In contrast, a depreciation of the local currency against the CLP does not affect prices. When exports are set in local currency, like in LCP models, a depreciation of the local currency against the CLP or USD does not affect prices in the short-run.
- In the medium-run, we find evidence of PCP: prices adjust gradually to changes in the bilateral exchange rate, regardless of the currency of invoice.
- Regarding quantities, when there is a depreciation of the local currency against the CLP, exports decline, as expected, since prices in local currency gradually increase and demand for Chilean exports declines.
- When analyzing the effects of a change in the USD against the local currency or the CLP, we find evidence of supply-side effects. Indeed, local prices increase when exports are set in USD, and there is a depreciation of the local currency against the USD. However, quantities remain stable, which suggests that a supply effect compensates for the fall in demand of the Chilean exporter, which sees an increase in its profitability when the CLP also depreciates.

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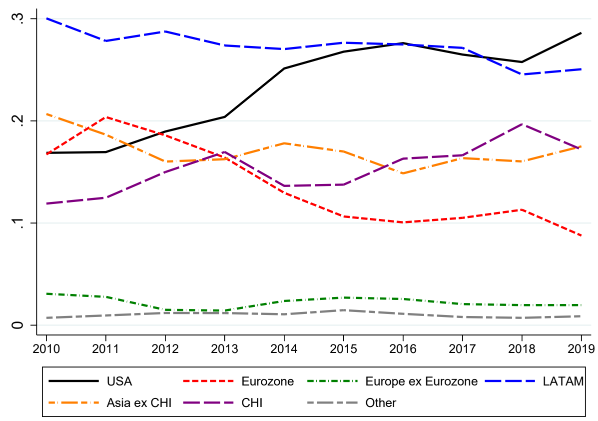
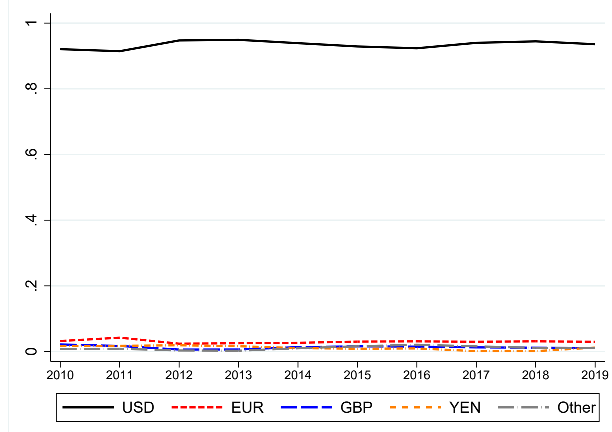
Figure 1: Exports Share

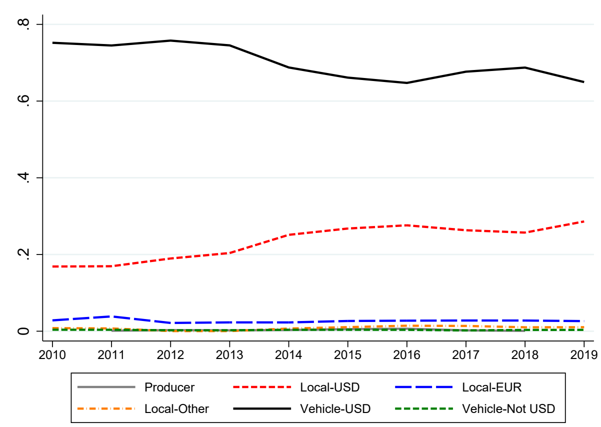
(a) By destination



(b) By currency



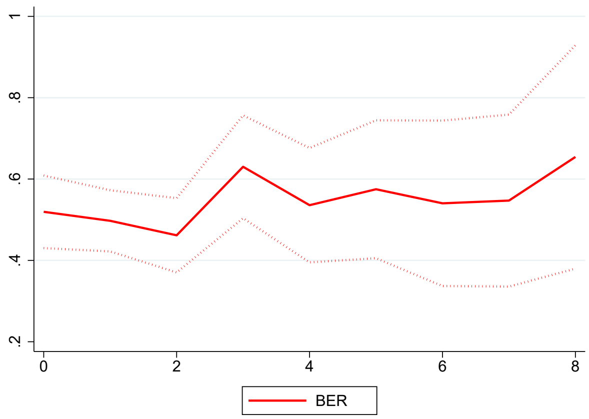
(c) By currency type



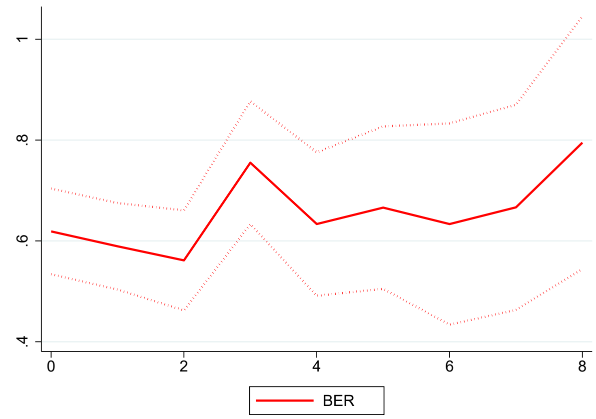
Notes: Exports share represent the FOB value percentage of exports considering non-mining data. *Source*: Author´s own calculations are based on Chile´s National Customs Service.

Figure 2: Bilateral Exchange Rate Pass-through

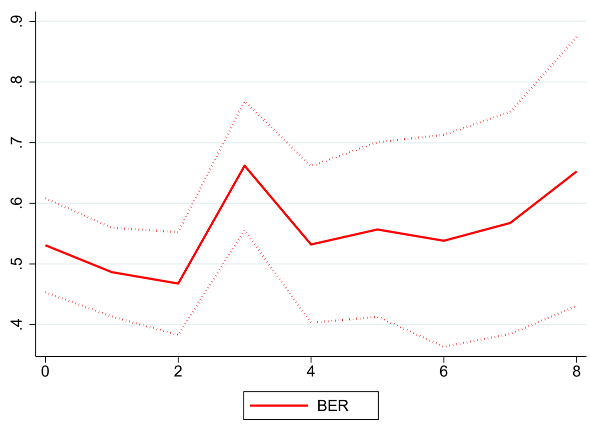
(a) All currencies, all destinations



(b) USD, non-dollarized destinations



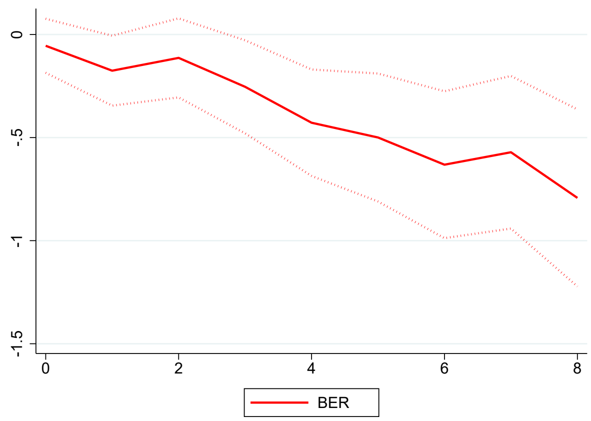
(c) All currencies, non-dollarized destinations



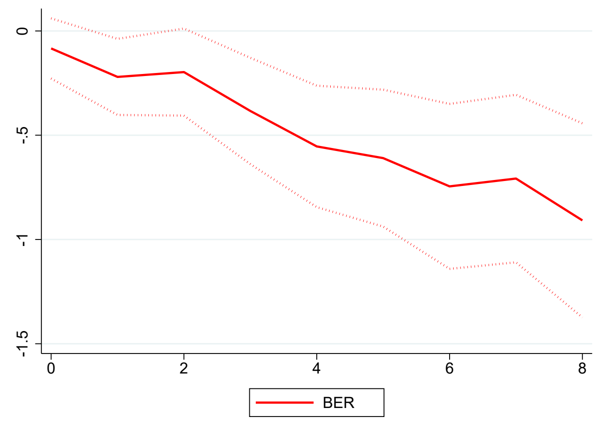
Notes: Results for estimation (8) using non-mining sector. Figure plots the sum of β_k^P.

Figure 3: Bilateral Exchange Rates and Quantities Correlation

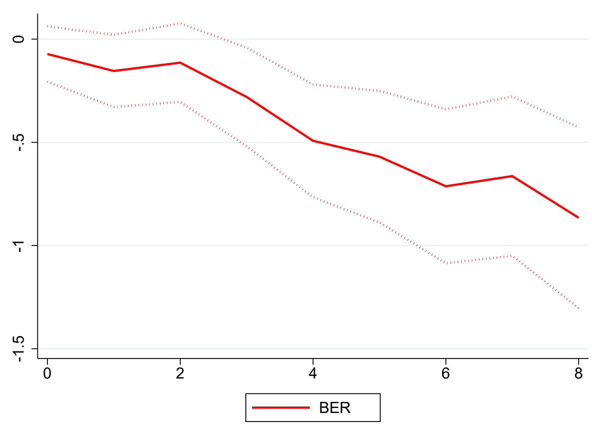
(a) All currencies, all destinations



(b) USD, non-dollarized destinations



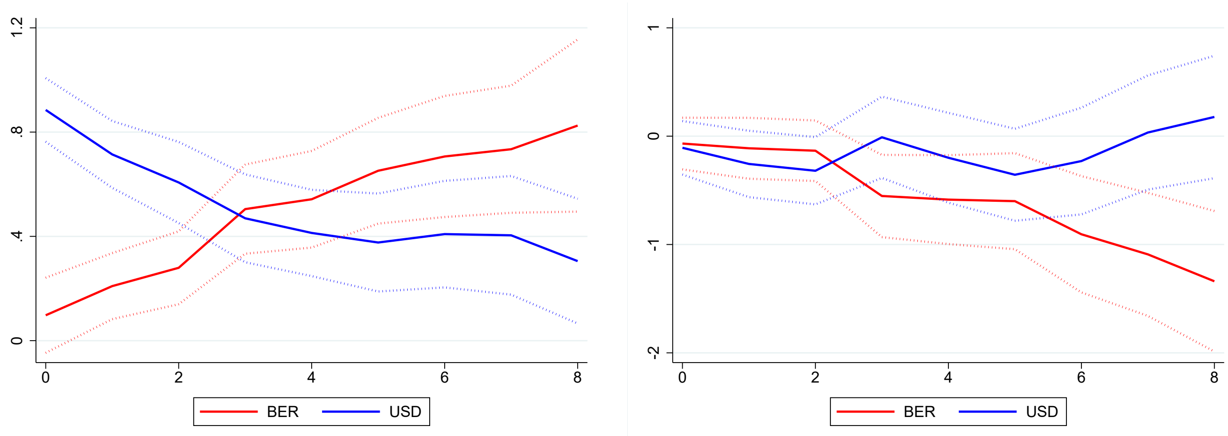
(c) All currencies, non-dollarized destinations



Notes: Results for estimation (9) using non-mining sector. Figure plots the sum of β_k^Q.

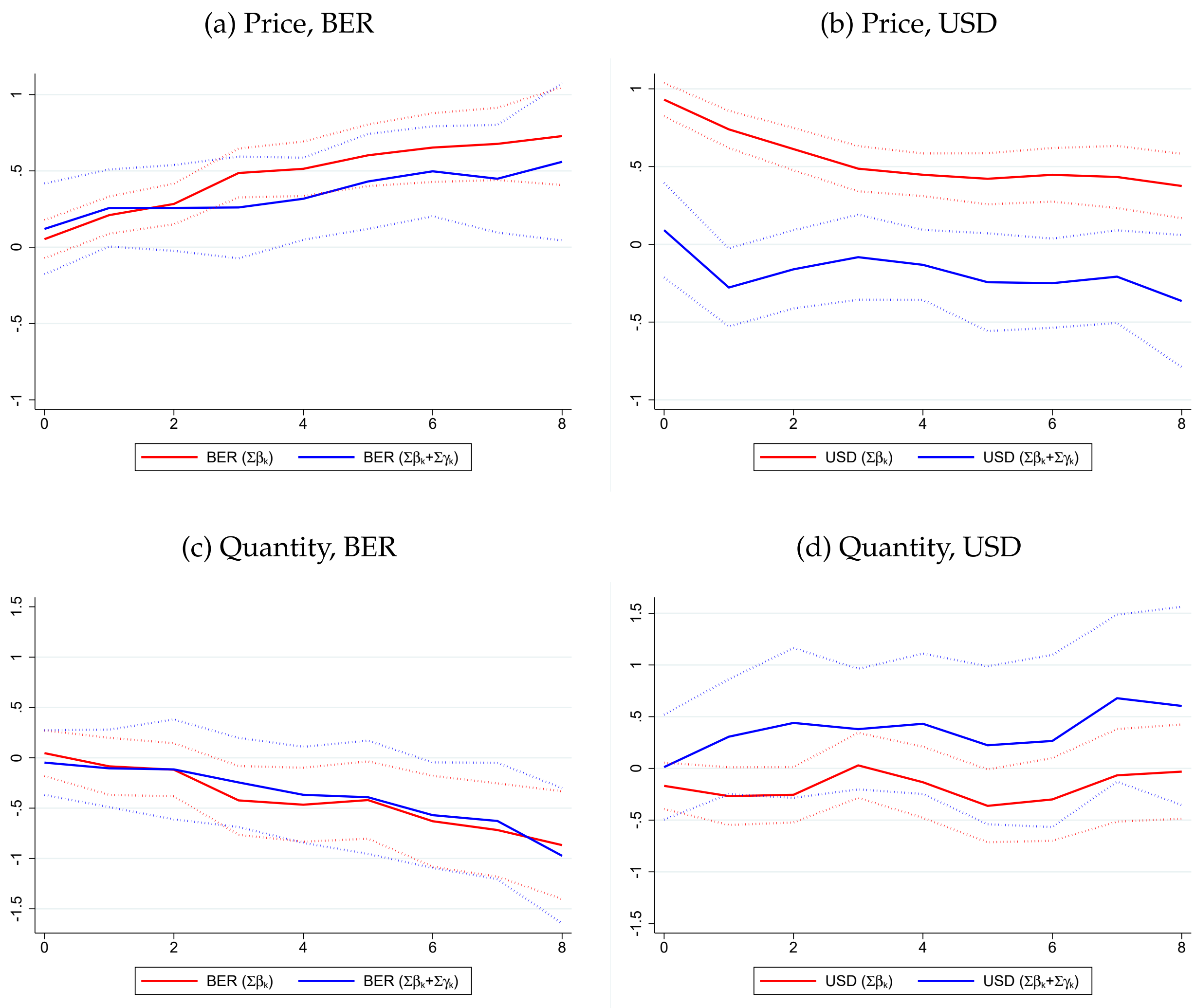
Figure 4: Bilateral and USD ERPT and Quantities

(a) Price (b) Quantity



Notes: Results for estimation (10) in panel (a) and (11) in panel (b), using non-mining sector and considerating USD to non-dollarized destinations. Panel (a) plots the sum of $\beta_k^{P,BER}$ and $\beta_k^{P,USD}$. Panel (b) plots the sum of $\beta_k^{Q,BER}$ and $\beta_k^{Q,USD}$.

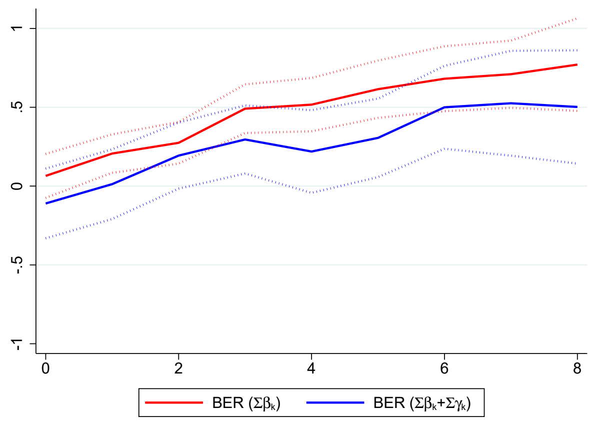
Figure 5: Local Currency Invoicing vs USD Invoicing



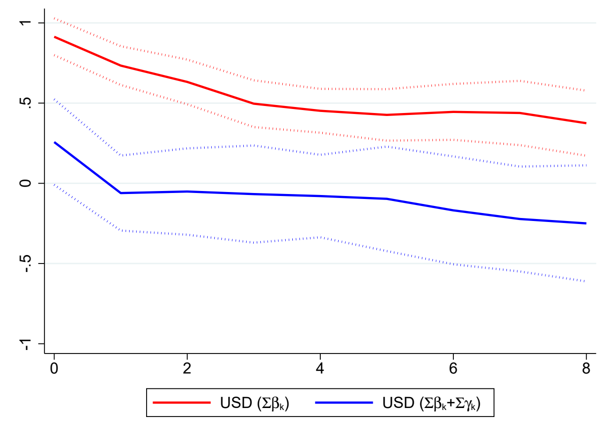
Notes: Estimation results for (12) and (13). Panel (a) and (b) are for Δp, and Panel (c) and (d) are for Δq as dependent variables. In all panels, red line is the effect for exports invoiced in USD and blue line is the effect for exports invoiced in the currency of destination.

Figure 6: Local Currency vs USD Invoicing for non USD destinations

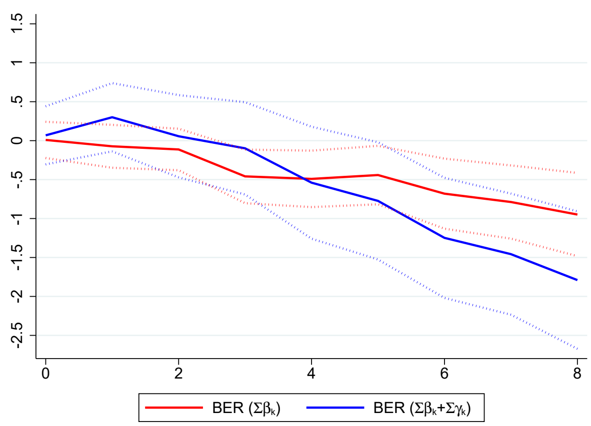
(a) Price, BER



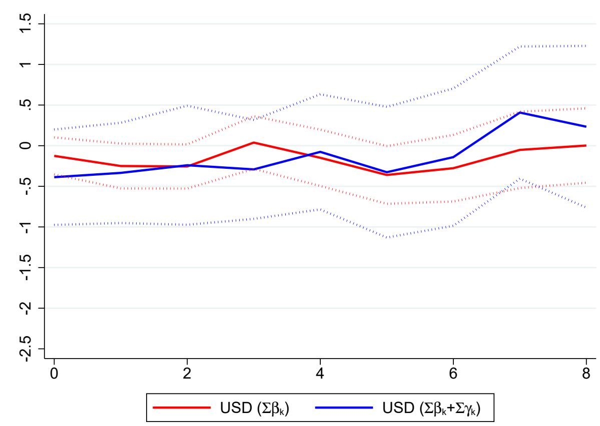
(b) Price, USD



(c) Quantity, BER



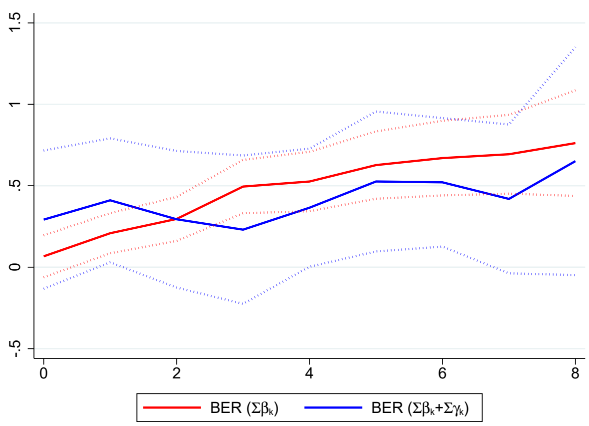
(d) Quantity, USD



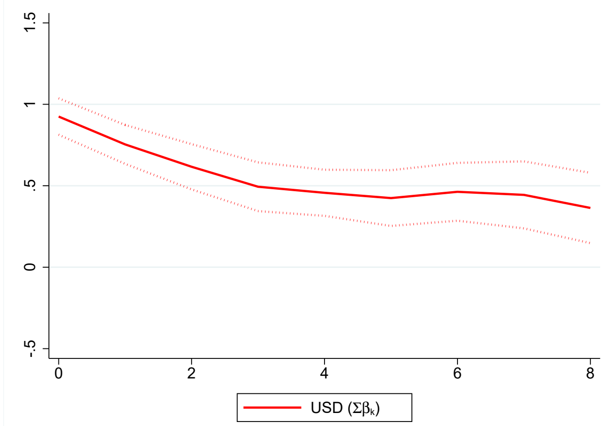
Notes: Results for estimations (12) and (13) but only using non-dollarized destinations, which in our is all countries but the US. Panel (a) and (b) is for Δp and Panel (c) and (d) is for Δq as dependent variable. In all panels, red line is the total effect for exports invoiced in USD and blue line is the total effect for exports invoiced in the currency of destination (local currency).

Figure 7: Exports Invoiced in USD

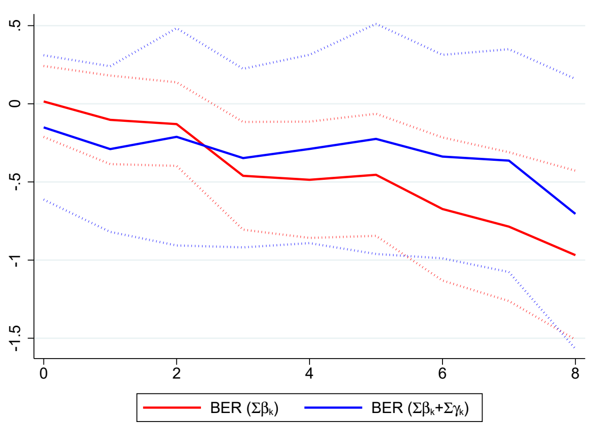
(a) Price, BER



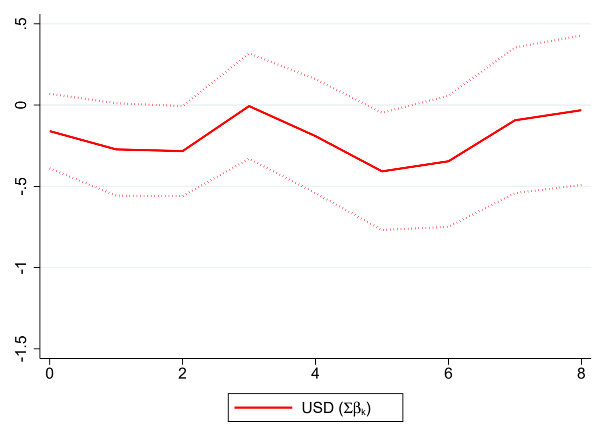
(b) Price, USD



(c) Quantity, BER



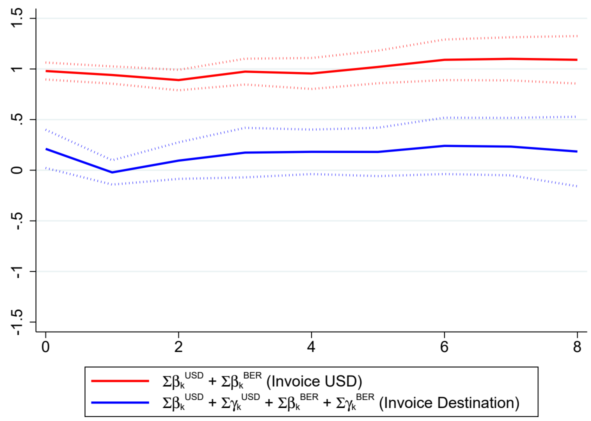
(d) Quantity, USD



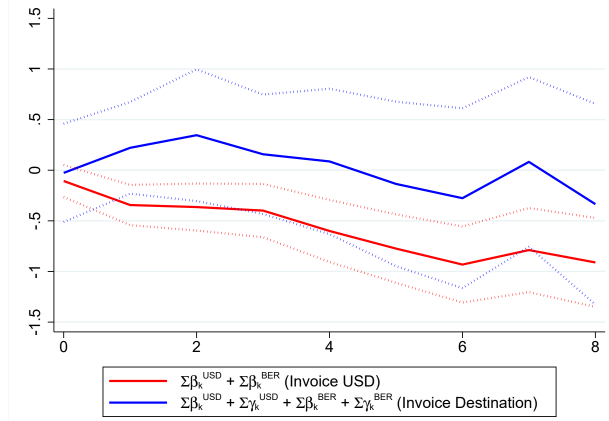
Notes: Estimation for results for (14) and (15) but only using export invoiced in USD. Panel (a) and (b) is for Δp and Panel (c) and (d) is for Δq as dependent variable. In all panels, red line is the total effect for exports invoiced in USD not to the U.S. and blue line is the total effect for exports invoiced in USD to U.S.

Figure 8: Demand and Supply Effects

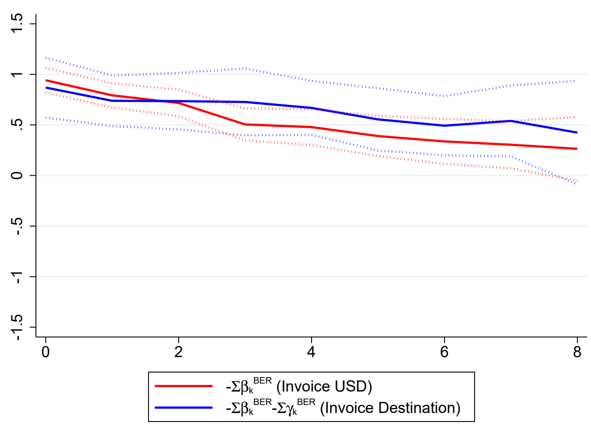
(a) Multilateral depreciation of curr j. Price



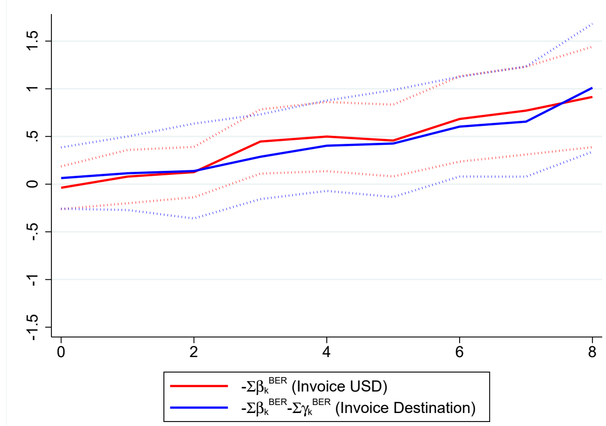
(b) Multilateral depreciation of curr j. Quantity



(c) Multilateral depreciation of CLP. Price



(d) Multilateral depreciation of CLP. Quantity



Notes: Estimation results for (12) and (13). Panel (a) and (b) is for a multilateral depreciation of currency j and panel (c) and (d) is for multilateral depreciation of CLP. In all panels, red line is the total effect for exports invoiced in USD and blue line is for exports invoiced in the destination currency.

Table 1: Descriptive statistics

	All		USD		Non USD	
	Mean	*Median*	*Mean*	*Median*	*Mean*	*Median*
# employees	482.3	144.3	464.1	134.2	705.5	392.1
# destinations	2.0	1.0	2.0	1	2.4	2.1
# products	2.7	1.6	2.6	1	3.3	2.9
# Total exports (USD million)	13,19	1,06	13,38	0.95	11,69	2,66
# firms	680		622		58	

Notes: Total exports represent the FOB value of exports considering non-mining data. Firms that export at least 95% invoiced in USD are labeled as "USD", if not, they are labelled as "Non USD". *Source*: Author´s own calculations are based on Chile´s National Customs Service.

Table 2: Currency Distribution by Destination

Destination	Currency	Value (%)	Transaction (%)
Asia ex China	USD	93.47	92.57
	YEN	6.32	7.11
	EUR	0.21	0.31
China	USD	99.84	99.65
	EUR	0.10	0.21
	RMB	0.06	0.13
	YEN	0.00	0.01
Europe no Eurozone	GBP	58.56	72.6
	USD	31.19	20.38
	EUR	7.85	4.13
	Other	2.41	2.89
Eurozone	USD	79.33	47.02
	EUR	20.55	52.84
	CLP	0.12	0.13
	GBP	0.00	0.01
LATAM	USD	95.89	90.72
	Other	2.98	6.80
	CLP	0.76	0.51
	EUR	0.36	1.96
USA	USD	99.91	99.99
	CLP	0.09	0.01
Other	USD	99.53	99.66
	EUR	0.47	0.34

Notes: Value represent the FOB value percentage of exports and transaction represent the number of transactions in percentage both considering non-mining data. *Source*: Author´s own calculations are based on Chile´s National Customs Service.

Table 3: ERPT Predictions Non-imported Materials

	Prices sticky in local currency		Prices sticky in dominant currency	
	Short-run	Long-run	Short-run	Long-run
PCP	$\beta_0^{P,BER} = 0, \beta_0^{P,USD} = 0$	$\sum_{k=0}^{8} \beta_k^{P,BER} = 1, \sum_{k=0}^{8} \beta_k^{P,USD} = 0$	$\beta_0^{P,BER} = 0, \beta_0^{P,USD} = 1$	$\sum_{k=0}^{8} \beta_k^{P,BER} = 1, \sum_{k=0}^{8} \beta_k^{P,USD} = 0$
LCP	$\beta_0^{P,BER} = 0, \beta_0^{P,USD} = 0$	$\sum_{k=0}^{8} \beta_k^{P,BER} = 0, \sum_{k=0}^{8} \beta_k^{P,USD} = 0$	$\beta_0^{P,BER} = 0, \beta_0^{P,USD} = 1$	$\sum_{k=0}^{8} \beta_k^{P,BER} = 0, \sum_{k=0}^{8} \beta_k^{P,USD} = 0$
DCP	$\beta_0^{P,BER} = 0, \beta_0^{P,USD} = 0$	$\sum_{k=0}^{8} \beta_k^{P,BER} = 0, \sum_{k=0}^{8} \beta_k^{P,USD} = 1$	$\beta_0^{P,BER} = 0, \beta_0^{P,USD} = 0$	$\sum_{k=0}^{8} \beta_k^{P,BER} = 1, \sum_{k=0}^{8} \beta_k^{P,USD} = 0$

Notes: Predictions based on discussion in Section 2.2

Table 4: Bilateral and USD ERPT and Quantities

Dependent Variables:	price	quantity	price	quantity
Model:	(1)	(2)	(3)	(4)
β_0^{BER}	0.6189***	-0.0838	0.0975	-0.0683
	(0.0433)	(0.0736)	(0.0735)	(0.1216)
$\sum_{k=0}^{4} \beta_k^{BER}$	0.6335***	-0.5537***	0.5425***	-0.5858***
	(0.0726)	(0.1486)	(0.0945)	(0.2093)
$\sum_{k=0}^{8} \beta_k^{BER}$	0.7949***	-0.9084***	0.8251***	-1.3394***
	(0.1278)	(0.2375)	(0.1684)	(0.3309)
β_0^{USD}			0.885***	-0.1073
			(0.0622)	(0.126)
$\sum_{k=0}^{4} \beta_k^{USD}$			0.4133***	-0.1995
			(0.0844)	(0.2115)
$\sum_{k=0}^{8} \beta_k^{USD}$			0.3052***	0.1773
			(0.122)	(0.2883)
Fixed effects	Yes	Yes	Yes	Yes
Observations	71,679	71,679	71,679	71,679
R^2	0.1165	0.1037	0.1212	0.1043

Notes: Results for $\Delta y_{fgjct} = \lambda^Y_{fgjc} + \sum_{k=0}^{8} \beta_k^{Y,USD} \Delta e_{USD,j,t-k} + \sum_{k=0}^{8} \beta_k^{Y,BER} \Delta e_{CLP,j,t-k} + \theta^{Y\prime} X^Y_{jt} + \varepsilon^Y_{fgjct}$ in columns (3) and (4). For columns (1) and (2) is the same equation but without $\Delta e_{USD,j,t-k}$ as regressors, with Y denotes prices or quantities. In all the cases, β_0 is the contemporary effect, $\sum_{k=0}^{4} \beta_k$ and $\sum_{k=0}^{8} \beta_k$ is the sum of the coefficient at the 4 and 8 quarters, respectively. BER is for bilateral exchange rate effect between currency j and CLP. USD is for exchange rate effect between currency j and US dollar. Fixed effects at firm-product-currency-destination level. Controls for the prices equations include the Chilean Producer Price Index and the destination Consumer Price Indices. For quantities, we include as well the destination Gross Domestic Product. Observations at item level from Chile´s National Customs Service. Estimation of non-mining sector for USD and non-dollarized destinations. Clustered (firm) standard-errors in parentheses. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1.

Table 5: Local Currency and USD Invoicing

	Whole sample		Non-USD destinations		Only invoiced in USD	
Dependent Variables:	price	quantity	price	quantity	price	quantity
	(1)	(2)	(3)	(4)	(5)	(6)
β_0^{BER}	0.0528	0.0465	0.0647	0.0094	0.0668	0.015
	(0.0637)	(0.1152)	(0.0711)	(0.1186)	(0.0657)	(0.1158)
$\sum_{k=0}^{4} \beta_k^{BER}$	0.5137***	-0.4659***	0.5168***	-0.4907***	0.5261***	-0.4861***
	(0.0911)	(0.1874)	(0.0863)	(0.1849)	(0.0932)	(0.1898)
$\sum_{k=0}^{8} \beta_k^{BER}$	0.7281***	-0.8674***	0.7707***	-0.9486***	0.7618***	-0.9684***
	(0.1636)	(0.2731)	(0.1497)	(0.2723)	(0.1654)	(0.2757)
γ_0^{BER}	0.0671	-0.0941	-0.1748	0.0589	0.2255	-0.1659
	(0.1289)	(0.1747)	(0.1105)	(0.2119)	(0.1921)	(0.2399)
$\sum_{k=0}^{4} \gamma_k^{BER}$	-0.1961	0.0981	-0.2974**	-0.0489	-0.1608	0.1973
	(0.1231)	(0.2518)	(0.1378)	(0.3917)	(0.1664)	(0.2936)
$\sum_{k=0}^{8} \gamma_k^{BER}$	-0.1683	-0.1063	-0.2685	-0.8416*	-0.1107	0.264
	(0.1983)	(0.3136)	(0.1863)	(0.4567)	(0.29)	(0.394)
β_0^{USD}	0.9305***	-0.1685	0.9136***	-0.1255	0.9249***	-0.1604
	(0.0543)	(0.1143)	(0.0586)	(0.1162)	(0.057)	(0.1171)
$\sum_{k=0}^{4} \beta_k^{USD}$	0.4475***	-0.1337	0.4522***	-0.1489	0.4568***	-0.1914
	(0.07)	(0.1757)	(0.0697)	(0.1769)	(0.0723)	(0.179)
$\sum_{k=0}^{8} \beta_k^{USD}$	0.3753***	-0.031	0.3748***	0.0021	0.3638***	-0.0318
	(0.1056)	(0.2325)	(0.1035)	(0.2338)	(0.1101)	(0.2346)
γ_0^{USD}	-0.8393***	0.1812	-0.6565***	-0.2622		
	(0.148)	(0.2722)	(0.1366)	(0.3129)		
$\sum_{k=0}^{4} \gamma_k^{USD}$	-0.5793***	0.5652	-0.5315***	0.0731		
	(0.1149)	(0.3442)	(0.1323)	(0.3582)		
$\sum_{k=0}^{8} \gamma_k^{USD}$	-0.7399***	0.635	-0.6245***	0.2312		
	(0.2)	(0.4516)	(0.1788)	(0.4757)		
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	101,564	101,564	84,587	84,587	88,656	88,656
R^2	0.0838	0.0609	0.0887	0.0627	0.0881	0.0657

Notes: Results for $\Delta y_{fgjct} = \sum_{k=0}^{8}(\beta_k^{Y,USD} + \gamma_k^{Y,USD} D_{fgjct}^{LC})\Delta e_{USD,j,t-k} + \sum_{k=0}^{8}(\beta_k^{Y,BER} + \gamma_k^{Y,BER} D_{fgjct}^{LC})\Delta e_{CLP,j,t-k} + \alpha D_{fgjct}^{LC} + \theta^{Y\prime} X_{jt}^{Y} + \lambda_{fg}^{Y} + \varepsilon_{fgjct}^{Y}$ in columns (1) and (2). For columns (3) and (4) is the same equation but excluding $\Delta e_{USD,j,t-k}$ as regressors, Y denotes prices or quantities, D^{LC} is 1 if the export is invoiced in local currency and 0 if in USD. Results for $\Delta y_{fgjt} = \lambda_{fg}^{Y} + \sum_{k=0}^{8}(\beta_k^{Y,BER} + \gamma_k^{Y,BER} D_{fgjt}^{US})\Delta e_{CLP,j,t-k} + \sum_{k=0}^{8} \beta_k^{Y,USD} \Delta e_{USD,j,t-k} + \alpha D_{fgjt}^{US} + \theta^{Y\prime} X_{jt}^{Y} + \varepsilon_{fgjt}^{Y}$ in columns (5) and (6), where D^{US} is 1 if the destination is the US, and 0 otherwise. In all the cases, β^0 is the contemporary effect, $\sum_{k=0}^{4} \beta_k$ and $\sum_{k=0}^{8} \beta_k$ is the sum of the coefficient at the 4 and 8 quarters, respectively. γ^0 is the differential contemporary effect, $\sum_{k=0}^{4} \gamma_k$ and $\sum_{k=0}^{8} \gamma_k$ is the sum of the coefficient at the 4 and 8 quarters, respectively. For columns (1) to (4), γ is the differential effect for exports invoiced in local currency. For columns (5) and (6) γ is the differential effects for exports to the US. BER is for bilateral exchange rate effect between currency j and CLP. USD is for exchange rate effect between currency j and US dollar. Fixed effects at firm-product level. Controls for the prices equations include the Chilean Producer Price Index and the destination Consumer Price Indices. For quantities, we include as well the destination Gross Domestic Product. Observations at item level from Chile´s National Customs Service. Estimation of non-mining sector. Clustered (firm) standard-errors in parentheses. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1.

Table 6: Bilateral and USD ERPT per Sector

Model:	Price					
Variable:	β_0^{BER}	$\sum_{k=0}^{4} \beta_k^{BER}$	$\sum_{k=0}^{8} \beta_k^{BER}$	β_0^{USD}	$\sum_{k=0}^{4} \beta_k^{USD}$	$\sum_{k=0}^{8} \beta_k^{USD}$
Pulp, paper and printing prod.	0.322	0.7061***	0.6148*	0.803***	0.4156	0.5528*
	(0.3201)	(0.3008)	(0.3582)	(0.1572)	(0.3447)	(0.2842)
Chemical industries	0.0148	0.5947**	1.0795***	0.7731***	0.4718***	0.1561
	(0.1125)	(0.2664)	(0.4252)	(0.1361)	(0.1852)	(0.2003)
Fishing industry	0.5699***	0.6255***	0.6543***	0.2236***	0.3154***	0.3793**
	(0.0757)	(0.1254)	(0.1787)	(0.0931)	(0.1264)	(0.1823)
Wood and furniture manufacture	-0.0398	0.3426***	0.2789	0.8646***	0.1149	0.0865
	(0.1398)	(0.0986)	(0.1987)	(0.1123)	(0.1852)	(0.245)
Rest of the food industry	0.0593	0.3971*	0.7431*	0.8809***	0.4693***	0.3264**
	(0.0988)	(0.2372)	(0.392)	(0.0667)	(0.1057)	(0.1536)
Wine elaboration	-0.0292	0.2715***	0.4449***	0.8655***	0.3852***	0.3021*
	(0.0639)	(0.1106)	(0.1814)	(0.0732)	(0.1258)	(0.1785)
Basic metal industry	0.122	0.2237	0.1209	0.3886*	0.2143	0.3178
	(0.2322)	(0.3318)	(0.4903)	(0.2103)	(0.3592)	(0.3644)
Metal prod., machinery and equip.	0.2334	0.9968***	1.7343***	0.8903***	0.2993	-0.1339
	(0.2971)	(0.3611)	(0.5604)	(0.2565)	(0.3523)	(0.4765)
Rubber and plastic production	-0.2222	0.0284	0.4441	1.3327***	0.8392***	0.6196**
	(0.2528)	(0.2784)	(0.4722)	(0.1781)	(0.2895)	(0.2842)
Other industries	0.1566	0.469	0.3624	0.908***	0.2299	0.3696
	(0.2781)	(0.3138)	(0.6195)	(0.2235)	(0.3608)	(0.4402)
Other beverages and tobacco prod.	0.3198**	0.4509***	-0.2476	1.2407***	0.5044	1.3477
	(0.1541)	(0.1902)	(0.4466)	(0.2917)	(0.4819)	(0.8275)
Mean	0.1370	0.4642	0.5663	0.8337	0.3872	0.3931
Transaction-weighted mean	0.1108	0.4427	0.6375	0.8135	0.3905	0.3033
Value-weighted mean	0.1829	0.5346	0.6636	0.7381	0.3752	0.3359

Notes: Price baseline regression interacting with each relevant sector. A sector is relevant if Exports value (%) > 0.01 according to Table A.2, sectors with Exports value (%) < 0.01 are added in other industries category. Sectors according to economy activity code-42 from Harmonized System Codes (HSC). Fixed effects at firm-product-currency-destination level. Observations at item level from Chile´s National Customs Service. Sectors in descending order by Exports value. Clustered (firm) standard-errors in parentheses. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1.

Table 7: Bilateral and USD Quanities per Sector

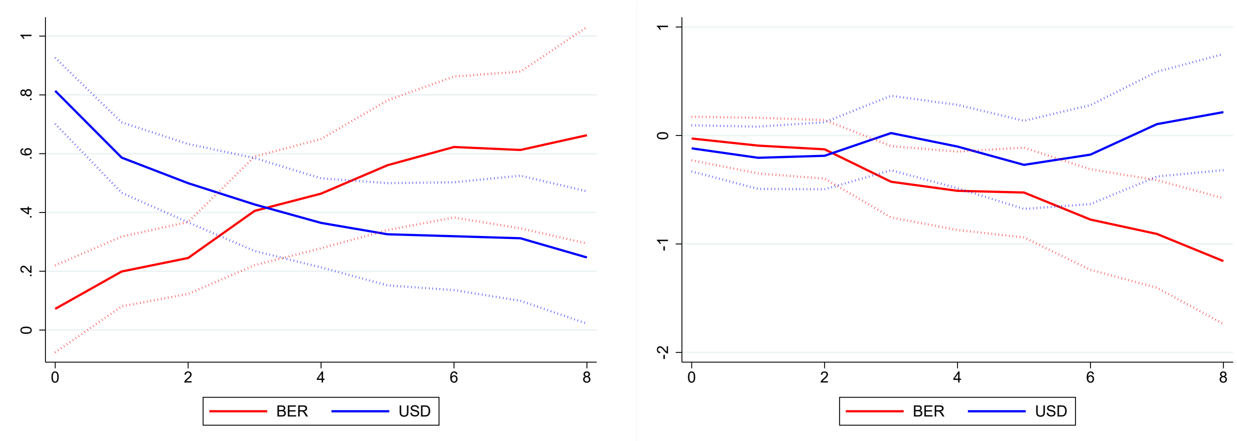
Model:	Quantity					
Variable:	β_0^{BER}	$\sum_{k=0}^{4}\beta_k^{BER}$	$\sum_{k=0}^{8}\beta_k^{BER}$	β_0^{USD}	$\sum_{k=0}^{4}\beta_k^{USD}$	$\sum_{k=0}^{8}\beta_k^{USD}$
Pulp, paper and printing prod.	-0.5557	0.0362	0.1266	0.2933	-0.2365	-0.0625
	(0.5485)	(0.3918)	(0.6943)	(0.4409)	(0.4285)	(0.6218)
Chemical industries	0.0536	-0.4985	-1.2272**	-0.0658	-0.1061	0.3003
	(0.2653)	(0.4236)	(0.6012)	(0.2896)	(0.2824)	(0.3682)
Fishing industry	-0.1911	-0.5043	-0.8385	0.2328	0.2731	0.7885
	(0.3112)	(0.3897)	(0.5473)	(0.3162)	(0.4131)	(0.5788)
Wood and furniture manufacture	0.0791	-0.4425	-1.0389	0.1301	-0.7209**	-0.0863
	(0.2917)	(0.4224)	(0.6583)	(0.2795)	(0.3317)	(0.4697)
Rest of the food industry	-0.105	-0.4418	-1.4904***	-0.3495*	-0.4451	-0.0988
	(0.1576)	(0.3031)	(0.4513)	(0.1866)	(0.3018)	(0.3525)
Wine elaboration	-0.0289	-0.758***	-1.7171***	-0.0965	0.3682	0.8939**
	(0.1386)	(0.2706)	(0.4325)	(0.1744)	(0.2954)	(0.4224)
Basic metal industry	-0.7803	-0.5362	-1.0413	0.3412	-0.8941	-1.3899
	(0.4851)	(0.7198)	(1.1069)	(0.6107)	(0.6596)	(1.05)
Metal prod., machinery and equip.	-0.0227	-0.9855	-1.6291**	-0.0589	0.4507	0.743
	(0.3823)	(0.6001)	(0.8301)	(0.3536)	(0.5182)	(0.6043)
Rubber and plastic production	0.4532	-0.2888	-0.8612	-0.7134**	-0.55	-0.4682
	(0.3857)	(0.5064)	(0.8445)	(0.3405)	(0.4214)	(0.6137)
Other industries	0.3271	-0.5852	-0.5019	-0.7045*	0.4006	0.6238
	(0.3723)	(0.5444)	(0.8506)	(0.3923)	(0.6318)	(0.7839)
Other beverages and tobacco prod.	-0.712	0.4628	2.1904*	0.6513	1.4036	1.3176
	(0.6155)	(0.9893)	(1.3102)	(1.0022)	(1.3426)	(1.3166)
Mean	-0.1348	-0.4129	-0.7299	-0.0309	-0.0051	0.2329
Transaction-weighted mean	-0.0071	-0.5181	-1.0987	-0.0928	-0.0538	0.3383
Value-weighted mean	-0.1781	-0.3739	-0.7968	0.0563	-0.1509	0.1801

Notes: Quantity baseline regression interacting with each relevant sector. A sector is relevant if Exports value (%) > 0.01 according to Table A.2, sectors with Exports value (%) < 0.01 are added in other industries category. Sectors according to economy activity code-42 from Harmonized System Codes (HSC). Fixed effects at firm-product-currency-destination level. Observations at item level from Chile´s National Customs Service. Sectors in descending order by Exports value. Clustered (firm) standard-errors in parentheses. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1.

A Additional Tables and Figures

Figure A.1: All currencies, all destinations

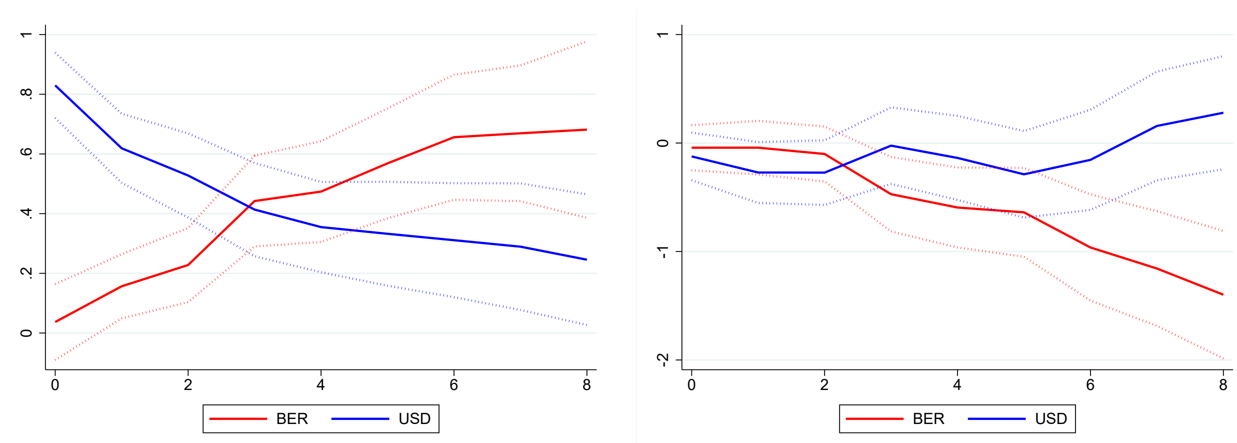
(a) Price (b) Quantity



Notes: Results for estimation (10) in panel (a) and (11) in panel (b), using non-mining sector and considerating all currencies and all destinations. Panel (a) plots the sum of $\beta_k^{P,BER}$ and $\beta_k^{P,USD}$. Panel (b) plots the sum of $\beta_k^{Q,BER}$ and $\beta_k^{Q,USD}$.

Figure A.2: All currencies, non-dollarized destinations

(a) Price (b) Quantity



Notes: Results for estimation (10) in panel (a) and (11) in panel (b), using non-mining sector and considerating all currencies and non-dollarized destinations. Panel (a) plots the sum of $\beta_k^{P,BER}$ and $\beta_k^{P,USD}$. Panel (b) plots the sum of $\beta_k^{Q,BER}$ and $\beta_k^{Q,USD}$.

Table A.1: Export Value and Transaction per Destination

Destination	Value(%)	Transaction(%)
USA	23.35	42.4
China	15.35	4.31
Japan	10.47	4.33
Brazil	9.57	6.92
Peru	6.10	13.86
Netherlands	5.78	1.94
Mexico	5.50	4.66
South Korea	4.47	2.02
Colombia	3.70	5.53
Italy	2.33	0.62
Belgium	2.08	0.28
United Kingdom	1.92	3.77
Canada	1.35	3.23
Spain	1.32	1.12
Germany	1.18	0.66
Costa Rica	1.07	1.15
Australia	1.01	1.23
Russia	0.97	0.96
France	0.93	0.39
Thailand	0.59	0.18
India	0.57	0.10
Sweden	0.30	0.28
Turkey	0.05	0.03
Switzerland	0.02	0.03

Notes: Value represent the FOB value percentage of exports and transaction represent the number of transactions in percentage both considering non-mining data. *Source*: Author´s own calculations are based on Chile´s National Customs Service.

Table A.2: Export Value and Transaction per Sector

Sector	Macrosector	Value (%)	Transaction (%)
Pulp, paper and printing prod. prod.	Manufacturing industry	24.14	4.53
Chemical industries	Manufacturing industry	18.03	7.15
Fishing industry	Manufacturing industry	15.57	16.73
Wood and furniture manufacture	Manufacturing industry	12.21	15.31
Rest of the food industry	Manufacturing industry	9.07	9.41
Wine elaboration	Manufacturing industry	5.72	18.85
Basic metal industry	Manufacturing industry	4.28	0.91
Metal prod., machinery and equip. manuf.	Manufacturing industry	3.88	9.20
Rubber and plastic production	Manufacturing industry	3.42	12.47
Other beverages and tobacco prod. elab.	Manufacturing industry	1.50	1.51
Fruit growing	Agricultural and Fishing	0.57	0.92
Textile industry	Manufacturing industry	0.49	1.55
Fishing	Agricultural and Fishing	0.42	0.15
Fuels elaboration	Manufacturing industry	0.20	0.07
Agriculture	Agricultural and Fishing	0.18	0.30
Non-metallic minerals manufacture	Manufacturing industry	0.15	0.57
Elect. gas and water supply	Elect. gas and water supply	0.12	0.17
Silviculture	Agricultural and Fishing	0.06	0.07
Ranching	Agricultural and Fishing	0.05	0.03
Other manufacturing industries	Manufacturing industry	0.01	0.12
Information services	Transport, info. and comm.	0.00	0.01

Notes: Sectors according to economy activity code-42 from Harmonized System Codes (HSC). Relevant sectors are those with Exports value (%) > 0.01, sectors with Exports value (%) < 0.01 are added in other industries category as shown in Table 6 and 7. Sectors in descending order by Exports value.

B Annex - A three currency example of export supply and demand

The results presented in this paper are empirical correlations suggestive of pricing decisions by exporting firms. Some of the results are consistent with the existence of both supply and demand responses to exchange rate fluctuations. In this annex we present a simple example of export supply and demand to show how supply effects might influence longer run effects of exchange rates on prices and quantities.

The three pricing paradigms discussed in the literature and presented in this paper imply nominal rigidities in the short run. Under PCP, export prices are sticky in the currency of the exporting firm. Following the Keynesian inspiration of Mundell-Fleming, sticky prices in the short run imply a perfectly elastic supply of goods (exports in this case). Thus, exchange rate movements potentially affect the price of exports at destination, and therefore change exports demanded. Under PCP, as long as the prices remain fixed in the currency of origin, the exporters are assumed to change seamlessly the quantities exported to respond to the new demand of exports.

Over time, however, if exporters face upward sloping supply curves, a different demand for exports will imply also changes in prices. In the long-run, prices in the currency of origin will adjust to the initial exchange rate movements so as to achieve an equilibrium between supply and demand.

A similar dynamic can be expected under DCP. Even though exchange rate movements in this case do not affect the price of exports at destination, they will impact over time the profitability of exporting firms in the currency of the exporting country. Again, as before, over time it should be expected that prices adjust to exchange rate movements so as to achieve equilibrium between supply and demand. Under LCP something similar happens.

A full-fleshed out equilibrum model of prices and exchange rates, with explicit optimal dynamics of adjustment by firms, and general equilibrium considerations such as the effect of exports on the equilibrium real exchange rate, is well beyond the scope of this paper. We show below how the passthrough from exchange rates to prices and quantities varies once one allows price flexibility to achieve demand and supply equilibrium.

We consider a single exported good by a single firm to a single destination. This allows to abstract the indexing of destination, firm, and exchange rate heterogeneity. There are three currencies, and thus three bilateral exchange rates: the (log) value of the destination market´s currency in terms of Chilean Pesos, e_{CLP}, the (log) value of the destination market´s currency in terms of the US Dollar, e_{USD}, and the log value of the US Dollar in terms of Chilean Pesos. As only two exchange rates are independently determined, the latter is equivalent to $e_{USD} - e_{CLP}$. The log price of the exported good in the currency of the destination market is p, and we assume that log export demand only depends on this price with a constant elasticity $-\eta$:

$$q^d = -\eta . p \tag{16}$$

In the short run prices are sticky. Under PCP, $p - e_{CLP}$ is fixed. Under DCP, $p - e_{USD}$ is fixed. And under LCP, p is fixed. As mentioned above, price rigidity can be interpreted as a perfectly elastic supply, and therefore exports will be determined solely by demand in the very short run. The short term export demand effects of a change of the bilateral exchange rate vis the Chilean peso, keeping the bilateral exchange rate vis the US Dollar constant, are then:

$$\left.\frac{\delta q^d}{\delta e_{CLP}}\right|_{PCP} = -\eta, \quad \left.\frac{\delta q^d}{\delta e_{CLP}}\right|_{DCP} = 0, \quad \left.\frac{\delta q^d}{\delta e_{CLP}}\right|_{LCP} = 0 \tag{17}$$

Similarly, a change of the destination currency value vis the US Dollar, keeping constant the exchange rate with the Peso (which is equivalent to assuming a global change in the value of the US dollar), leads to:

$$\left.\frac{\delta q^d}{\delta e_{USD}}\right|_{PCP} = 0, \quad \left.\frac{\delta q^d}{\delta e_{USD}}\right|_{DCP} = -\eta, \quad \left.\frac{\delta q^d}{\delta e_{USD}}\right|_{LCP} = 0 \tag{18}$$

If the destination currency moves by the same magnitude with respect to the US dollar and the Peso:

$$\left.\left[\frac{\delta q^d}{\delta e_{CLP}} + \frac{\delta q^d}{\delta e_{USD}}\right]\right|_{PCP,DCP} = -\eta, \quad \left.\left[\frac{\delta q^d}{\delta e_{CLP}} + \frac{\delta q^d}{\delta e_{USD}}\right]\right|_{LCP} = 0 \tag{19}$$

Over time, the assumption of sticky prices, or perfectly elastic supply, is not tenable. We posit then a medium term supply schedule of exports that depends on the price of exports in the currency of the exporting economy (in our case, Chilean Pesos). This can reflect both extensive and intensive margins of adjustment. For simplicity we assume it responds with a constant elasticity σ to the unit export price in Chilean pesos. Other cost shifters are possible. For instance, the exporting firm might use imported inputs. Or it might export to other destinations, including the domestic market. To take these into consideration we posit that supply also depends on the US Dollar value in terms of Chilean Pesos $e_{USD} - e_{CLP}$ through an elasticity ϕ. This elasticity can be positive or negative. For instance, if the exporter´s returns in Chilean pesos increase when the Chilean peso depreciates vis a vis the US dollar, then the elasticity ϕ would be positive. If, on the other hand, the exporter uses imported inputs the elasticity ϕ would be negative, and it would represent the share of imported inputs (priced in USD) in the production function.

Given the above, the profit function for the exporting firm is given by:

$$\Pi = \left[(P.E_{CLP}^{-1}) - (E_{USD}.E_{CLP})^{\phi}\right].P^{-\eta} \tag{20}$$

The term in brackets is the difference between the peso returns from unit exports and the marginal cost, here assumed to be associated with the Peso USD exchange rate. The total exported volume depends on the specified demand for exports.

As over time all prices (except the nominal exchange rates, which are assumed have exogenous variation) can adjust and are flexible, thus making the invoicing currency moot. It is indeed equivalent to assume that prices in the currency of the exporting firm are flexible, or those invoiced in US Dollars, or in the currency of the destination economy. The price in destination currency that maximizes profits is obtained from:

$$\tilde{P} = \arg\max_{P} \Pi\left(P|\Omega\right) \tag{21}$$

Which then results in

$$\tilde{P} = \frac{\eta}{1+\eta} E_{CLP}^{1+\phi} . E_{USD}^{\phi} \tag{22}$$

In logs:

$$\tilde{p} = \ln\left[\frac{\eta}{\eta - 1}\right] + (1+\phi)e_{CLP} + \phi e_{USD} \tag{23}$$

From this expression the effects of changes in the exchange rates on the price of exports at destination in the long run is straight forward. The effects on quantities are:

$$\frac{\delta q}{\delta e_{CLP}} = -\eta(1+\phi) \tag{24}$$

$$\frac{\delta q}{\delta e_{USD}} = -\eta\phi \tag{25}$$

$$\frac{\delta q}{\delta e_{CLP}} + \frac{\delta q}{\delta e_{USD}} = -\eta(1+2\phi) \tag{26}$$

C Alternative version

In this Appendix section, we want to illustrate potential *supply* side effects not fully captured by our baseline estimation. It is motivated by the fact that bilateral depreciation of the destination's currency does not generate a substantive drop in quantities, despite the rise in prices.

To do so, we consider the simple case of a single-product firm that has the following supply and demand functions (in logs):

$$q^D = -\eta p \tag{27}$$

$$q^S = \sigma(p - e_{j,CLP}) - \phi(e_{j,USD} - e_{j,CLP}), \tag{28}$$

where p is expressed in unit of the destination's currency. Parameter η and σ are the slopes of demand and supply curves, respectively. We assume

$$p = \frac{1}{\eta + \sigma}\left[(\phi + \sigma)e_{j,CLP} - \phi e_{j,USD}\right] \tag{29}$$

$$\frac{\partial p}{\partial e_{USD,CLP}} = \frac{\sigma + 2\phi}{\sigma + \eta} \tag{30}$$

$$\frac{\partial q}{\partial e_{USD,CLP}} = -\eta\frac{\sigma + 2\phi}{\sigma + \eta} \tag{31}$$

Disclaimers:

The views expressed are those of the authors and do not necessarily represent the views of the Central Bank of Chile (CBC) or its board members.

This study was developed within the scope of the research agenda conducted by the CBC in economic and financial affairs of its competence. The CBC has access to anonymized information from various public and private entities, by virtue of collaboration agreements signed with these institutions.

To secure the privacy of workers and firms, the CBC mandates that the development, extraction and publication of the results should not allow the identification, directly or indirectly, of natural or legal persons. Officials of the Central Bank of Chile processed the disaggregated data. All the analysis was implemented by the authors and did not involve nor compromise the SII, Aduanas and AFC.

The information contained in the databases of the Chilean IRS is of a tax nature originating in self-declarations of taxpayers presented to the Service; therefore, the veracity of the data is not the responsibility of the Service.