Great Financial Crisis and Dollar Dominance

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Abstract

This paper studies how large global shocks can undermine the dominance of the US dollar in the international monetary system. Following the Great Financial Crisis, the share of Chilean imports denominated in US dollars steadily decreased by nearly 10%, while the share denominated in Chilean pesos increased by 7% by the end of 2019. These changes in aggregate invoicing shares stem from firms switching from US dollar to Chilean peso invoicing. Notable, the first importers to switch to Chilean peso invoicing were large firms with substantial US dollar currency mismatches. We propose a model of invoicing choice where imports serve as a form of working capital, and importing firms select the currency of financing in the presence of natural hedging and strategic complementarities motives. Invoicing decisions depend on the relative cost of financing in vehicle and domestic currency – or, equivalently, on uncovered interest parity deviations. The presence of sunk cost in currency management creates hysteresis in invoicing choices following a temporary shock in UIP deviations. We show that the invoicing patterns observed in Chilean imports, alongside the lack of similar trends in exports or other economies, can be rationalized by the cross-currency heterogeneity in the dynamics of UIP deviations. We then test the key theoretical mechanisms using firm-level data and a range of econometric techniques. Finally, we explore the implications of large changes in invoicing choices for the sensitivity of the terms of trade balance and inflation to exchange rate depreciations.

JEL Codes: F14, F31, F33, F41.
Keywords: Exchange rate, invoicing currency, vehicle currency, dollar dominance, dominant currency, trade finance, working capital, firm-level trade.

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1 Introduction

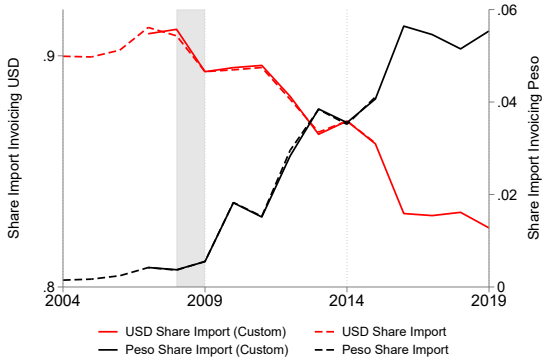
The global economy is characterized by the presence of a dominant currency, the US dollar, that is used to invoice the majority of international trade transactions, safe assets and international debt, and central banks' international reserves (Gopinath, 2015; Gopinath and Stein, 2021). Prior literature has expressed great interest to the implications of such dominance for several macroeconomics facts, including exchange rate pass-through, shocks transmissions and spillovers across countries, and the dynamics of external adjustment (Gourinchas et al., 2019; Adler et al., 2020). However, comparatively little attention has been devoted to understanding the forces and shocks that can undermine the widespread use of the US dollar and push the global economy out of dollar dominance.

Although we know from history that abrupt shifts in the international monetary system can occur following permanent shifts in economic conditions, this paper examines how large, temporary shocks to dollar financing and UIP deviations have long-lasting effects on the invoicing decisions of international trade transactions. The majority of these transactions require external financing, which is typically heavily dollarized and sourced locally through domestic banks (Bruno and Shin, 2019; Niepmann and Schmidt-Eisenlohr, 2017). Our study provides a unique setting to explore how the temporary scarcity of dollar financing during periods of distress, such as the Great Financial Crisis (henceforth GFC), and the associated abnormal UIP deviations, permanently affect firms' invoicing decisions – and not just trade flows or investment choices (Amiti and Weinstein, 2011; Ahn et al., 2011; Salomao and Varela, 2022; Kalemli-Özcan and Varela, 2021).

This paper is motivated by a unique shift in import invoicing patterns in Chile following the GFC (Figure 1). Using Chilean import transactions from 2004 to 2019, we show that the share of imports denominated in US dollars declined by 10 percentage points after the Great Financial Crisis, without recovering thereafter. At the onset of the GFC, approximately 90% of Chilean imports were invoiced in US dollars. By the end of 2019, this share had fallen to around 80%. Simultaneously, the use of the Chilean peso – virtually nonexistent before 2008 – accounted for nearly 7% of total imports by 2019. Importantly, we do not observe similar patterns on the export side, where the US dollar continued to be used almost exclusively.

We analyze the dynamics of aggregate invoicing shares and find that the majority of these changes are driven by within-firm, within-sourcing strategy invoicing choices. Leveraging the granular nature of our data, we perform a dynamic Olley-Pakes decomposition (Melitz and Polanec, 2015) to identify which firms are driving the changes observed at the

Figure 1: Aggregate Invoicing Shares for Imports - Chile



Note: Figure 2 shows the time series of the aggregate share of imports denominated in US Dollar and Chilean Peso for Chile between 2004-2019. The left vertical axis of Figure 2 reports the share of Chilean imports denominated in US dollar. The right axis shows the share of Chilean imports denominated in Chilean Peso. Data from 2007 for imports are from Chilean Customs Agency. Data before 2007 are from Garcia-Marin et al. (2019). The grey shaded area represents the NBER recession period.

aggregate level. Our findings show that more than 80% of the aggregate shift away from US dollar invoicing is attributable to incumbent firms, with a minimal role played by the invoicing decisions of new entrants. Additionally, incumbents firms actively switched from dominant currency invoicing to alternative currencies, almost exclusively the Chilean peso. Notably, the aggregate dynamics are primarily driven by within-firm adjustments rather than a reallocation of market shares towards firms invoicing relatively less in US dollars.

We document selection in the decision to first switch away from US dollar invoicing along two margins: i) firms that are more operationally unhedged in US dollars and ii) larger firms are more likely to switch first. The former suggests that the higher financing costs faced by firms during periods of dollar financing scarcity, such as the GFC, are particularly relevant for those with relatively more negative cash flows denominated in US dollars. This is especially critical for large firms that are primarily importers or that import significantly more in US dollars than they export, as they tend to have larger financial needs. Moreover, the fact that more firms switch away from dollar invoicing over time, and that the size of these new switchers decreases over time, indicates the presence of strategic complementarities in firms' invoicing decisions (Amiti et al., 2022,0). Smaller firms gradually adjust their invoicing practices, following the currency choices of competitors, even after the GFC.

To guide our analysis, we develop a theoretical framework to rationalize the empirical findings on invoicing choice dynamics, focusing on the invoicing of firms' liabilities. We model a small open economy populated by importing firms that choose the currency of denomination

for their trade credit on imported inputs, taking into account strategic complementarities and natural hedging. Imported inputs are treated as working capital, requiring advance financing (Bahaj and Reis, 2020). Financing and invoicing decisions depend on the relative borrowing costs in domestic versus vehicle currencies or, equivalently, on UIP deviations (Salomao and Varela, 2022). Asymmetric shocks to financing costs across currencies, such as the GFC, make trade finance in certain currencies more attractive, ultimately influencing invoicing patterns. This effect is amplified when firms rely more heavily on imported inputs, as they are more exposed to exchange rate fluctuations, capturing natural hedging forces.

A key and novel element of the model is the introduction of a sunk cost associated with adopting a new currency for import invoicing. Strategic complementarities arise from the assumption that the firm-level fixed cost of managing invoicing currencies decreases with the number of users of that currency (Crowley et al., 2020). We further expand on this by incorporating a sunk component into the fixed costs. This sunk cost generates long-lasting effects on invoicing choices due to hysteresis. When firms incur a sunk cost to invoice in a new currency, it permanently reduces the fixed cost of managing invoicing in that currency. This shift alters the relative convenience of invoicing imports and trade credit in different currencies, even in the presence of temporary shocks.

We test the key mechanisms of our theoretical framework and provide strong empirical support for its predictions. Our empirical analysis begins by mapping the theoretical borrowing cost differentials to the data. Using data on bank lending rates from the Chilean bank regulator, we find that during the GFC, US dollar financing in Chile temporarily became more expensive than financing in Chilean pesos. This transitory shock aligns with the theoretical mechanism required to explain the decline in the share of vehicle currency invoicing. Furthermore, while UIP deviations in other emerging economies exhibited similar qualitative dynamics, only Chile experienced a sharp reversal of UIP deviations around the GFC. These patterns help explain the lack of changes in invoicing patterns in other economies, as well as in Chilean exports, reinforcing the key mechanism proposed in our theoretical framework.

Next, we document the key theoretical mechanisms using firm-level customs data. First, we show that the differential between dollar- and peso-invoiced financing is a key determinant of firms' dollar invoicing. In the cross-section, an increase in the dollar-peso financing differential reduces the share of imports invoiced in US dollars. Consistent with other testable implications of the model, we find that the effects of fluctuations in the dollar-peso financing differential are amplified by firms' exposure to US dollar liabilities and mitigated by the presence of strategic complementarities. Leveraging the dynamic nature of our setting, we

use an event study design to show that firms more exposed to negative US dollar cash flows before the GFC switched to Chilean peso invoicing more strongly than less exposed firms.

Also consistent with the model, we provide evidence supporting the presence of sunk costs in invoicing choices. We find that previous invoicing decisions strongly predict current invoicing choices at the firm level, supporting the key assumption in our model that generates the hysteresis observed in the data.

To conclude, we examine the macroeconomic implications of the decline in the aggregate share of dollar-denominated imports, particularly regarding the transmission of exchange rate fluctuations to domestic prices, the dynamics of the terms of trade and trade balance, and, ultimately, macroeconomic policy. Consistent with previous literature, invoicing is a key determinant of the degree of exchange rate pass-through, with pass-through rates being higher when transactions are invoiced in a dominant currency and lower when invoiced in a local currency (Gopinath et al., 2010; Barbiero, 2021). As a result, in 2019, the sensitivity of import inflation to exchange rate fluctuations decreased by 5% compared to 2007, while the sensitivity of the trade balance and terms of trade fell by approximately 30%.

Related Literature This paper is closely related to several strands of literature on dominant international currencies. Most models of currency dominance have in common the fact that they either define under which conditions a currency becomes dominant or they define under which conditions a currency remains dominant. Examples in this line of work are Eichengreen et al. (2018), Chahrour and Valchev (2022), Farhi and Maggiori (2018), and Gopinath and Stein (2021).[1] Fewer papers instead focus on forces and shocks that can perturb the current dollar dominant equilibrium. Chahrour and Valchev (2023) and Corsetti et al. (2022) share the same perspective in analyzing how geo-political fragmentation and Brexit, respectively, affect the current dominant currency equilibrium. Bahaj and Reis (2020) and Bahaj and Reis (2022) focus on currency competition in the central banks' swap line market as a channel through which the People's Bank of China jump-started the international use of the RMB, challenging the dominant role of the dollar. Our paper complements this literature concerned with discontinuities in the international monetary system as we shed light on how large macroeconomic events such as the Great Financial Crisis might impair the dominance of a single currency and the mechanism that could lead to the rise of

[1] Other recent contributions such as Gopinath et al. (2020) and Mukhin (2022) focus on understanding the consequences that the US dollar dominance has on international trade dynamics, and the global economy in general. Refer to Gourinchas et al. (2019) for a survey.

another competitive currency.[2]

Our theoretical framework emphasizes the crucial role of trade finance. International trade transactions require external financing, which is typically heavily dollarized and sourced locally via domestic banks (Niepmann and Schmidt-Eisenlohr, 2017). The forces driving currency dominance in trade and finance are closely intertwined. The availability of safe, liquid, short-term government-backed liabilities fosters invoicing dominance, as shown by Coppola et al. (2023) and Eren and Malamud (2022). Similarly, Chahrour and Valchev (2023) highlights that dollar dominance arises from the need for both parties in an international trade transaction to post collateral. Empirically, Kalemli-Özcan and Varela (2021) and Salomao and Varela (2022) demonstrate how UIP deviations influence foreign investment and the currency of invoicing for investment financing, respectively. We complement these contributions by providing evidence that the scarcity of dollar-denominated trade finance – or, equivalently, large UIP deviations – during the GFC not only affected trade volumes (Bruno and Shin, 2019; Amiti and Weinstein, 2011), but also impacted invoicing decisions in international trade flows, with potential long-term consequences for dollar dominance.

The key theoretical mechanism we use to rationalize our empirical findings relies on the complementarity between the currency of denomination of their trade finance decisions and imported working capital. Bruno and Shin (2019) and Drenik and Perez (2020) stress the importance of the choice in which firms decide to invoice their credit for financing working capital because it influences the degree of exchange rate pass-through to the firm's production costs.[3] The closest to our theoretical framework is Bahaj and Reis (2020), which we extend by introducing sunk cost in the use of currencies for international transactions. This novel element is key to generate hysteresis in invoicing patterns as documented in the data.

We also contribute to the empirically oriented line of research on the firm-level determinants of invoicing choices and heterogeneous pass-through rate using micro-level data. Several papers have focused on the importance of variable markups and strategic complementarities in price-setting (Amiti et al., 2019,0), international input intensity and operational hedging (Amiti et al., 2014), firm characteristics such as size and productivity (Berman et al., 2012). See Burstein and Gopinath (2014), Itskhoki (2021), and Gopinath and Itskhoki

[2]Only few other papers share the same approach and focus on a large aggregate transition in invoicing patterns like in our setting: Garofalo et al. (2024), which focuses on the UK after Brexit, and Mehl and Mlikota (2023) on the EU enlargement.

[3]Gopinath and Stein (2021) focus on the complementarity between trade and finance but from the point of view of domestic banks, which extend dollar credit to domestic firms in order to match domestic households' dollar deposits.

(2022) for the most recent survey articles on this vast literature. We add to the literature showing that firm-level margins are relevant not only to understand cross-sectional differences in invoicing patterns, but also the gradual adoption of different currencies as firms change their invoicing choices after large aggregate shocks such as the GFC.

2 Data

The main data source we use is the universe of Chilean trade transaction from the Chilean Customs Agency (*Aduanas*). The Chilean Customs Agency publishes information at the transaction level for each firm, product, destination/origin, currency and day, for both export and import. The following information is included: the origin or the destination country; the quantity exchanged in the transaction expressed in kilograms (KG) and in the unit of measure of the good; the classification of the goods exchanged at the 8-HS digit code; the value (both FOB and CIF) of the transaction expressed in US Dollar. Importantly, every transaction reports the currency in which the transaction was invoiced. All the major currencies are reported (US dollar, euro, Chilean peso, UK pound, and Chinese yuan), together with minor regional currencies such as Latin-American currencies. The datasets have a time-invariant, anonymous, firm identifier which enables to create a panel of importers and exporters for Chile.

The data are available from 2007 to 2023 for export transactions, while import transactions are available from 2009 to 2023. Given our main interest is about the impact of the Great Financial Crisis on the usage of the US dollars in international trade, we complement the main dataset from the Chilean Customs Agency with a similar dataset from Garcia-Marin et al. (2019).[4] This additional dataset contains the same information as official customs records starting from 2004, and thus it allows us to cover the time period right before the GFC, and exclude potential pre-trends. The only difference between the two different data sources is that the latter covers the customs transactions from the main trade partners of Chile. Nevertheless, the dataset covers 98% of the total Chilean transactions in terms of value and quantity when compared with the official data from the Chilean Customs Agency. This gives us confidence on the quality and validity of the data.

We also use data from the Chilean public authority responsible for regulating the financial and banking markets (CMF, *Comision para el Mercado Financiero*). They agency collects and provides data on the banking industry both at the aggregate and bank level, such

[4]We kindly thank Santiago Justel to share the dataset with us.

as deposit and lending rates distinguishing domestic and foreign invoiced loans, different maturity and loan size, commercial and non-commercial clients. We leverage information on the commercial lending rates that Chilean banks charge on short-term (less than one year) loans denominated in domestic currency and US dollar. Rates are aggregated at the monthly level. We consider short-term loan rates given that trade financing for international transactions relies heavily on this type of financing (Amiti and Weinstein, 2011; Ahn et al., 2011; Schmidt-Eisenlohr, 2013). The data span the period around the Great Financial Crisis until a change in regulation and data collection in 2013 does not allow a consistent comparison between domestic currency and US dollar invoiced loans. Due to the fact that our coverage is limited to 2013, we are only able to document the dynamics of financing costs in the period 2007-2009 and adjacent periods. Because of this, our analysis excludes the COVID-19 episode and the global financing shock that occurred in 2020.

We use data on a balanced panel of eight currencies from January 2006 to December 2012, including euro, Brazilian real, Canadian dollar, Swiss franc, Mexican peso, British pound, South African rand, and Turkish Lira. We obtain data for the spot and one-month forward exchange rates at a daily frequency from Datastream and Thompson Reuters. All exchange rates are defined against the US dollar. To calculate the one-month interest rate, we took the difference between the logarithm of the one-month forward exchange rate and the logarithm of the spot exchange rate, assuming that the covered interest parity holds. We then computed weekly averages for the spot exchange rates, the one-month interest rate differentials, and deviations from uncovered interest parity.

Lastly, we use a collection of standard macro-level variables from a variety of sources. For instance, we use daily bilateral exchange rates between Chilean Peso and the currency of Chilean trade partners for the time period under analysis, obtained from Bloomberg and Datastream; the domestic inflation rate for Chile and its trade partners from the Central Bank of Chile and the IMF, respectively.

3 Macro and Micro Dynamics in Invoicing

In this section, we use firm-level transactions data to document a set of macro and micro-level stylized facts about the dynamics of invoicing choices. At the aggregate level, we show that the share of total Chilean imports denominated in US dollars (Chilean pesos) decreased (increased) in the decade following the Great Financial Crisis, while no changes occurred in the invoicing patterns on the export side. We further explore the micro-origin of the

dynamics in the aggregate invoicing shares, and show that the bulk of changes in aggregate invoicing shares is due to firms switching from US dollar to Chilean peso, as opposed to reallocation between firms or firm entry. Lastly, we explore the micro-level characteristics of the first importers to switch to Chilean peso invoicing. We find that there is selection in the first switchers, as they are large firms with wider US dollar currency mismatches, suggesting that both natural hedging and strategic complementarities are relevant in shaping invoicing choices. These facts together point to the role that shocks to the financing costs of imports, such as the GFC, might play in import invoicing choices, in addition to standard forces such as natural hedging and strategic complementarities.

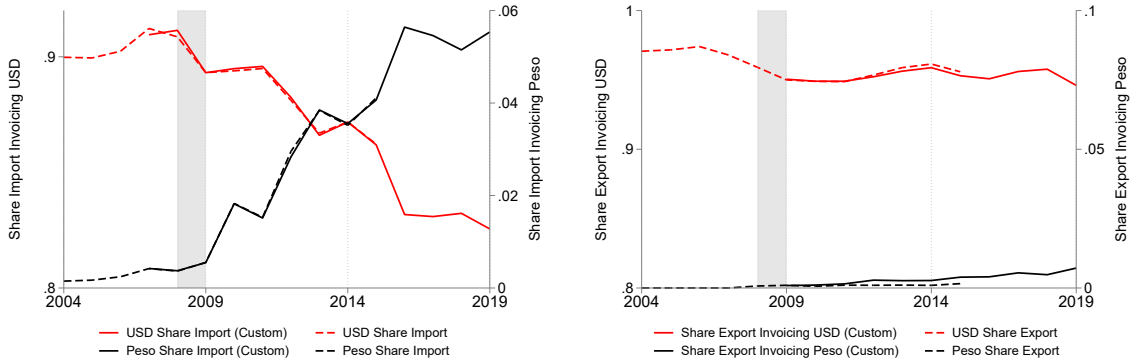
Aggregate. Following the Great Financial Crisis, the share of imports invoiced in US dollars declined by 10 p.p. while no change in invoicing patterns happened on the export side. In addition, the share of imports invoiced in Chilean Peso increased by a virtually 0% in 2004 to approximately 6% in 2019. Figure 2 shows that at the onset of the GFC, the share of imports denominated in US dollars is approximately 90%. Over a time span of 10 years, it declines until it amounts to just above 80% leading to a decline of almost 10 p.p. Differently, the share of imports invoiced in Chilean Peso was virtually 0% in 2004 and it increased to approximately 6% in 2019. Notably, we do not observe such changes in the share of exports invoiced in different currencies. In fact, the share of exports denominated in the main currencies (US dollar, euro, Chilean peso, and other currencies) remain stable over time.[5]

Firm Level Decomposition. To understand where the dynamics of the aggregate invoicing shares reported in Figure 2 originates from, we perform the following dynamics Olley-Pakes decomposition in the spirit of Melitz and Polanec (2015) to assess the role i) played by firms' entry and exit, ii) imports reallocation between and within firms, and iii) firms' sourcing strategies (origin and product level).

The change in the aggregate share of total imports invoiced in US dollar at time t, $\Delta\Lambda_{\$t}$,

[5]See Table 5 in Appendix B.

Figure 2: Aggregate Invoicing Shares for Imports and Exports



Note: Figure 2 shows the time series of the aggregate share of imports denominated in US dollars and Chilean pesos for Chile between 2004-2019. The left vertical axis of Figure 2 reports the share of Chilean imports denominated in US dollar. The right axis shows the share of Chilean imports denominated in Chilean pesos. Data from 2007 (2009) for imports (exports) are from Chilean Customs Agency. Data before 2007 (2009) are from Garcia-Marin et al. (2019). The grey shaded area represents the NBER recession period.

can be written as:

$$\Delta\Lambda_{\$t} = \Delta\text{Incumbents} + \text{Net Entry}, \tag{1}$$

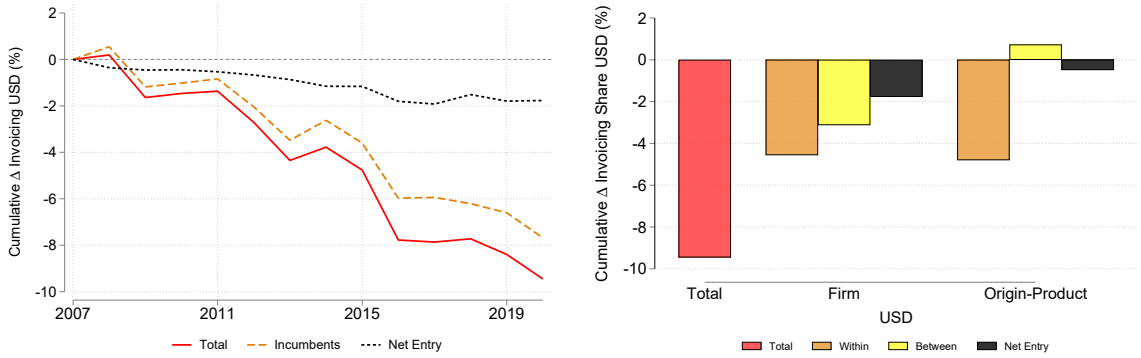
$$\Delta\text{Incumbents} = \text{Within Margin} + \text{Between Margin}, \tag{2}$$

$$\begin{aligned}\text{Within Margin} = {} & \text{Within Origin-Product} + \text{Between Origin-Product} \\ & + \text{Net Entry Origin-Product},\end{aligned} \tag{3}$$

where the change in the share of incumbents can be further decomposed into a within-firm, capturing the firms switching away from US dollar invoicing, and a between-firm margins, capturing reallocation in the share of imports towards firms with less US Dollar invoicing. Lastly, the third equation shows that the within margin of each incumbent can be decomposed to account for the product and origin dimensions, given that it is possible that certain products or countries prefer US dollar invoicing in case invoicing depends on the sourcing country. Appendix A provides additional details on the derivation of key equations of the decomposition.

We apply the decomposition outlined above to the universe of Chilean import transaction from 2007 and show that the bulk of changes in aggregate invoicing shares is due to incumbent firms switching from US dollar to Chilean Peso within each origin×product. The left panel of Figure 3 plots the decomposition according to Equation (1). The decline in the aggregate share of imports denominated in US dollar is primarily driven by incumbent importers who

Figure 3: Decomposition Invoicing Share for US Dollar



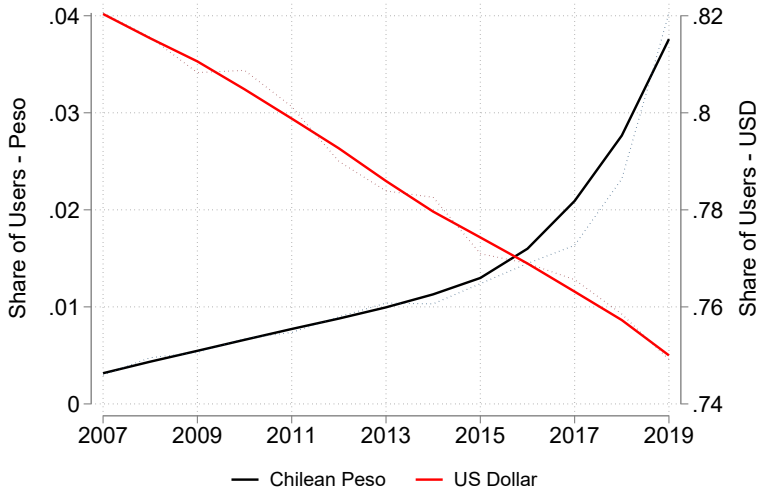
Note: The right panel of Figure 3 plots the results of the first decomposition exercise reported in Equation (1) for the US Dollar. The left panel of Figure 3 plot the results of the decomposition specifications of Equation (2) and (3) for the US Dollar. Tables 3 in Appendix B reports the corresponding numbers of the decomposition.

reduced their use of the US dollar for invoicing transactions after the GFC. Moreover, the reduction in the aggregate share of imports invoiced in US dollars due to net entry suggests the entrants use relatively less US dollars than exiting firms.

The right panel of Figure 3 presents the results of the decomposition from Equations (2) and (3). The first red bar of the histogram represents the aggregate cumulative change in the share of imports invoiced in US dollars. The three middle bars display the decomposition into within, between, and net entry margins (Equation (2)), while the three bars on the right break down the within margin into the within, between, and net entry margins across origin-product categories (Equation (3)). The decomposition of incumbent firms' share shows that most of the change is driven by the within component. Furthermore, the within component of incumbent firms is fully explained by the within origin×product term. In other words, the three-layer decomposition indicates that incumbent firms were importing a specific product from a given origin in US dollars, but after the GFC, they began importing the same product from the same origin in a different currency.

Firm-level Adoption and Dynamics: Selection in Switching We study whether there exist firm's observables that correlate with the decision to be among the first firms to switch away from the US dollar in invoicing. We define an adopter (or a first switcher) a firm that, at time t, starts to use an alternative new currency and is already importing by invoicing in US dollars. We provide evidence that i) firms gradually substitute US dollar invoicing with Chilean peso invoicing, and ii) larger firms and those more exposed to US

Figure 4: Share of Users by Currency within Origin



Note: The Figure plots the share of firms using the USD (right axis) and the CLP (left axis) at each point in time.

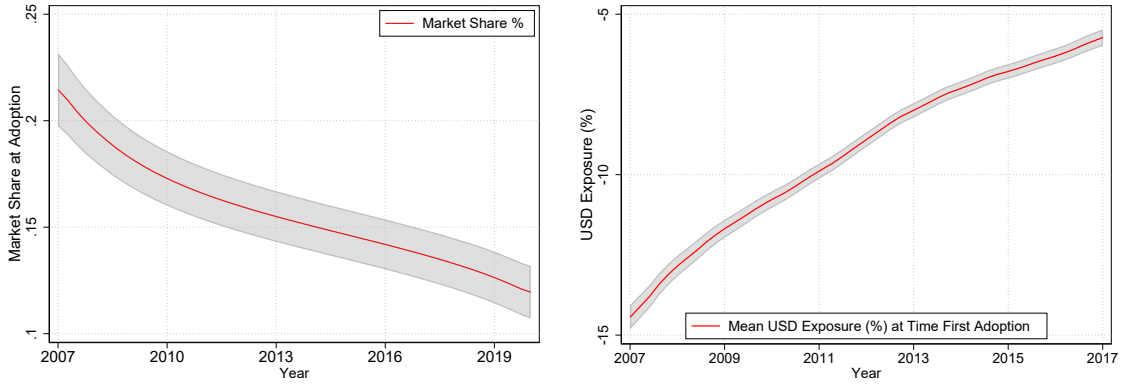
dollar fluctuations are the first to switch away from US dollar invoicing.[6]

Consistent with the previous findings, Figure 4 shows that the share of users of US dollar invoicing within origin gradually decreases over a time span of 12 years starting with the onset of the GFC. By contrast, the share of users of Chilean pesos within origin gradually grows over the same time horizon, suggesting that firms switch away from US dollar to Chilean peso invoicing gradually over time, even though the GFC is a relatively short-lived temporary shock.

The left panel of Figure 5 shows the average market share of adopters within origin over time. As it is clear from the plot, firms that were the first to shift from US dollar invoicing to an alternative currency had, on average, the highest market share within the origin at the onset of the GFC. Similarly, the right panel of Figure 5 shows that firms most exposed to US dollar unbalances were the first to adopt an alternative currency, followed by less exposed importers. We measure the US dollar exposure as the difference between the total exports denominated in US dollars and the total imports denominated in US dollars, normalized by the firm's total trade. A negative value implies that a firm is importing relatively more in

[6]Figure 15 in Appendix B provides evidence consistent with the ability of Chilean importers to choose the currency of invoicing. We show that the increase in the adoption of CLP is stronger in countries that rely more heavily on Chile as a market for their exports, indicating the presence of bargaining power. Similarly, the behavior of exchange rate pass-through at the firm level is consistent with a model of buyer market power (Alviarez et al., 2023).

Figure 5: Size and Hedging at Time of First Adoption



Note: The left panel plots the average market share of firms adopting a new currency at each point in time. Market share is defined at the origin level. The right panel plots the average US dollar exposure of firms adopting a new currency at each point in time. US dollar exposure is the difference between the total exports denominated in US dollars and the total imports denominated in US dollars normalized by the firm's total trade. In both panels, an adopter is a firm which, at time t, starts to use an alternative new currency and is already importing by invoicing in US dollars.

US dollars with than it is exporting, resulting in a currency mismatch, meaning the firm is not naturally hedged. The average firm that switched currencies when the GFC hit had an exposure of approximately 15%, which decreased to 5% by 2017.

Figure 5 provides evidence not only of selection in being a first adopter, but also of the existence of strategic complementarities in currency switching (Amiti et al., 2022; Corsetti et al., 2022; Crowley et al., 2020). As Figure 5 shows, as larger firms began to adopt alternative currencies for invoicing their transactions, smaller firms gradually adjusted their invoicing decisions in response to their competitors' currency choices, even after the end of GFC.

Robustness We perform a series of robustness checks of our empirical analysis. Table 4 in Appendix B displays the results from a dynamic Olley-Pakes decomposition with entry and exit for imports at the origin level, abstracting away from the product dimension, providing the same qualitative patterns as our benchmark decomposition.[7] We also report the decomposition for all major currencies used to invoiced import transactions. Table 5 in Appendix B displays the results from our benchmark decomposition applied to exports, showing no

[7]We also performed alternative decompositions such as: Griliches and Regev decomposition, Baily, Hulten, and Campbell decomposition, and Foster, Haltiwanger, and Krizan decomposition. As expected, all these alternatives provide different contributions of the role of net entry, leaving the relative importance of the other margins unchanged.

particular movement as at the aggregate level. Figure 13 in Appendix B shows that aggregate invoicing dynamics are not driven by some specific product types (BEC classification) or trading partners, as the within-group invoicing share in Chilean pesos (US dollars) increases (decreases) across all major trading partners or types of product. Lastly, Figure 14 in Appendix B shows that first switchers are firms that use trade finance more often, in line with our evidence of being relatively in need of less financing.

4 A Model of Currency Choice

In this section, we propose a new theory to explain the empirical evidence observed among Chilean importers. Our model combines insights from the literature on invoicing choice in international trade with those on invoicing choice in the denomination of borrowing cost for firms' working capital. It includes standard forces, such as natural hedging and strategic complementarities (Amiti et al. (2022) among others), while the framework for modelling the borrowing costs across currencies follows Bahaj and Reis (2020) (henceforth BR2020). Additionally, we introduce sunk costs associated with adopting a new currency for invoicing, which generates hysteresis in invoicing choices after temporary shocks. This helps us rationalizing the empirical evidence in Section 3.

4.1 Environment

A small open economy has a continuum of importers indexed by $i \in [0, 1]$. The firm sells a differentiated output domestically, pricing it in domestic currency. The demand faced by firm i in the domestic market d is $y_i^d = \left(\frac{p_i^d}{q^d}\right)^{-\theta}$, where q^d is a market specific demand shifter, and θ the constant demand elasticity ($\theta > 1$).

Each importer combines domestic labor, l, and imported inputs, x, using a CRS Cobb-Douglas production function:

$$y_i = A_i \left(l_i\right)^{1-\alpha_i} \left(x_i\right)^{\alpha_i}, \tag{4}$$

where y_i denotes the output of firm i, α_i the share of imported inputs used in production by firm i, and $A_i \equiv \left(\frac{1}{\alpha_i}\right)^{\alpha_i} \left(\frac{1}{1-\alpha_i}\right)^{1-\alpha_i}$ is a normalizing constant . Importantly, we assume that the imported inputs, x, are working capital and must be paid ahead of production, while labor can be paid later when revenues are generated.

In each period there are two sub-periods, a morning and an evening. In the morning, the firm must finance the imported inputs that are used as working capital and chooses the

corresponding financing currency. The firm can borrow in either local d or vehicle currency v. Prices are nominally sticky and determined in the morning. In the evening, the firm buys its inputs, satisfies its demand given the sticky price, collects revenues and pays off its loans. The choice of working capital made in the morning affects the production function in the evening because the exchange rate and the cost of credit in foreign currency are not known at the moment in which the firm chooses its input mix. Therefore, different realizations of the exchange rate have an impact on the future costs of production.

Firms face the following production technology for imported inputs:

$$x_i = \min\left(\frac{x_i^d}{\eta_i}, \frac{x_i^v}{1-\eta_i}\right). \tag{5}$$

By choosing η_i, the firm chooses the relative shares of two imported inputs, x_i^d denominated in domestic currency d, and x_i^v denominated in vehicle currency v.

The firm must borrow to finance imported inputs and can choose between borrowing in domestic or foreign currency. We follow BR2022 and restrict our attention to the case in which the currency of financing coincides with the currency of invoicing of the imported inputs. This behaviour arises optimally because firms want to reduce the exchange rate risk originating from the mismatch between financing and input invoicing. The firm has two options: i) borrowing in domestic currency with interest rate $(1+i_d)$; ii) borrowing in vehicle currency with interest rate $(1+i_v)$. We assume that the interest rates are known when the borrowing decision is taken, while the exchange rate between the domestic currency and the vehicle currency s^v is not. This implies that the ex-post marginal cost of production for firm i expressed in domestic currency is:

$$C_i(s^v, \eta_i) = \frac{1}{A_i}\left[\frac{\eta_i(1+i_d)\rho_d + (1-\eta_i)\rho_v s^v(1+i_v)}{\alpha_i}\right]^{\alpha_i}\left[\frac{w}{1-\alpha_i}\right]^{1-\alpha_i}, \tag{6}$$

where w is the domestic wage rate; ρ_d and ρ_v are the price of the domestic and the imported intermediate inputs expressed in domestic and vehicle currency, respectively. We assume all prices and borrowing costs are exogenous. Importantly, it follows from standard theory that firms optimally invoice imported inputs entirely in domestic or vehicle currency, i.e. $\eta_i^\star = \{0, 1\}$.

Firms using currency j for international transactions incur into currency-specific fixed cost, F_i^j. In the spirit of Crowley et al. (2020), we assume that the fixed cost of currency j depends inversely on the number of firms using currency j for international transactions.

We enrich their specification including a sunk cost in the use of new currencies, implying that each firm's fixed cost of using currency j depends on the last period's invoicing choice. We specify the following reduced-form representation for firm i's fixed cost of invoicing in currency j at time t, F_{it}^j:

$$F_{it}^j = f_{it}^j - \gamma^j \widetilde{\omega_{t-1}^j}, \tag{7}$$

where $\widetilde{\omega_{t-1}^j}$ is the share of firms using currency j in period $t-1$, and $f_{it}^j = \kappa_0^j$ the first time firm i uses currency j, and $f_{it}^j = \kappa_1^j < \kappa_0^j$ for all subsequent periods. The first term in Equation (7) captures the firm-specific component of the fixed cost, and exhibits the presence of sunk costs.[8] The difference $\kappa_0^j - \kappa_1^j$ represents the sunk entry cost of invoicing in a new currency, and captures the existence of one-time costs to managerial costs such as setting up foreign currency bank accounts. The second term in Equation (7) creates externalities in adoption and allows to capture the cost reduction due to complementarities in currency j usage, as the usage benefits increase in the number of users (Amiti et al., 2019; Crowley et al., 2020; Alviarez et al., 2023).[9] The magnitude of these complementarities is governed by the parameter γ^j, which requires the following stability condition $0 < \gamma^j < f_{it}^j < 1$.

Lastly, to make progress in understanding the mechanism at play, we make the simplifying assumption that the exchange rate s_v is distributed log normal with mean μ and variance Σ.[10]

4.2 Working Capital Invoicing Choice

With these ingredients, we solve for the optimal invoicing choice and pricing decision, and discuss the key forces shaping them. Firms are risk neutral and maximize the expected profits after forming expectations on the exchange rate and on the cost of credit in different currencies. Different exchange rate realizations imply ex-post changes in the cost of credit in vehicle currency, generating deviations from the optimal markup over the marginal cost and reducing profits.

[8] The firm-specific component depends only on last period's usage of currency j. We can relax this assumption and expand to richer specifications in which longer invoicing history is relevant, allowing a slower accumulation. See Alessandria et al. (2021) for a review of sunk costs in the trade literature.

[9] In our framework, we capture complementarities in invoicing choices across firm. The decomposition in Section 3 shows that invoicing switching is not driven by specific destination-product pairs within each firm. Nevertheless, our framework can be easily extended to include multi-market firms, capturing both within-firm and across-firm externalities.

[10] While log-normality provides analytical solutions, the same intuition holds using a second-order approximation with a general distribution.

Optimal invoicing decision Given the isoelastic demand function and the imported inputs technology in Equation (5), firm i maximizes the ex-ante profits:[11]

$$\max_{\eta_i, p_i^d} \mathbb{E}\left[\pi_i^j\right] = p_i^d \left(p_i^d\right)^{-\theta} - \mathbb{E}\left[C_i(s^v, \eta_i)\right] \left(p_i^d\right)^{-\theta} - \eta_i F_i^d - (1-\eta_i) F_i^v. \tag{8}$$

Thus, for a given η_i, the optimal domestic price is: $p_i^{d\star} = \frac{\theta}{\theta-1} E[C_i]$. Given $p_i^{d\star}$, firm i chooses to invoice imported inputs in vehicle currency ($\eta_i^\star = 0$) if the following condition is satisfied:

$$\eta_i^\star = 0 \qquad \text{iff} \qquad \mathbb{E}\left[(\rho_v(1+i_v)s^v\epsilon)^{\alpha_i}\right]^{1-\theta} - (\rho_d(1+i_d))^{\alpha_i(1-\theta)} > \tau\left(F_i^v - F_i^d\right), \tag{9}$$

where τ is a collection of parameters, $\tau = \frac{1}{w^{1-\alpha_i}}$. Abstracting away from the presence of fixed costs ($F^v = F^d = 0$) and leveraging the log-normality of the exchange rate distribution, we can grasp more intuition on the forces at play by rewriting the cut-off condition as follow:

$$\eta_i^\star = 0 \qquad \text{iff} \qquad [\mu + \alpha_i \Sigma] < \log\left(\frac{\rho_d}{\rho_v}\right) + \log(i_d) - \log(i_v), \tag{10}$$

where μ and Σ are the mean and variance of the exchange rate s_v, respectively.

Equation (10) shows that invoicing imported inputs in the vehicle currency v is optimal when the cost of financing in vehicle currency is sufficiently low to offset the uncertainty arising from the exchange rate realization (captured by Σ), after accounting for the difference in the cost of inputs (ρ_d, ρ_v). The firms' profits are maximized by keeping a constant mark up over marginal cost. Invoicing in vehicle currency means that the ex-post marginal cost of production depends on the realization of the exchange rate, potentially creating costly departure from the optimal markup. Firms choose to invoice in vehicle currency only when the financing cost in vehicle currency is cheaper enough relative to the domestic financing cost to offset the potential cost of departing from the optimal constant markup due to exchange rate fluctuations.

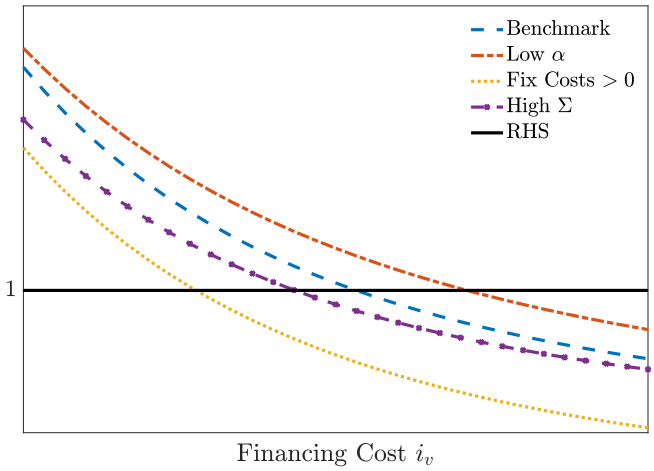
We can rewrite the optimality condition in Equation (10) in terms of UIP deviations:

$$\eta_i^\star = 0 \qquad \text{iff} \qquad \log(i_v) - \log(i_d) + [\mu + \alpha_i \Sigma] \equiv \text{UIP deviation} < \log\left(\frac{\rho_d}{\rho_v}\right). \tag{11}$$

Firms optimally choose to invoice in vehicle currency v if the (firm-specific) UIP deviation relative to the domestic financing cost is sufficiently low – specifically, lower than the cost

[11] Without loss of generality, we assume that the demand shifter q_d is normalized to one.

Figure 6: Invoicing Choice - Comparative Statics



Note: The Figure plots the optimality condition in Equation (9), $\mathbb{E}\left[(\rho_v(1+i_v)s^v\epsilon)^{\alpha_i}\right]^{1-\theta} - \tau\left(F_i^v - F_i^d\right) > (\rho_d(1+i_d))^{\alpha_i(1-\theta)}$, for different levels of i_v on the x-axis. The RHS is normalized to one. The blue line represents a benchmark calibration, while all the others represent comparative statics with respect to key parameters of the model: α_i (red line); fixed cost adjustment $F_i^v - F_i^d$ (yellow line); variance of the exchange rate Σ (purple line).

differential in imported inputs. Thus, fluctuations in UIP deviations may impact firm-level invoicing decisions and the dominance of a currency.

Figure 6 graphically represents the optimal decision rule in Equation (9) and how it is influenced by the different parameters of the model. It represents the expected profits given domestic and vehicle currency financing for different levels of financing cost in vehicle currency, i_v. Expected profits with domestic currency financing are independent of i_v and normalized to one (horizontal line). Expected profits when working capital is invoiced in vehicle currency are decreasing in the cost of financing in vehicle currency as higher i_v increases the marginal cost (downward-sloped line). The intersection between the two pins down the cut-off level in i_v above which it is optimal to invoice in domestic currency, $\eta^\star = 1$.

On natural hedging Equation (10) shows that the trade-off between cheaper financing option and costly departure from the optimal markup depends on the exposure of the marginal cost to exchange rates, α_i, capturing firm's operational hedging motive (Amiti et al., 2022). *Ceteris paribus*, firms prefer to match their input currency with that of their revenues (e.g. domestic currency), and the incentive is stronger the larger the share of imported inputs (high α_i). Thus, the repayment in foreign currency that makes a firm indifferent between

domestic and foreign financing is lower the larger the firm's share of imported inputs. Figure 6 shows that a lower α_i shifts the line representing the expected profits when working capital is invoiced in vehicle currency to the right, making invoicing in vehicle currency more likely.

On fixed costs and strategic complementarities The term on the right hand side of Equation (9) captures how fixed costs in currency use influence the invoicing choice.[12] Assuming the fixed cost of using the vehicle currency is larger than the fixed cost for domestic currency ($F^v > F^d$), the firm optimally invoices in vehicle currency when the financing cost denominated in vehicle currency is sufficiently low to offset not only the costly departure from the optimal constant markup, but also the higher fixed cost. In line with this reasoning, Figure 6 shows that the presence of fixed costs plays the role of a shifter, moving the line representing the expected profits when working capital is invoiced in vehicle currency to the right, making invoicing in vehicle currency less likely.

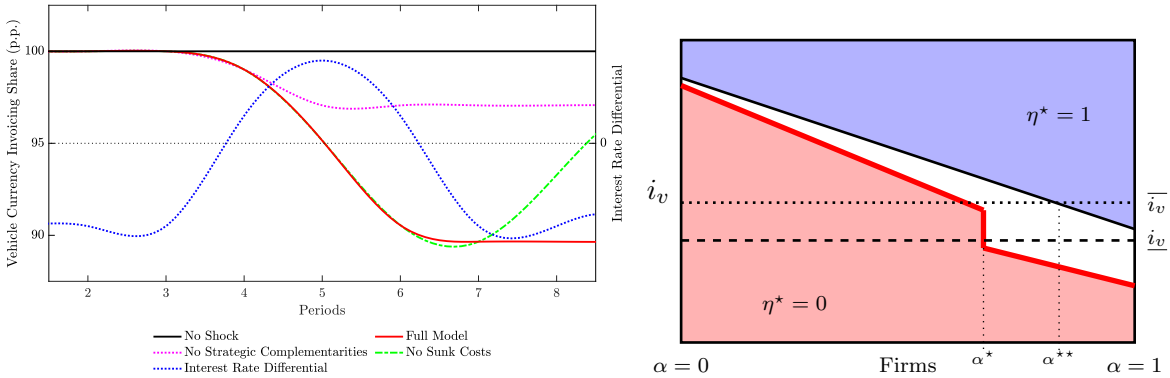
The dynamics of fixed costs are influenced by the presence of strategic complementarities. The core idea behind complementarities is that usage increases as overall utilization rises. We capture this mechanism by modeling the fixed cost of invoicing in currency j as decreasing with the number of firms using currency j to invoice their working capital, which increases the probability and the usage of currency j. Demand specifications with variable elasticity allows the introduction of strategic complementarities in models where exporters set the invoicing currency of their products (Amiti et al., 2019). In such settings, deviations from the optimal markup in the destination market arise due to fluctuations in the realized export price. Our framework differs from this class of model, as the source of costly fluctuations in the realized markup comes from financing cost on the production side.

4.3 Temporary Shocks, Invoicing Dynamics and Hysterisis

We consider a rise in the cost of finance in vehicle currency i_v – or, equivalently, an increase in UIP deviations – that permanently reverts to its original level after a few periods periods. We show that our theory can rationalize the main empirical findings of Section 3: i) the long lasting effects on the individual and aggregate import invoicing patterns; ii) firms that are larger and more exposed to exchange rate are the first to switch to domestic currency invoicing. Figure 7 displays these results graphically.

[12] In deriving the optimal invoicing choice, we assume that firms do not internalize the effect that their invoicing choice has on the aggregate invoicing share and, thus, on fixed costs (Equation (7)).

Figure 7: Shock to Vehicle Currency Financing



Note: The right panel plots the optimal invoicing decision for each level of i_v (y-axis) conditional on the level of α (x-axis). The left panel plots the dynamics of the aggregate shares of US dollar invoicing. The red line represents the full model; the green one abstracts away from sunk costs; the purple one abstracts away from strategic complementarities. The blue line represents the dynamics of the relative costs of financing $i_v - i_d$. We use the following symbolic calibration: we normalize ρ_v and ρ_d to one; the elasticity of demand σ is set equal to 5; domestic wage is set to 0.2 (Saravia and Voigtländer, 2012); α_i are uniformly distributed; without loss of generality, we consider the following specification for the fixed costs of invoicing in US dollar: $F^v - F^d = k_0^v - f^d - \gamma^v \omega_{t-1}^v - \gamma_1^v(\omega_{t-2}^v - \omega_{t-1}^v)$, where γ^v is set equal to 0.7, $\gamma^d = 0$, $\gamma_1 = 2.5$, $k_0^v = 1$, and $f^d = \{k_1^d, k_0^d\} = \{0.2, 0\}$; we consider a 3% increase in $i_v - i_d$.

The firm-level invoicing patterns presented in Section 3 support the assumption that all firms initially invoice in vehicle currency and have no prior experience invoicing in domestic currency. As a result, firms must pay a sunk cost to switch to domestic currency invoicing. Moreover, we assume that the share of imported goods used in production, α_i, is uniformly distributed: $\alpha_i \sim U[0, 1]$.[13]

Short-run response The right panel of Figure 7 graphically represents each firm's invoicing choice. On the horizontal axis, firms are ranked such that a higher is i corresponds to a higher share of imported inputs used by the firm, α_i. The vertical axis represents the cost of financing in vehicle currency, i_v. For any given level of i_v, there is a threshold $\tilde{\alpha}$ such that firms with $\alpha_i < \tilde{\alpha}$ invoice in domestic currency ($\eta^\star = 1$), while firms with $\alpha_i > \tilde{\alpha}$ invoice in vehicle currency ($\eta^\star = 0$). The downward-sloped line dividing the box in two areas – domestic (blue area) and vehicle (non-blue area) currency financing – represents the locus of $\tilde{\alpha}$ as a function of i_v.

Following the rise in the cost of financing in vehicle currency, larger and more exposed firms are the first to switch to domestic invoicing, consistent with the empirical presented in Section 3. The initial cost of financing in vehicle currency, $\underline{i_v}$, is low enough that it is

[13]The main insights are qualitatively unchanged regardless of the distributional assumption on α_i.

optimal for all firms to invoice in vehicle currency. This is represented by $\underline{i_v}$ (dash horizontal line) lying below the initial locus of $\tilde{\alpha}$ (solid black line). When i_v increases from the initial level $\underline{i_v}$ to a higher level $\overline{i_v}$ – meaning foreign invoicing becomes less convenient – a mass of firms with $\alpha_i > \alpha^{\star\star}$ begin borrowing and invoicing in domestic currency. Notably, the first firms to switch are those with high α_i, which represents a sufficient statistics for both their unhedged exposure to vehicle currency and their market share in the imported inputs market.[14]

The presence of strategic complementarities creates a positive feedback in domestic currency invoicing, further expanding its use in imports. The left panel of Figure 7 shows that the aggregate share of imports invoiced in vehicle currency continues to decline even after the cost of financing in vehicle currency, i_v, starts to revert. The use of domestic currency by a group of firms after the shock reduces the fixed cost of invoicing in domestic currency for others, increasing the likelihood that more firms will adopt it. As seen in the data, firms with lower α_i value, relative to the initial switchers, begin to use domestic currency to invoice their imported inputs as domestic invoicing becomes more convenient for them.[15]

Hysteresis in invoicing The presence of sunk cost in invoicing implies that once a firm switches to domestic currency invoicing, the relative convenience of domestic versus vehicle currency invoicing is permanently altered. As a result, the sunk-cost model generates invoicing hysteresis: even if i_v permanently reverts to the original level $\underline{i_v}$, firms do not switch back to vehicle currency invoicing. Specifically, the difference between the fixed costs of invoicing in vehicle and domestic currency, $F^v - F^d$ in Equation (9), decreases, making domestic currency invoicing more permanently attractive than vehicle currency invoicing.

Graphically, this is represented by a downward shift in the threshold between domestic and vehicle currency invoicing for firms that begin invoicing in domestic currency (i.e. those with $\alpha_i > \alpha^\star$). The area where domestic invoicing is optimal ($\eta^\star = 1$) extends to include the area above the solid red line (i.e. both the white area and the original blue area). Thus, the new cut-off rule implies that for firms with $\alpha_i > \alpha^\star$, it remains optimal to invoice in

[14]The former follows immediately from the fact that firms are importers only, with revenues denominated in domestic currency. The latter follows from the fact that firms are assumed to have identical size. Thus, higher α_i implies more imported inputs and, thus, a larger market share in the input market.

[15]In the right panel of Figure 7, firms with $\alpha^\star < \alpha_i < \alpha^{\star\star}$ gradually switch to domestic currency invoicing as fixed costs decrease. At the aggregate level, the pink dashed line in the left panel shows that, when the i_v starts to revert, the share of vehicle currency invoicing stops decreasing in the absence of strategic complementarities.

domestic currency even when ϵ reverts to the original level, $\underline{i_v}$.[16]

At the aggregate level, this implies that the share of imports invoiced in domestic currency does not return to one after i_v reverts to the original level, which is consistent with the observed data. The absence of any partial reversion in the aggregate share of imports invoiced in domestic currency suggests that the sunk cost associated with domestic currency invoicing is significant enough to make the switch permanent. The green dashed line in the left panel shows that, if the sunk cost were smaller, the aggregate share of invoicing could (partially) increase back, as it might become optimal for some firms to revert to vehicle currency invoicing. This would occur if the decrease in the fixed costs of domestic invoicing, F^d, is insufficient to make domestic currency invoicing optimal at the original level of i_v, $\underline{i_v}$.

5 Model Validation

In this section, we test the key mechanisms of the model. First, we demonstrate that the dynamics of uncovered interest parity (UIP) deviations and the costs of financing in different currencies around the Global Financial Crisis (GFC) align with the theoretical framework necessary to explain the decline in the share of vehicle currency invoicing. We then examine the model's key mechanisms using firm-level data and a range of econometric techniques.

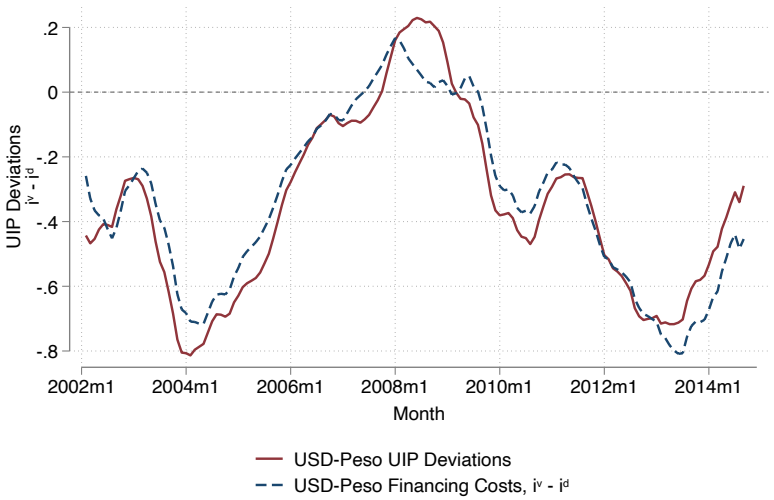
5.1 Dynamics of UIP deviations

We show that, during the Great Financial Crisis, the US dollar financing in Chile became temporarily more expensive than financing in Chilean pesos. Importantly, we do not observe similar dynaimcs in UIP deviations in other economies, validating the key mechanism as we do not observe similar invoicing patterns across countries.

UIP deviations in Chile Figure 8 shows that during the GFC, the cost of financing in US dollars become relatively more expensive than in domestic currency. We use data on bank lending rates from the Chilean public authority responsible for regulating the financial

[16]Notice that domestic currency invoicing becomes more appealing even for firms that have not yet paid the sunk cost, i.e. firms with $\alpha_i < \alpha^\star$. This is because the fixed cost of invoicing in domestic currency decreases also for them, due to strategic complementarities. Relative to the initial steady state, where all invoicing was in vehicle currency, the fixed cost of invoicing in vehicle currency is now higher since a subset of firms has permanently switched to domestic invoicing. The higher fixed cost of invoicing in vehicle currency F^v makes domestic invoicing more competitive for all firms.

Figure 8: Cost of Borrowing in Chile



Note: The Figure plots the relative short-term (1-year) cost of borrowing in US dollars with respect to the Chilean pesos. A value above zero implies that borrowing in Chilean pesos is relatively cheaper than in US dollars. We use data on bank lending rates from the Chilean public authority responsible for regulating the financial and banking markets.

and banking markets. The blue dotted line represents the difference between the short-term ($<$ 1 year) cost of borrowing for firms in Chile in US dollars versus domestic currency. Similarly, the red line depicts the dynamics of UIP deviations, calculated as the difference in the short-term borrowing costs between US dollars and Chilean pesos, adjusted for the realized 3-month ahead depreciation (or appreciation) in the bilateral nominal exchange rate between the two currencies. As shown in the plot, the short-term borrowing costs for Chilean firms becomes relatively cheaper in Chilean pesos compared to borrowing in US dollars at the onset of the GFC, reverting to its previous level after the end of the crisis. This transitory shock is consistent with the theoretical mechanism necessary to explain the decline in the share of vehicle currency invoicing.[17]

[17]The dynamics of borrowing costs invoicing in different currencies in Chile are in line with previous evidence from Vial et al. (2020) and Betancour et al. (2006). Moreover, changes in bank or capital market regulations do not align with the timing or the effects of the phenomena we document. The 2010 banking reform aimed at liberalizing the financial sector, increasing transparency and supervision, and deepen global integration - e.g. providing better access to FX hedging instruments (Fund, 2010). Similarly, Chile updated its prudential framework after other advanced economies and OECD countries, Madeira and Olivares (2021) and https://www.sipa.columbia.edu/sites/default/files/2023-02/Macroprudential-Policies-A-View-From-Chile.pdf. Basel III was in fact implemented in 2019 (https://www.cmfchile.cl/portal/principal/613/w3-article-50324.html).

UIP deviations across countries We show that the invoicing patterns observed in Chilean imports, alongside the lack of similar trends in exports or other economies, can be rationalized by the cross-currency heterogeneity in the dynamics of uncovered interest parity (UIP) deviations.

We use data on a balanced panel of eight currencies from January 2006 to December 2012, including currencies from advanced economies – such as euro, Canadian dollar, Swiss franc, British pound – as well as currencies from emerging economies close to – such as Brazilian real, Mexican peso, South African rand, and Turkish Lira. We construct one-month realized UIP deviations against the US dollar using spot and forward exchange rates at a daily frequency.

Figure 9 shows that, while UIP deviations in other emerging economies exhibit similar qualitative dynamics, only the UIP deviations in Chile experienced a sharp reversal of sign around the GFC.[18] Thus, the relative convenience of financing in US dollar reversed solely in Chile. Furthermore, currencies of advanced economies did not show significant changes in UIP deviations, indicating that their relative convenience remained largely unchanged during that period. These patterns together help explain the absence of changes in invoicing patterns in other economies and in Chilean exports, supporting the key mechanism proposed in our theoretical framework.

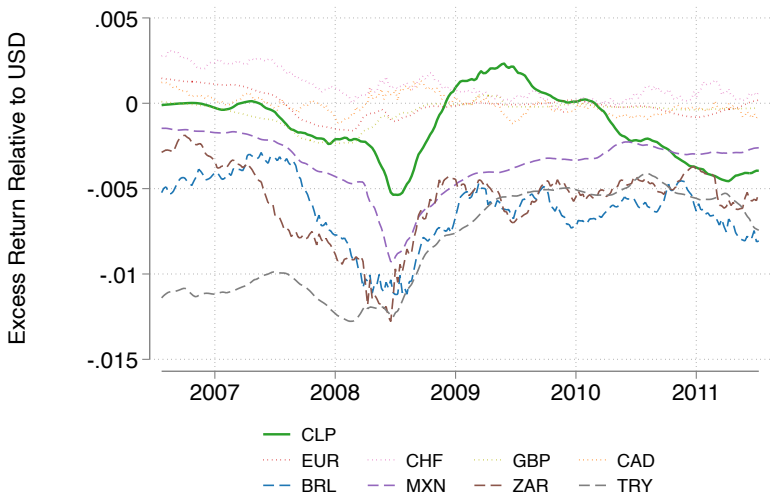
5.2 Firm-level evidence

We now test the following theoretical predictions: i) using an event study approach, we examine whether firms that are more exposed to US dollar fluctuations (higher α) are more likely to shift away from US dollar invoicing and switch to the Chilean peso, as the cost of borrowing becomes relatively more expensive in US dollars than in Chilean pesos; ii) through cross-sectional regression analysis, we investigate how strategic complementarities influence invoicing dynamics. Lastly, we provide evidence supporting the presence of sunk costs in invoicing choices, which is a key assumption of our model that generates the observed hysteresis in the data.

Event study design We estimate the dynamic effects of the GFC to financing costs on invoicing decisions relying on the following specification at the firm-product-origin (fio) level

[18] These evidence resonate with the evidence from emerging economies documented in Kalemli-Özcan and Varela (2021) or specific to the Peruvian case (Gutierrez et al., 2023).

Figure 9: UIP deviations across countries



Note: The Figure plots the dynamics of realized UIP deviations for the Chilean peso and other eight currencies from January 2006 to December 2012. We construct one-month realized UIP deviations against the US dollar using spot and forward exchange rates at a daily frequency. Data are obtained from Datastream.

and at yearly (t) frequency:

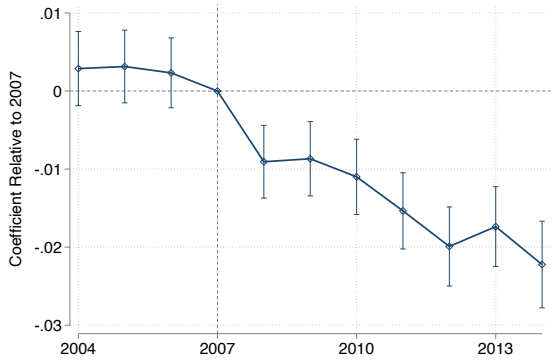
$$s^{\$}_{foit} = \sum_{\tau=2003}^{2015} \left[\beta_\tau \alpha_{f,2006} \times \Delta(i^{\$}_{2007} - i^{CLP}_{2007}) \times_{\tau=t}\right] + FE + \nu_{foit}, \tag{12}$$

where $s^{\$}_{foit}$ is the share of US dollar invoicing of a given firm in a product-origin pair at time t, $\Delta(i^{\$}_{2007} - i^{CLP}_{2007})$ is the change in the difference in currency-specific cost of financing in 2007, $\alpha_{f,2006}$ is the exposure of firm f to US dollar financing in 2006, $\mathbf{1}_{\tau=t}$ is an equal to 1 in year τ and 0 otherwise, and FE is a set of fio fixed effects. We follow our theory, and define $\alpha_{f,2006}$ as the share of US dollar imports over the total imports of the firm. Alternatively, we measure firms' exposure as the difference between the total exports denominated in US dollar and the total imports denominated in US dollars normalized by the firm's total trade, or as the market share of a firm in a given product-origin pair.[19] For this exercise, we use data from Garcia-Marin et al. (2019) as they cover the window around the GFC.

Figure 10 shows that, consistently with our theory, the share of US dollar invoicing decreases relatively more for those firms that are more exposed before the shock. The effect

[19] $\Delta(i^{\$}_{2007} - i^{CLP}_{2007})$ is defined as the two-year average around 2007 of the change in the difference between the short-term (< 1 year) cost of borrowing for firms in Chile in US dollars and in domestic currency, adjusted for the exchange rate depreciation rate.

Figure 10: Testing the Model - Event Study



Note: The Figure plots the coefficients β_τ from the event study specification in Equation (12), capturing the differential reduction in US dollar invoicing by more exposed firms. Coefficient in 2007 is normalized to zero. Exposure is measured by: share of imports denominated in US dollars over the total imports of the firm. Data are from Garcia-Marin et al. (2019). Standard errors are clustered at firm level.

is strong at impact and also gradually builds over time, even after the end of temporary dollar financing shock. Importantly, we do not observe any pre-trend or anticipation effect that could potentially undermine our empirical approach. In Appendix B, we show that the key qualitatively results hold when we use alternative measures of firms' exposure to US dollar financing (Figure 16).

Cross-sectional analysis We leverage the panel nature of our data to further investigate the implications of the model in Section 4. Specifically, we show that i) the differential in US dollar - domestic financing costs is a determinant of invoicing choices, and ii) its effect is stronger for more dollar exposed firms or in the presence of weaker complementarities.

We run the following specification:

$$\begin{aligned} s^{\$}_{foit} = \beta_0 \Delta(i^{\$}_t - i^{CLP}_t) + \beta_1 \alpha_{ft} + \beta_2 SC^{\$}_{(-f)sot} + \\ + \beta_3 \alpha_{ft} \times \Delta(i^{\$}_t - i^{CLP}_t) + \beta_4 SC^{\$}_{(-f)sot} \times \Delta(i^{\$}_t - i^{CLP}_t) + \\ + FE + \nu_{foit}, \end{aligned} \tag{13}$$

where $s^{\$}_{foit}$ is the share of US dollar invoicing of a given firm in a product-origin pair at time t, $\Delta(i^{\$}_t - i^{CLP}_t)$ is the change in the difference in currency-specific cost of financing, α_{ft} is the exposure of firm f to US dollar financing at time t, $SC^{\$}_{(-f)sot}$ is the strategic complementarity index, and FE is a set of fio and year fixed effects. We follow our theory, and define α_{ft} as the share of imports invoiced in US dollars over the total imports of the firm or as

the difference between the total exports denominated in US dollars and the total imports denominated in US dollars normalized by the firm's total trade. We construct the strategic complementarities measure as the average share of imports invoiced in US dollars among all competitors in a given sector(HS6)-origin pair Amiti et al. (2022). Given the endogeneity of the latter, we instrument it following Crowley et al. (2020): we use the import-weighted average US dollar exposure of all competitors in a given sector(HS6)-origin pair, where the exposure is defined as the difference between the total exports denominated in US dollars and the total imports denominated in US Dollars normalized by the firm's total trade. For this exercise, we use data from Garcia-Marin et al. (2019) as they cover the window around the GFC.

Our theory predicts that the rise in the cost of dollar financing reduces US dollar invoicing (β_0¡0), and this effect is stronger for firms with higher α_{ft} (β_3¡0) while it is attenuated by the presence of complementarities (β_4¿0). Table 1 broadly confirms the qualitative predictions of our model. Column (1) reports the average effect of changes in the cost of financing on invoicing decision. We estimate it separating the window around the GFC (2006-2009) to the rest of the sample. The coefficient is negative and, on average, stronger during the GFC. Column (2) and (3) report the heterogeneous effects of exposure and complementarities. As predicted the effect of complementarities is positive, dampening the overall effect of changes in the cost of financing when many competitors keep invoicing in US dollars. Firm's exposure to US dollar financing cost amplifies the effect of changes in the cost of financing. We use the share of US dollar imports over the total imports of the firm in Column (2), while we use the difference between the total exports denominated in US dollars and the total imports denominated in US dollars normalized by the firm's total trade in Column (3). In the former (latter) case, an increase in α_{ft} translates in a higher (lower) exposure, explaining the opposite sign.

On sunk costs A key element of the theoretical framework in Section 4 to explain the hysteresis in invoicing choices is the presence of sunk cost in invoicing. We follow the international trade literature in providing evidence consistent with the presence of sunk costs in invoicing.

The key implication of sunk costs is that the decision of invoicing in a specific currency increases when the same currency has been previously used. Therefore, conditional on the other forces determining invoicing choices, the past invoicing share should be a predictor of

Table 1: Testing the Model - Cross-section Analysis

	Average Effect	Heterogeneous Effect	
	(1)	(2)	(3)
$\Delta(i^{\$} - i^{CLP})$	-0.004		
	(0.000)		
$\Delta(i^{\$} - i^{CLP}) \times \mathbf{1}_{Post2009}$	0.003		
	(0.001)		
$\Delta(i^{\$} - i^{CLP}) \times \log SC^{\$}_{(-f)sot}$		0.087	0.058
		(0.031)	(0.030)
$\Delta(i^{\$} - i^{CLP}) \times \alpha_{ft}$		-0.012	0.005
		(0.003)	(0.001)
Controls	Yes	Yes	Yes
Firm × Product × Origin	Yes	Yes	Yes
Year	No	Yes	Yes
N	1275379	1147087	1147087

Note: The Table reports the coefficients from specification in Equation (13). The specification in Column (1) estimates Equation (13) excluding the interaction terms and year fixed effects. The specifications in Column (2) and (3) estimates Equation (13). Given the presence of year fixed effect, the coefficient β_0 cannot be identified. We introduce the level of all interacted variables in all specification, which are not reported for convenience. In Column (2), α_{ft} is the share of imports invoiced in US dollars over the total imports of the firm. In Column (3) α_{ft} is the difference between the total exports denominated in US dollars and the total imports denominated in US dollars normalized by the firm's total trade. The strategic complementarities variable is the average share of imports invoiced in US dollars among all competitors in a given sector(HS6)-origin pair. In all specification the strategic complementarity measure is instrumented with the import-weighted average US dollars exposure of all competitors in a given sector(HS6)-origin pair. Standard errors are robust. We use data from Garcia-Marin et al. (2019) from 2005-2014.

current invoicing choices. This idea translates in the following econometric specification:

$$y^{\$}_{foit} = \beta y^{\$}_{f,t-1} + Controls_{foit} + FE + \nu_{foit}, \tag{14}$$

where $y^{\$}_{foit}$ is the (log) share of US dollar invoicing or a dummy variable equal to 1 when US dollar invoicing is used and 0 otherwise, $y^{\$}_{f,t-1}$ is the lagged (log) share of US dollar invoicing at the firm level, and β is the coefficient of interest.

The presence of the lagged endogenous variable on the right side poses potential endogeneity concerns due to highly serially correlated unobserved characteristics that induce persistence in invoicing choices, potentially bias upward the coefficient of interest β. We follow the literature and, in addition to standard controls such natural hedging and strategic complementarities (Amiti et al., 2022), we saturate the specification with fixed effects

Table 2: Testing the Model - Sunk Cost

	Dummy USD				Share USD		
	(1) OLS	(2) OLS	(3) OLS	(4) IV	(5) IV	(6) First Difference - IV	(7) First Diffrence - GMM
Lagged Dollar Share	0.216	0.126	0.040	0.040	0.157		
	(0.009)	(0.006)	(0.005)	(0.005)	(0.046)		
Lagged ΔDollar Share						0.036	-0.056
						(0.017)	(0.011)
Controls	No	No	Yes	Yes	Yes	Yes	Yes
Origin × Year & Product × Year	No	Yes	Yes	Yes	No	No	No
Firm × Product × Origin & Year	No	No	No	No	Yes	Yes	No
Observations	2187942	2181688	774868	774868	623768	356394	260203

Note: The Table reports the coefficients from specification in Equation (14). The dependent variable in specifications (1) to (5) is a dummy variable equal to 1 when US dollar invoicing is used and 0 otherwise; The dependent variable in specifications (5) to (7) is the (log) share of US dollar invoicing. Column (6) is estimated in first difference via OLS. Column (7) is estimated using an Arellano-Bond GMM estimator using lagged levels of the right-side variables as instruments. "Lagged Dollar Share" refers to the lagged (log) share of US dollar invoicing at the firm level. Controls include: a natural hedging measure defined as the share of export invoiced in US dollar; a strategic complementarities measure as the average share of imports invoiced in US dollar among all competitors in a given sector(HS6)-origin pair. IV columns refers to the case in which the strategic complementarity measure is instrumented with the import-weighted average US Dollar exposure of all competitors in a given sector(HS6)-origin pair. Standard errors are clustered at firm level. We use data from official customs 2007-2019.

(Bernard and Jensen, 2004; Timoshenko, 2015; Das et al., 2007).[20] We alternatively estimate Equation (14) in first difference via OLS and via an Arellano-Bond GMM estimator using lagged levels of the right-side variables as instruments.

Table 2 provides strong support for the presence of sunk costs in invoicing. The benchmark specifications in Column (4) and (5) show that a 1% increase in the past share of US dollar invoicing increases the probability of invoicing by 4% and the current share of US dollar invoicing by 0.16%, respectively. Alternative specifications using first difference also show the relevance of past US dollar invoicing share for the contemporaneous invoicing decision. In Appendix B, Table 6 shows that the results are robust to the use of lagged (log) share of US dollar invoicing at the firm-origin-product level, rather than firm level, suggesting that these costs exhibit also some product-origin specific component.

[20] We introduce a natural hedging measure defined as the share of export invoiced in US dollars (Crowley et al., 2020), and a strategic complementarities measure as the average share of imports invoiced in US dollars among all competitors in a given sector(HS6)-origin pair Amiti et al. (2022). We also construct an instrument for the latter following Crowley et al. (2020): we use the import-weighted average US dollar exposure of all competitors in a given sector(HS6)-origin pair, where the exposure is defined as the difference between the total exports denominated in US dollars and the total imports denominated in US dollars normalized by the firm's total trade.

6 Aggregate Implications

In this section we quantitatively assess the macroeconomic implications of the large changes in invoicing shares after the GFC. We focus on the implications of invoicing choices for the dynamics of terms of trade and trade balance. We proceed as follow. We first estimate short-run and long-run price and quantities elasticities to exchange rate fluctuations accounting for the different invoicing currencies, building on existing empirical frameworks (Adler et al., 2020; Barbiero, 2021; Chen et al., 2022). We then leverage the estimated elasticities and the evolution of invoicing shares to conduct accounting exercises (Auer et al., 2021). We find that the change in the invoicing shares after the GFC implies a trade balance elasticity to exchange rate which is 30% higher.

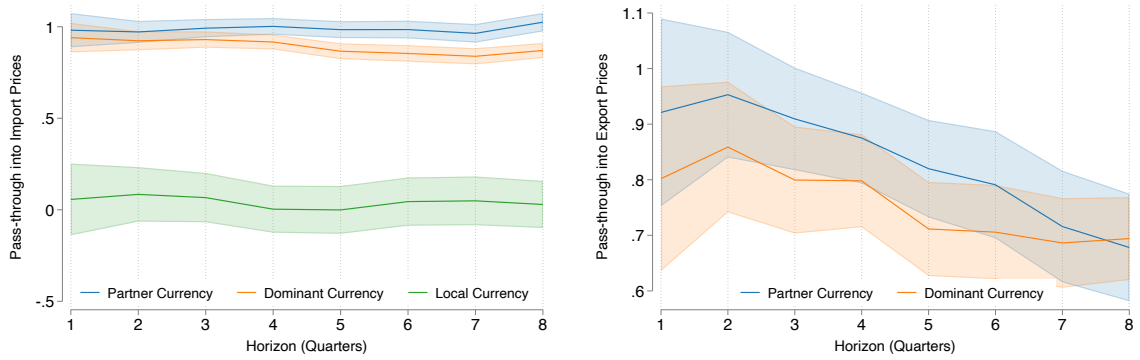
Price and Quantity Elasticities to Exchange Rate We first estimate the exchange rate pass-through to border prices and quantities, both in the short-run and in the long-run, conditioning on the currency of invoicing. Following existing econometric frameworks such as Adler et al. (2020), the benchmark specification is:

$$\Delta y_{jt} = \sum_l \Bigg[\underbrace{\beta_l^{y,CLP} D_j^{CLP}}_{\text{Chilean Peso}} + \underbrace{\beta_l^{y,p} D_j^{p}}_{\text{Partner}} \Bigg] \Delta e_{t-l}^{CLP/p} + \sum_l \underbrace{\beta_l^{y,D} D_j^{D} \Delta e_{t-l}^{CLP/\$}}_{\text{Dominant}} + \sum_l \underbrace{\beta_l^{y,D} D_j^{D} \Delta e_{t-l}^{\$/p}}_{\text{Dominant}} + \\ + \alpha_j + \phi x_{jt} + \delta_{t \times \Delta} + \varepsilon_{jt}, \tag{15}$$

where Δy_{jt} is the log difference between either the unit values (expressed in Chilean peso), quantity (expressed in kilograms), or values (expressed in Chilean peso) of good j between quarter t and the quarter of the last transactions. A good j is a unique combination of firm, 8-digit HS code, partner country, and invoicing currency. The exchange rate $e_t^{CLP/p}$ is the log average Chilean peso value per unit of currency p in quarter t. An increase in $\Delta e_t^{CLP/p}$ represents a depreciation of the Chilean peso with respect to currency p during the corresponding period t. $D_j^{CLP}, D_j^{p}, D_j^{D}$ are dummy variables that capture whether the transaction is invoiced in local, producer or dominant currency, respectively. For dominant-priced products, we split the bilateral peso-partner exchange rate, $\Delta e^{CLP/p}$, into the sensitivity to peso-dollar fluctuations and to partner-dollar fluctuations (Barbiero, 2021).

Figure 11 plots the estimates of the cumulative exchange rate pass-through into import (left panel) and export (right panel) prices obtained from the main specification in Equation (15). We show that exchange rate pass-through varies substantially across invoicing choices,

Figure 11: Price Sensitivities to Exchange Rates



The left (right) panel show the estimated coefficients from the specification in Equation (15) using import (export) prices as dependent variable. We use data from official customs running from 2007 to 2019 for imports and 2009 to 2019 for exports. We exclude the LCP case for export prices because of the absence of sufficient observations in the estimation.

both in the short-run and in the long-run. Pass-through into import prices is zero when transactions are invoiced in local currency (Chilean peso), while it is complete when transactions are invoiced in dominant and partner currencies. Pass-through rates into import prices remain at essentially the same level after two years. On the export side, pass-through rates are almost complete in the short-run when transactions are invoiced in dominant and partner currencies (80% and 90%, respectively).[21] In the long-run, the pass-through rate decreases to approximately 70% in both cases. These patterns are in line with previous findings and with the idea that prices are sticky in the currency in which they are invoiced (Chen et al., 2022; Gopinath et al., 2010).

Figure 17 in Appendix B reports the pass-through rates into import and export quantities. We show that different pass-through rates into prices translates into different response of quantities, providing evidence of allocative effects of invoicing choices (Amiti et al., 2022). Import quantities do not react in the short-run, independently of the invoicing currency. They decrease by 20% in the long-run when invoiced in dominant or partner currencies.[22] The response of quantities remains essentially unchanged in the long-run when invoiced in local currency, consistent with the fact that, after a depreciation, prices invoiced in Chilean pesos do not adjust. The sluggish response of quantities is in line with expenditure switching

[21] We do not report the pass-through rate into export prices conditional on being invoiced in Chilean peso because of very noisy estimates due to a very restricted sample of only approximately 500 observations.

[22] These magnitudes are smaller compared to the estimates from the macro (Boehm et al., 2023) or trade literature (Broda and Weinstein, 2006). Nevertheless, the quantity response may be muted by the fact that we are working with customs prices, without considering additional rounds of incomplete pass-through into final consumer prices (Auer et al., 2021).

forces toward domestic goods.

Thus, abstracting from invoicing choices improperly informs on the effects of exchange rate fluctuations on the macroeconomy (Gopinath and Itskhoki, 2022; Barbiero, 2021). We now explore the quantitative relevance focusing on the dynamics of the terms of trade.

On the Effects on Trade Balance In traditional models of international economics (e.g. Mundell-Fleming), in which international prices are invoiced in the exporter's currency, exchange rates play a key role in external adjustment. Exchange rate changes induce movements in imported and exported quantities by influencing the relative price of domestic and foreign goods. However, the widespread use of US dollar invoicing, together with the large differences in price and quantity elasticities documented above, impacts how the trade balance responds to exchange rate fluctuations. We focus on the dynamics of a country's external imbalance following a movement of its exchange rate vis-a-vis all other currencies, and how invoicing patterns at the aggregate level influence its response to exchange fluctuations.

Let define the trade balance of Chile as the same of net export from the rest of the world, as follow: $TB_t = \sum_{i \in I} \left(P_{it}^X Q_{it}^X - P_{it}^M Q_{it}^M \right)$, where P_{it}^X and Q_{it}^X (P_{it}^M and Q_{it}^M) are the price and quantity of exports to (import from) country i, respectively. It follows that the effect of exchange rates on the trade balance (relative to GDP, Y_t) at horizon l is given by:

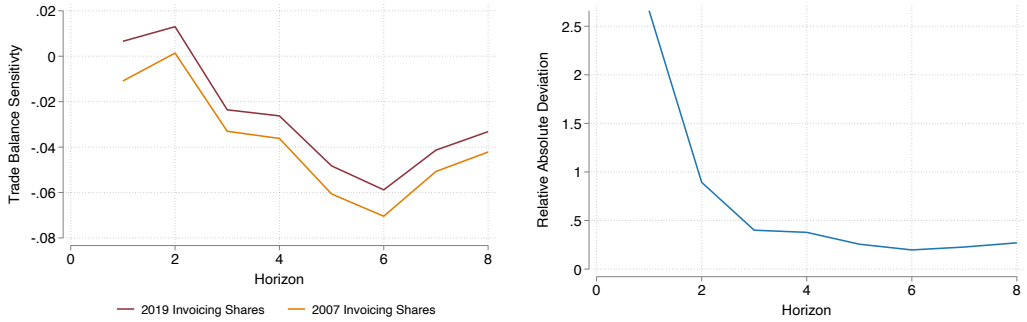
$$\frac{\Delta TB_t^l}{Y_t} = \Delta e \times \frac{X_t}{Y_t} \left[\sum_{\tau=0}^{l} \left(\beta_\tau^{PX,CLP} + \beta_\tau^{QX,CLP} \right) S^{X,CLP} + \left(\beta_\tau^{PX,D} + \beta_\tau^{QX,D} \right) S^{X,D} + \left(\beta_\tau^{PX,p} + \beta_\tau^{QX,p} \right) S^{X,p} \right] \tag{16}$$

$$- \Delta e \frac{M_t}{Y_t} \left[\sum_{\tau=0}^{l} \left(\beta_\tau^{PM,CLP} + \beta_\tau^{QM,CLP} \right) S^{M,CLP} + \left(\beta_\tau^{PM,D} + \beta_\tau^{QM,D} \right) S^{M,D} + \left(\beta_\tau^{PM,p} + \beta_\tau^{QM,p} \right) S^{M,p} \right], \tag{17}$$

where $S^{X,z}$ ($S^{M,z}$) the share of exports (imports) invoiced in currency z, and $\beta_\tau^{j,z}$ is the elasticity of j to exchange rates when invoiced in currency z at horizon τ, with j being import and export prices and quantities ($\{PX, PM, QX, QM\}$) and $z \in \{CLP, p, D\}$. In other words, the aggregate response of trade balance to a movement of the exchange rate vis-a-vis all other currencies is a weighted sum of the response of import and export prices and quantities, weighted by their respective invoicing shares.

Figure 12 shows that the large increase in the share of Peso invoicing after the GFC lowers the sensitivity of the Chilean trade balance at all horizons. In 2019, trade balance is

Figure 12: Trade Balance Sensitivity to Exchange Rates



Notes: The left panel plots the 2-periods moving average of the response of the trade balance to a depreciation of the Chilean peso computed from the formulas in Equation (17). We use the estimated coefficients from Equation (15). Invoicing shares are computed from official import (export) customs data from 2007 (2009) for the initial period (orange line) and from 2019 for the last period (red line). The share of export and import on GDP is computed from IMF data. The right panel plots the difference between the response of the trade balance in 2007 and in 2019 relative to the 2019 case.

approximately 30% less sensitive in the long-run, while the sensitivity flips sign and become positive in the short-run. The key driver is the fact that imports denominated in Chilean peso exhibit a lower sensitivity at all horizons, especially in the short run. The lower sensitivity of trade balance raises questions about the benefits of exchange rate flexibility.[23]

On the Effects on Terms of Trade and Import Inflation We follow the same steps to assess how the sensitivity of import inflation and the terms of trade evolved after the GFC. Figure 19 in Appendix B shows that the import price index of Chile becomes less sensitive to exchange rate fluctuations by approximately 5% at all horizon, as a larger share of imports is non-sensitive to exchange rate fluctuations. Similarly, Figure 18 in Appendix B shows how lower import price sensitivity translates into a lower sensitivity for the terms of trade. In this case, following a depreciation, the terms of trade decrease by less in 2019 compared to 2007, with a larger discrepancy in the short-run.

Conclusion

Although we know from history that abrupt shifts in the international monetary system can occur following permanent shifts in economic conditions, our analysis showcases how

[23]Notice that the trade balance does not follow the standard J-curve dynamic after a depreciation of the exchange rate. This is a consequence of the Dominant Currency Paradigm, which departs from the producer-pricing assumption of the traditional models of international economics.

temporary large shocks to dollar financing availability weakens dollar dominance.

We document a gradual 10 percentage point decline in the share of Chilean imports denominated in US Dollars over a decade, coupled with a corresponding increase in Chilean Peso denominations. We conduct different decomposition exercises, and show that surviving firms emerge as the primary contributors to the observed change, accounting for approximately 80% of the aggregate variation. Larger and more exposed firms to fluctuations in US dollar exchange rate and financing take the lead in substituting the dominant currency with the Chilean peso. Moreover, complementarities within and across firms fuel the adoption of the Chilean peso over time.

We develop a model in which firms decide on the currency of trade finance for imported inputs. A key aspect is treating imported inputs as working capital, requiring advance financing. The decision relies on the relative interest rates on trade finance denominated in domestic and vehicle currency. In the model, temporary shock to the financing costs – or, equivalently, to UIP deviations – influences the invoicing patterns. Lastly, a sunk cost associated with using a new currency for import invoicing introduces hysteresis in invoicing choices, permanently altering the convenience of invoicing in different currencies. The theory predicts that the threshold to use domestic or vehicle currency financing depends on two forces, namely strategic complementarities and natural hedging.

We extensively test the key mechanisms in the data and find evidence consistent with our theory. We show that the invoicing patterns observed in Chilean imports, alongside the lack of similar trends in exports or other economies, can be rationalized by the cross-currency heterogeneity in the dynamics of uncovered interest parity deviations. We then examine the model's key mechanisms using firm-level data and a range of econometric techniques, confirming key aspects such as the role of strategic complementarities and sunk costs.

Lastly, we explore the macroeconomic implications of large changes in invoicing patterns. We show that the sensitivity of trade balance, terms of trade, and import inflation is substantially lower in 2019 compared to 2007. Thus, our analysis demonstrates how significant shocks, such as the Great Financial Crisis, can have enduring effects on invoicing decisions at both micro and macro levels.

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A Decomposing Invoicing Share

A.1 General Intuition

Let i be a firm and k a currency. Let S_i be the share of firm i in total import (or export). Also, let Λ_{ik} be the share of import (export) denominated in currency k by firm i. Define for any variable X:

$$\Delta X_t \equiv X_t - X_{t-1},$$
$$\overline{X_t} \equiv \frac{1}{2}(X_t + X_{t-1}),$$
$$\Delta X_T \equiv X_t - X_0,$$

We can now decompose:

$$\Delta\Lambda_{kt} = \underbrace{\sum_i \overline{S_{it}}\Delta\Lambda_{kit}}_{\text{Within}} + \underbrace{\sum_i \Delta S_{it}\overline{\Lambda_{kit}}}_{\text{Cross}}. \tag{18}$$

It follows that:

$$\Delta_T\Lambda_k = \sum_t\sum_i \overline{S_{it}}\Delta\Lambda_{kit} + \sum_t\sum_i \Delta S_{it}\overline{\Lambda_{kit}}. \tag{19}$$

We account for firms' entry and exit. Let Ω_{kt} be the set of firms denominating in currency k at time t, $\overline{\Omega_{kt}}$ be the set of common firms between time t and $t-1$, Ω^+_{kt} the set of new firms at time t, and Ω^-_{kt} the set of firms exiting between time t and $t+1$. We can then write:

$$\Delta\Lambda_{kt} = \underbrace{\sum_{i\in\overline{\Omega_{kt}}} \overline{S_{it}}\Delta\Lambda_{kit}}_{\text{Within}} + \underbrace{\sum_{i\in\overline{\Omega_{kt}}} \Delta S_{it}\overline{\Lambda_{kit}}}_{\text{Cross}} + \underbrace{\sum_{i\in\Omega^+_{kt}} S_{it}\Lambda_{kit} - \sum_{i\in\Omega^-_{kt-1}} S_{it-1}\Lambda_{kit-1}}_{\text{Net Entry}}. \tag{20}$$

A.2 Derivations

Let λ_{ikt} and s_{it} be the share of firm i's imports invoiced in currency k at time t and the import share of firm i at time t on the total imports of Chile, respectively.[24] Thus, the change in the aggregate share of total imports invoiced in currency k at time t, $\Delta\Lambda_{kt}$, can

[24] Thus, $\lambda_{ikt} = \frac{\text{Imports of } i \text{ denominated in } k}{\text{Imports of } i}$ and $s_{it} = \frac{\text{Imports of } i}{\text{Total imports Chile}}$.

be written as follow:

$$\Delta\Lambda_{kt} = \underbrace{\sum_{i\in inc} \lambda_{ikt} s_{it} - \sum_{i\in inc} \lambda_{ikt-1} s_{it-1}}_{\Delta\text{Incumbents}} + \underbrace{\sum_{i\in ent} \lambda_{ikt} s_{it} - \sum_{i\in ex} \lambda_{ikt-1} s_{it-1}}_{\text{Net Entry}} \tag{21}$$

$$= \underbrace{\lambda^{inc}_{kt} - \lambda^{inc}_{kt-1}}_{\Delta\text{Incumbents}} + \underbrace{\alpha^{en}_{kt}(\lambda^{en}_{kt} - \lambda^{inc}_{kt})}_{\text{Entry}} - \underbrace{\alpha^{ex}_{kt-1}(\lambda^{ex}_{kt-1} - \lambda^{inc}_{kt-1})}_{\text{Exit}}, \tag{22}$$

where a firm i is considered an incumbent (inc) when $s_{it} > 0$ and $s_{it-1} > 0$, entrant (en) when $s_{it} > 0$ and $s_{it-1} = 0$, and exiting (ex) when $s_{it} = 0$ and $s_{it-1} > 0$. In other words a firm is considered: an incumbent if it imports goods for two consecutive periods, an entrant firm it starts importing in the current period and, an exiting firm if it stops importing in the current period. In addition, let λ^{en}_{kt}, λ^{inc}_{kt} and λ^{ex}_{kt} denote the aggregate share of imports invoiced in currency k of all the firms entering in period t, of all the firms that survived between period t and $t-1$, and of all the firms that exit at period t, respectively. Lastly, α^{en}_{kt} and α^{ex}_{kt-1} represent the aggregate share of imports of entrant and exiting firms, respectively.

Equation (22) allows us to determine whether the aggregate variation observed in Figure 2 is mainly driven by incumbents firms or by the entry or exit of firms. Intuitively, if the aggregate change is due to incumbents firms, Equation (22) implies that the group of incumbent firms have been importing less in US Dollar over time and thus contributing to the decline in the aggregate share we observe in the data ($\lambda^{inc}_{kt} < \lambda^{inc}_{kt-1}$). Similarly, Equation (22) captures the case in which entrant firms have been importing less in US Dollar over time with respect to a reference level given by the aggregate share of the surviving firms ($\lambda^{en}_{kt} < \lambda^{inc}_{kt}$). In addition, their contribution is properly weighted by their import market share α^{en}_{kt}. The same logic applies to the last terms in Equation (22) referring to the group of the exiting firms.

We further decompose Equation (22) to quantify the change in the aggregate share of incumbents that it is played by within firms dynamics and between firms reallocation:

$$\lambda^{inc}_{kt} - \lambda^{inc}_{kt-1} = \underbrace{\sum_{i\in inc} \Delta\tilde{s}_{it}\overline{\lambda_{ikt}}}_{\text{Incumbent - Between}} + \underbrace{\sum_{i\in inc} \Delta\lambda_{ikt}\overline{\tilde{s}_{it}}}_{\text{Incumbent - Within}}, \tag{23}$$

where $\overline{x_t} \equiv \frac{1}{2}(x_t + x_{t-1})$, $\Delta x_t \equiv x_t - x_{t-1}$, and $\tilde{s}_{it}$ denotes the import share of firm i at time t relative to the total import of incumbents firms.[25] The first term is the between-

[25] Hence, $\tilde{s}_{it} = \frac{\text{Imports of } i}{\text{Total imports of } inc}$.

firm contribution and it assesses the role played by across firms reallocation in the share of imports denominated in US Dollar. By contrast, the second term quantifies the role played by within-firm substitution in the denomination of the same quantity of imports across different currency.

Lastly, we further decompose the within-firm component to understand whether the observed change in the US Dollar invoicing share of incumbent firms is driven by a shift in their sourcing strategies across origin×product, $o \times g$, or whether it is due to a simple reduction in the quantity of imports within origin×product. Specifically, the change in the share of i's imports invoiced in currency k, $\Delta\lambda_{ikt}$, can be decomposed as follows:

$$\begin{aligned}\Delta\lambda_{ikt} = &\underbrace{\sum_{o\times g\in I_{it}} \Delta\lambda_{ikto\times g}\overline{\hat{s}_{ito\times g}}}_{\text{Within origin-product}} + \underbrace{\sum_{o\times g\in I_{it}} \overline{\lambda_{ikto\times g}}\Delta\hat{s}_{ito\times g}}_{\text{Between origin-product}} + \\ &+ \underbrace{\sum_{o\times g\in I^{+}_{it}} \lambda_{ikto\times g}\hat{s}_{ito\times g}}_{\text{Origin-Product entry}} - \underbrace{\sum_{o\times g\in I^{-}_{it}} \lambda_{ikt-1o\times g}\hat{s}_{it-1o\times g}}_{\text{Origin-Product exit}},\end{aligned} \tag{24}$$

where I_{it}, I^{-}_{it} and I^{+}_{it} refer to the set of origin-product from which firm i imports both in t and $t-1$ (continuing origin-product), only in $t-1$ (exiting origin-product) and only in t (entrant origin-product), respectively. $\hat{s}_{ikto\times g}$ denotes the share of imports of firm i from origin-product $o \times g$ over the total import imports of firm i.[26]

[26] Formally, $\hat{s}_{ikto\times g} = \frac{\text{Imports of } i \text{ from } o \times g}{\text{Total imports of } i}$.

B Additional Results

B.1 Additional Results: Decomposition

Table 3: Dynamic Olley-Pakes Decomposition with Entry and Exit: Imports at the Origin-Product Level

	USD	Peso	Euro	Others
-				
Aggregate Invoicing Share	-9.452	6.093	3.611	-0.251
Contribution Net Entry				
Total	-1.769	0.778	0.813	0.178
Firm Entry	-2.618	0.856	1.872	-0.110
Firm Exit	0.850	-0.078	-1.059	0.288
Contribution Incumbents				
Total	-7.683	5.315	2.798	-0.430
Within Firm	-4.560	6.367	-1.337	-0.470
Between Firm	-3.123	-1.052	4.134	0.041
Within Firm				
Total	-4.560	6.367	-1.337	-0.470
Net Entry Origin	-0.489	0.875	-0.188	-0.198
Within Origin	-4.801	5.192	-0.213	-0.177
Between Origin	0.729	0.301	-0.935	-0.095

Notes: The Table reports the results from the dynamic Olley-Pakes decomposition with entry and exit for imports at the origin-product level. It shows the corresponding numbers of Equations (22), (23), and (24).

Table 4: Dynamic Olley-Pakes Decomposition with Entry and Exit: Imports at the Origin Level

	USD	Peso	Euro	Others
-				
Aggregate Invoicing Share	-9.452	6.093	3.611	-0.251
Contribution Net Entry				
Total	-1.769	0.778	0.813	0.178
Firm Entry	-2.618	0.856	1.872	-0.110
Firm Exit	0.850	-0.078	-1.059	0.288
Contribution Incumbents				
Total	-7.683	5.315	2.798	-0.430
Within Firm	-4.560	6.367	-1.337	-0.470
Between Firm	-3.123	-1.052	4.134	0.041
Within Firm				
Total	-4.560	6.367	-1.337	-0.470
Net Entry Origin	0.634	0.080	-0.222	-0.491
Within Origin	-6.118	5.589	0.435	0.095
Between Origin	0.924	0.699	-1.549	-0.074

Notes: The Table reports the results from a dynamic Olley-Pakes decomposition with entry and exit for imports at the origin level. It shows the corresponding numbers of Equations (22), (23), and (24).

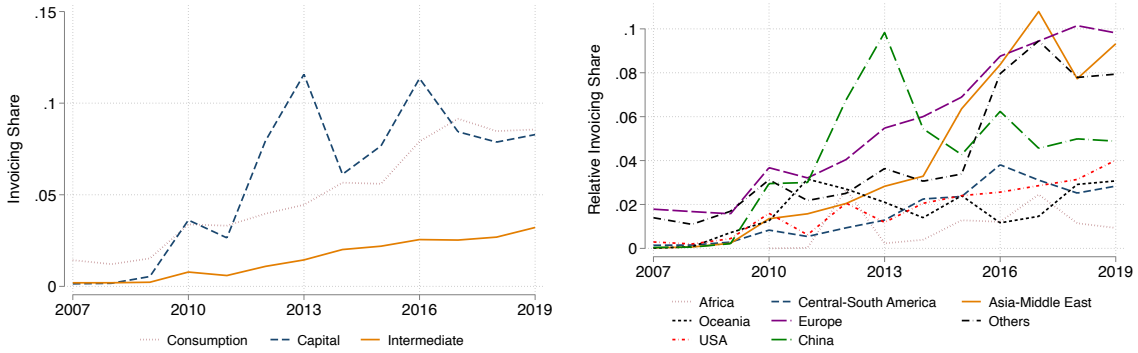
Table 5: Dynamic Olley-Pakes Decomposition with Entry and Exit: Exports at the Firm Level

	USD	Peso	Euro	Others
-				
Aggregate Invoicing Share	0.488	0.009	-0.949	0.452
Contribution Net Entry				
Total	0.015	-0.000	-0.230	0.215
Firm Entry	-0.305	0.012	0.087	0.205
Firm Exit	0.319	-0.013	-0.317	0.010
Contribution Incumbents				
Total	0.473	0.009	-0.719	0.237
Within Firm	0.717	-0.326	-0.472	0.081
Between Firm	-0.244	0.335	-0.247	0.156
Within Firm				
Total	0.717	-0.326	-0.472	0.081
Net Entry Destination	-1.551	2.107	-0.528	-0.028
Within Destination	0.932	-2.445	1.272	0.242
Between Destination	1.336	0.013	-1.215	-0.133

Notes: The table reports the results from the benchmark dynamic Olley-Pakes decomposition with entry and exit for export at the firm level. It shows the corresponding numbers of Equations (22), (23), and (24).

B.2 Additional Results: Product vs Origin

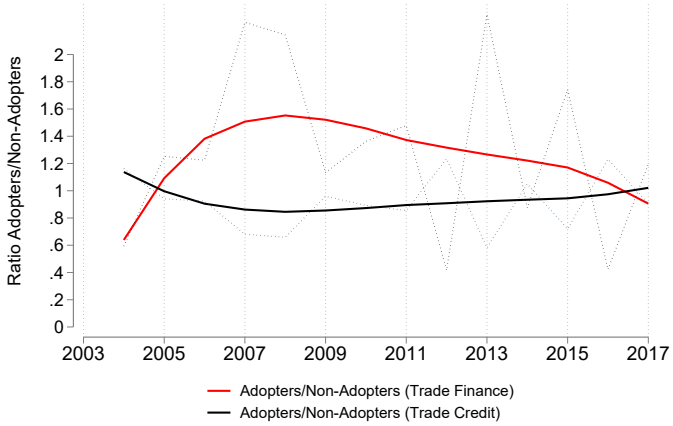
Figure 13: Subgroup by Origin or Product Type - Chilean Peso Invoicing



Notes: The left panel shows the evolution of the invoicing share in Chilean Peso in imported goods within three broad product categories: Consumption, capital, and investment goods as defined according to the BEC classification. The right panel shows the evolution of the invoicing share in Chilean Peso in imported goods within major trade partners: USA, Europe, China, Central-South America, Asia-Middle East, Africa and Others.

B.3 Additional Results: Role of trade credit

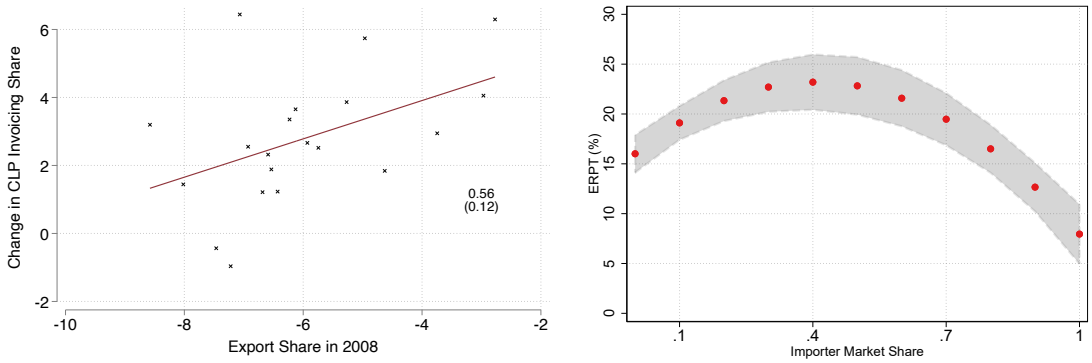
Figure 14: Trade Credit and Invoicing



Notes: The Figure plots the ratio between the value imported by firms adopting of a new currency over the value imported by firms using US dollar invoicing. We compute the ratio distinguishing between transactions that took place under trade finance (i.e. pre-shipment payment) and under trade credit (i.e. post-shipment payment). Data are from Garcia-Marin et al. (2019).

B.4 Additional Results: Importers' Bargaining Power in Invoicing

Figure 15: Invoicing as Importers' Choice



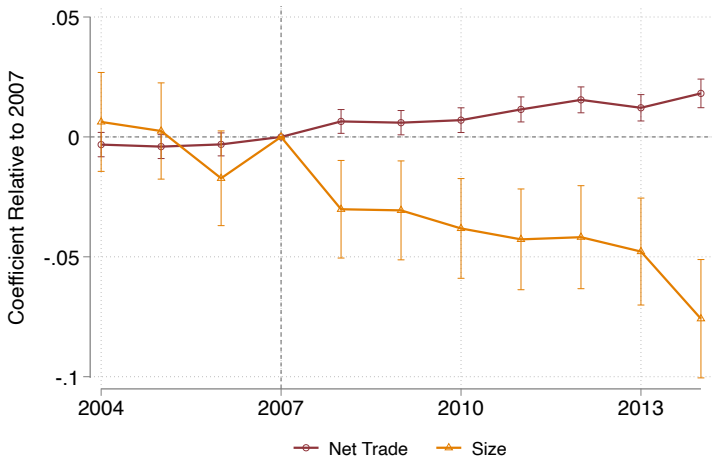
Notes: The left panel plots the relationship between the cumulative change in the aggregate share of CLP at the origin level and the Chilean export share in the origin's total exports in 2008 (in logs). We compute the cumulative change starting from 2008. We consider all horizons from 5 to 10 years, and plot the relationship after absorbing time fixed effects. The right panel plots the estimated quadratic relationship between the importer's market share and the pass-through rate of exchange rate fluctuations in import prices, estimated using the following specification:

$$\Delta \log p_{foit} = \beta_1 \Delta \log e_{ot} + \beta_2 S_{fsit} + \beta_3 \Delta \log e_{ot} \times S_{fsit} + \epsilon_{foit},$$

where S_{fst} is the market share of importer f in sector s (HS4-origin), and $\log p_{foit}$ is the unit import price in local currency for importer f, product i (HS8) from origin o.

B.5 Additional Results: Model Validation

Figure 16: Testing the Model - Event Study



Note: The Figure plots the coefficients β_τ from the event study specification in Equation (12), capturing the differential reduction in US Dollar invoicing by more exposed firms. Coefficient in 2007 is normalized to zero. Exposure is measured by: i) the difference between the total exports denominated in US Dollar and the total imports denominated in US Dollars normalized by the firm's total trade ("Net Trade"); ii) the market share of a firm in a given product-origin pair ("Size"). Data are from Garcia-Marin et al. (2019).

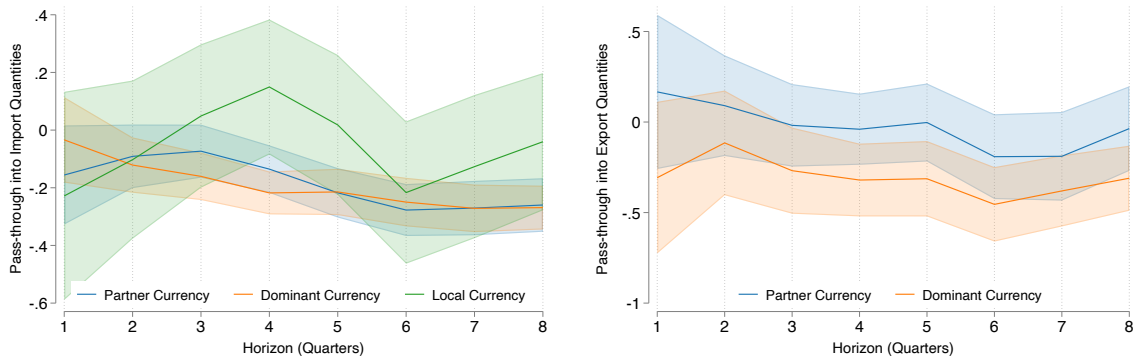
Table 6: Testing the Model - Sunk Cost

	Dummy USD			Share USD		
	(1) OLS	(2) OLS	(3) IV	(4) IV	(5) First Difference - IV	(6) First Diffrence - GMM
Lagged Dollar Share	0.160	0.062	0.061	0.158		
	(0.000)	(0.005)	(0.005)	(0.044)		
Lagged ΔDollar Share					-0.382	-0.224
					(0.017)	(0.013)
Controls	No	Yes	Yes	Yes	Yes	Yes
Origin × Year & Product × Year	Yes	Yes	Yes	No	No	No
Firm × Product × Origin & Year	No	No	No	Yes	Yes	No
Observations	1776386	768375	768375	623768	356394	260203

Note: The Table reports the coefficients from specification in Equation (14). The dependent variable in specifications (1) to (5) is a dummy variable equal to 1 when US Dollar invoicing is used and 0 otherwise; The dependent variable in specifications (5) to (7) is the (log) share of US Dollar invoicing. Column (6) is estimated in first difference via OLS. Column (7) is estimated using an Arellano-Bond GMM estimator using lagged levels of the right-side variables as instruments. "Lagged Dollar Share" refers to the lagged (log) share of US Dollar invoicing at the firm-origin-product level. Controls include: a natural hedging measure defined as the share of export invoiced in US Dollar; a strategic complementarities measure as the average share of imports invoiced in US Dollar among all competitors in a given sector(HS6)-origin pair. IV columns refers to the case in which the strategic complementarity measure is instrumented with the import-weighted average US Dollar exposure of all competitors in a given sector(HS6)-origin pair. Standard errors are clustered at firm level. We use data from official customs 2007-2019.

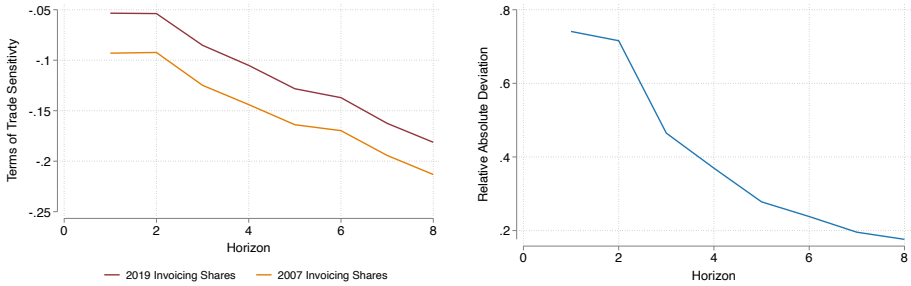
B.6 Additional Results: Counterfactual Exercises

Figure 17: Quantity Sensitivities to Exchange Rates



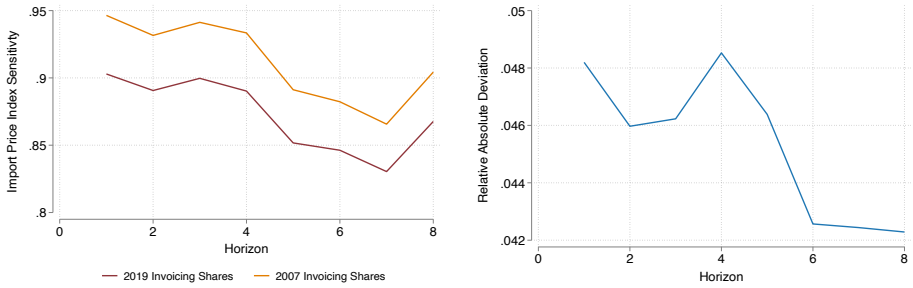
Notes: The left (right) panel show the estimated coefficients from the specification in Equation (15) using import (export) quantities as dependent variable. We use data from official customs running from 2007 to 2019 for imports and 2009 to 2019 for exports. We exclude the LCP case for export quantities because of the absence of sufficient observations in the estimation.

Figure 18: Terms of Trade Sensitivity to Exchange Rates



Notes: The left panel plots the 2-periods moving average of the response of the terms of trade (TOT) to a depreciation of the Chilean peso. For each horizon l, we use the following formula: $\Delta TOT_t^l = \Delta e \left[\sum_{\tau=0}^{l} \beta_\tau^{PX,CLP} \times S^{X,CLP} + \beta_\tau^{PX,D} \times S^{X,D} + \beta_\tau^{PX,p} \times S^{X,p}\right] - \Delta e \left[\sum_{\tau=0}^{l} \beta_\tau^{PM,CLP} \times S^{M,CLP} + \beta_\tau^{PM,D} \times S^{M,D} + \beta_\tau^{PM,p} \times S^{M,p}\right]$. We use the estimated coefficients from Equation (15). Invoicing shares are computed from official import (export) customs data from 2007 (2009) for the initial period (orange line) and from 2019 for the last period (red line). The right panel plots the difference between the response of the trade balance in 2007 and in 2019 relative to the 2019 case.

Figure 19: Terms of Import Inflation to Exchange Rates



Notes: The left panel plots the response of the import price index (IPI) to a depreciation of the Chilean peso. For each horizon l, we use the following formula: $\Delta IPI_t^l = \Delta e \left[\sum_{\tau=0}^{l} \beta_\tau^{PM,CLP} \times S^{M,CLP} + \beta_\tau^{PM,D} \times S^{M,D} + \beta_\tau^{PM,p} \times S^{M,p}\right]$. We use the estimated coefficients from Equation (15). Invoicing shares are computed from official import customs data from 2007 for the initial period (orange line) and from 2019 for the last period (red line). The right panel plots the difference between the response of the trade balance in 2007 and in 2019 relative to the 2019 case.