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A TEST OF DOMINANT CURRENCY HYPOTHESIS: EVIDENCE FROM A NON-USD-NON-EURO COUNTRY

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ABSTRACT

We examine the determinants and the dynamics of the exchange rate pass-through of the Japanese exporters, utilizing the official Customs declaration data. We first estimated the invoicing currency exchange rate pass-through and found that export prices invoiced in producer currency are the most rigid. Among local currency or vehicle currency use, US dollar invoicing is relatively more rigid than non-US dollar invoicing. The destination exchange rate pass-through estimates for local currency invoicing are between 35 and 40 percent, whereas those for Japanese yen or US dollar invoicing are close to complete. In addition, we find these discrepancies are even more accentuated in the longer run by analyzing the dynamics of the exchange rate pass-through.

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1 Introduction

Research on the effect of exchange rate changes on the domestic economy has a long tradition. An exchange rate change as an external shock affects trade balance and domestic inflation. The traditional assumption on export price is that the price is fixed on the exporter's currency, which can be found as old as in the early 20th century in the work of Marshall-Learner condition. Magee (1973) raised the issue of passing a change of exchange rate on export prices. Krugman (1986) coined the term pricing-to-market, in which local prices are differentiated by destination markets. The pricing behavior has a one-to-one correspondence with the invoicing strategy if the price is rigid in invoicing currency. Devereux and Engel (2002) investigated the role of local currency pricing, LCP, in place of producer currency pricing, PCP, long assumed in the literature.

Recent studies investigate the role of the US dollar as the dominant currency, the phenomenon that a large portion of the world's economic transactions are conducted with US dollars, more than the proportionate size of the US economy, (Gopinath, Boz, Casas, Díez, Gourinchas, and Plagborg-Møller 2020, Boz, Casas, Georgiadis, Gopinath, Le Mezo, Mehl, and Nguyen 2022, Amiti, Itskhoki, and Konings 2022). The special role of the US dollar in the world has long been well-known in international finance literature. Ninety percent of foreign exchange transactions are associated with the US dollar. The majority of the foreign reserves held by central banks are in US dollars. The US dollar is used as an invoicing currency even between two countries, the official currencies of which are not the US dollar. Gopinath, Boz, Casas, Díez, Gourinchas, and Plagborg-Møller (2020) proposes the dominant currency paradigm with three key features and finds that the dollar exchange rate quantitatively dominates the bilateral exchange rate in price pass-through.

In this study, we revisit the dominating effect of the dollar exchange rate in the exchange rate pass-through. Our significant contributions in the empirical approach consist of two ideas: *invoicing currency* exchange rate and *invoicing* ERPT. The studies in the literature focus on two exchange rates: the bilateral exchange rate between an exporting country and an importing country and the US dollar exchange rate against the currency of an importing country. We devise to construct the exchange rate series with the invoicing currency for the set of panel data consisting of over 40 million records. What makes the difference between this invoicing currency exchange rate and the bilateral or USD exchange rates is the domain of variations. The invoicing currency exchange rate is firm-product-time varying, whereas the bilateral and USD exchange rates are only destination-time varying. In the latter, the same exchange rates are applied to all products, regardless of invoicing currencies if shipped to the same destination country.

There are several stages in which the price of internationally traded goods can be observed. From the accessible public data, the price at the port of the exporting country, reported in general in the producer currency, and the price at the port of the importing country, reported in general in the local currency, are available. With the customs data of the selected countries, the prices are also available in the originally invoiced currency. By fully utilizing the information on the invoicing currency, the exchange rate pass-through is estimated by invoicing strategies, namely producer currency pricing/invoicing (PCP), local currency pricing/invoicing (LCP), and vehicle currency pricing/invoicing (VCP). In this paper, we also decompose invoicing strategies into three mutually exclusive sets as in the literature: PCP, LCP, and VCP. Further, we decompose LCP and VCP into those invoiced in US dollars and those invoiced in non-USD currencies. Through this decomposition, we can investigate whether the US dollar has its own idiosyncratic effect or if it is simply its large share in international trade that matters.

Gopinath, Itskhoki, and Rigobon (2010) is the seminal work on the literature to examine the exchange rate pass-through by invoicing currency. They grouped import prices by invoicing currency, namely USD and non-USD invoicing, and evaluated the import price responses to exchange rate changes. They found that the degree of exchange rate pass-through differed widely by invoicing currency. The US dollar invoiced goods showed zero pass-through after one month and gradually showed some responses in the later period but only up to 17 percent after two years. On the other hand, import prices invoiced in other currencies demonstrated almost 100 percent pass-through throughout the period.[1]

Our empirical specification closely follows the empirical model suggested by Amiti, Itskhoki, and Konings (2014). In their model, demand structure of Atkeson and Burstein (2008) and cost function of Halpern, Koren, and Szeidl (2015) are incorporated. As an approximation to exchange rate pass-through elasticity, Amiti, Itskhoki, and Konings (2014) showed that market share and import intensity are sufficient to represent the underlying parameters. Utilizing the corresponding variables constructed in Yoshida, Shimizu, Ito, Sato, Yoshimi, and Yoshimoto (2024), we estimated the exchange rate pass-through with controlling market share, import intensity, and marginal costs.

The dominant currency paradigm proposed by Gopinath, Boz, Casas, Díez, Gourinchas, and Plagborg-Møller (2020) drew a testable implication for exchange rate pass-through from their model. Their ERPT implication can be simplified as the following: if the prices are rigid in the invoicing currency, the import price in terms of local currency responds the most to the exchange

[1] Gopinath, Itskhoki, and Rigobon (2010) use the survey database provided by the Bureau of Labor Statistics. The price and invoicing information is collected directly from the US importing firms. Gopinath and Rigobon (2008) also use the same database.

rate based on the invoicing currency against the local currency. In fact, this implication does not require a theoretical model, but it reflects a simple accounting between two different currencies. The import price in local currency is calculated as the export price in the invoicing currency times the corresponding exchange rate in local currency per unit of the invoicing currency. When this simple accounting fact is aggregated to the national level, the share of invoicing currency is crucial to determine to what extent the import price responds to which exchange rates. Their empirical evidence from both the world panel data and the Columbian customs data show that the ERPT magnitude is greater for the dollar exchange rate (USD versus importer's currency) than the bilateral exchange rate (exporter versus importer's currency).

In this study, we provide empirical evidence to the more fundamental question for their ERPT implications: How long do the prices of invoicing currency remain sticky? In Gopinath, Boz, Casas, Díez, Gourinchas, and Plagborg-Møller (2020), the price is assumed rigid in the invoice currency. We measure how rigid the price of the invoice currency is. Does this duration differ among invoicing strategies? Is the dominant currency stickier than other currencies? In this paper, partly because of the available data on the exporter's side, we are able to distinguish the local currency invoicing of the US and US dollar-peg countries from the rest of the world. Similarly, we also decompose vehicle currency invoicing between US dollar and non-US dollar currencies

First, we emphasize that strictly defining currency invoicing is crucial in the ERPT analysis. Producer currency is obvious. In the strict definitions, the use of the US dollar is defined as local currency invoicing for the US, the US dollar-peg countries, and dollarization countries, and dual currency countries with the US dollar. Vehicle currency pricing (VCP) is defined as using a currency other than producer and local currency, VCP is also affected by the strict definition of LCP. VCP is further broken down into two mutually exclusive categories: VCP_{USD} and VCP_{NOUSD}.

Second, we introduce alternative exchange rates besides traditional exchange rates used in the literature. The traditional exchange rates in the literature only involve the producer currency, the US dollar, and local currency, namely, JPY/LC, JPY/USD, and USD/LC, see Figure 2. We propose *invoicing currency* exchange rates. The exchange rate for invoicing currency against the exporting country's currency should have been proposed when the invoicing currency information became available for the first time. In fact, this invoicing currency exchange rate is quantitatively as good as the dollar exchange rate in price pass-through.

Exchange rate pass-through is estimated either at the exporting country or at the importing country. The distinction is made by denominating the prices in the corresponding currency. We

propose to estimate the ERPT measured in the originally invoiced currency.

We found that the responses of export prices to exchange rate fluctuations largely depend on the invoicing currency. Our main findings are threefold. First, the most sensitive export prices are invoiced in local currencies. Second, the dominant currency with respect to the destination currency is more important for export prices than the dominant currency with the producer currency. Third, as shown in our dynamic analysis, these features become more significant for the longer-term ERPT.

Lastly, the examination of Japanese exports has one obvious advantage. Because of the strong influence of the dominant currencies, that is, the US dollar and possibly the Euro as well, on other countries, examining the customs data of a member country in the dominant currency regime may be biased. The customs-level data of the country that is neither a part of the US dollar nor the euro area is more suitable for examining the pure effect of the invoicing strategy.

The structure of the rest of the paper is as follows. The next section defines invoicing strategies and explains how the exchange rate should be based on the invoicing currency. Section 3 describes the empirical model specifications and section 4 shows the result of panel estimations. Section 5 examines the dynamics of exchange rate pass-through. The last section concludes.

2 Invoicing strategies and the corresponding Exchange Rates

2.1 Export Prices

We use the entire sample of Japanese exports at the transaction level and construct monthly price series at the firm-product-destination-invoice level between January 2014 and December 2022. The unit prices in invoicing currency, including Japanese yen invoicing among other currencies, are obtained by dividing the export values by export quantity aggregated at monthly frequency. The only dimension eliminated from this aggregation is the frequency of transactions within a month.[2]

The Japan Customs data includes information on export values denominated in Japanese yen. If the invoicing currency is not Japanese yen, the export values are converted to the equivalent Japanese yen by the Japan Customs' official exchange rates.[3]

[2]To be precise, the product in this study is defined at HS 9-digit category, which is a more broad category than a specific product name reported by an exporter. However, the errors possibly associated with matching the same products by product names, which can be misspelled or have several labels, degrade the reliability of the data source.

[3]Please see the definitions of the official rate. The same definition is applied to exports as well. `https://www.customs.go.jp/english/c-answer_e/imtsukan/1406_e.htm`

When there is only a single product exported with an export declaration, the value in invoicing currency correctly represents the value of the product. However, when there are multiple products associated with an export declaration, the value in invoicing currency represents the total value of all products. Only the value of the Japanese yen is reported for each product in the export declaration. We need to reverse-engineer the original invoicing currency value for each product by using the official rate. Correctly done, we can obtain the originally reported values for each product in the invoicing currency.

2.2 Defining Invoicing Strategies

Theoretical models assume an explicit one-to-one correspondence between an invoicing strategy and a corresponding currency. However, in reality, some countries have multiple currencies associated with each invoicing strategy. For the following empirical exercises, it is imperative to make an inclusive list of currencies for each invoicing strategy for each destination country.

To begin with the broadest set of currencies in the world, we referred to the IBAN website, in which 249 countries are assigned at least one currency with the 3-letter ISO code.[4] We first describe how we categorize the invoicing currency choice as invoicing strategies in the following subsection. Then, we argue that the local currency series should be more carefully constructed than the standard in the literature.

2.2.1 PCP, LCP, VCP, and DCP

The PCP is defined straightforwardly: Transactions with the Japanese yen invoicing are PCP. The defining LCP is discussed thoroughly in the following subsection. Once PCP and LCP are precisely defined, VCP can be defined as any invoicing currencies of neither PCP nor LCP. PCP, LCP, and VCP are mutually exclusive.

In this study, we define DCP broadly as all US dollar invoicing. However, DCP can be decomposed into two narrow categories; VCP_{USD} and LCP_{USD}, see Figure 1. DCP is not mutually exclusive with other pricing strategies. For example in Figure 1, US dollar pricing to Korea and UK is VCP whereas US dollar pricing to USA and Bolivia is LCP. To accentuate the role of US dollar as a vehicle currency, we decompose VCP into VCP_{USD} and VCP_{NOUSD}.

[4]The IBAN website's URL is https://www.iban.com/currency-codes. In this section, 'countries' refer to either countries, territories, or special districts. The IMF coverage is smaller because country information is restricted to only IMF member countries. See the descriptions in the next subsection.

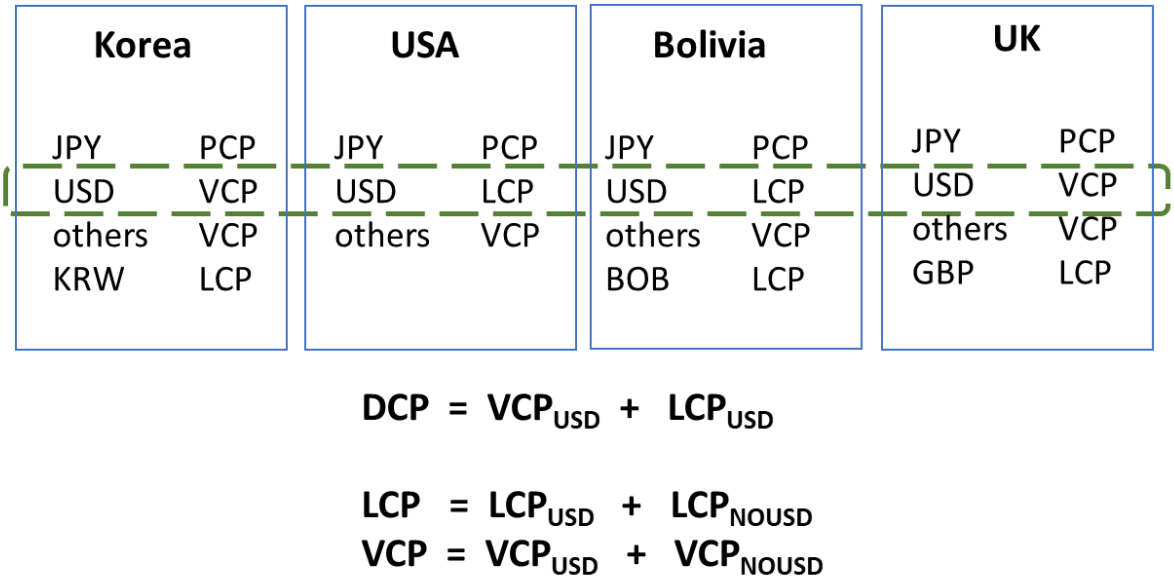

Figure 1: The structure of dominant currency, local currency, and vehicle currency

2.2.2 Local Currency: The national currencies and pegging currencies

Defining local currency invoicing involves several issues: multiple currencies, dollarization, common regional currency, and pegging. First, some countries use more than one currency, i.e., dual or multiple currencies. Out of 249 countries, 13 countries are listed with more than one currency. Bhutan uses its own national currency, ngultrum (BTN), and also the Indian rupee. El Salvador, Haiti and Panama use their own national currency and also the US dollar. Lesotho and Namibia use their own national currency and also the South African rand. The two national currencies with different ISO codes are listed for Bolivia, Chile, Columbia, Cuba, Mexico, Uruguay, and Venezuela. One of two currencies in these seven countries, for example, MXV in Mexico and BOV in Bolivia, is a unit of account that is inflation-adjusted. Excluding SDR and the seven Central and Southern American inflation-adjusted currencies, there remain 157 unique currencies.

Second, some countries use the currency of other countries, a phenomenon known as dollarization. The US dollar is solely used in 16 countries, including the US. The Euro is solely used in 35 countries, including the official 20 EU countries adopting the Euro. Besides the USD and EUR, the Norwegian krone, Australian dollar, New Zealand dollar, Pound sterling, Danish krone, Swiss franc, Kyrgyz tenge, and Morrocan dirham are also solely used in other countries.

Third, some countries use common regional currencies besides Euro. There are four regional currencies. The CFA franc BCEAO (Banque Centrale des Etats de l'Afrique de l'Ouest), CFA

franc BEAC (Banque des Etats de l'Afrique Centrale), CFP franc (Colonies Francaises du Pacifique), and East Carribiean dollar are used in 8, 6, 3, and 8 countries, respectively.

Fourth, some currencies are de facto pegged to the other currency. For the exchange rate series, we use the International Financial Statistics (IFS) of the IMF, (Exchange Rates, National Currency Per U.S. Dollar, Period Average, Rate). There are 187 countries in the IFS. 31 countries' currencies are pegged to the US dollar, and their exchange rate against the US dollar is constant for the entire sample period[5]. The currencies of the 19 non-Euro countries are pegged to the euro. 16 countries of these are member countries of the CFA franc BCEAO, the CFA franc BEAC, or the CFP franc. Three other countries pegging to the Euro are (i) the Union of the Comoros, (ii) Montenegro, and (iii) the Republic of San Marino. Besides these countries, Croatia, Poland, and Romania have high correlations with the Euro. The correlation between their currency against the US dollar and the Euro against the US dollar are 0.9878, 0.9166, and 0.8940, respectively. In this study, we include these three countries as Euro-pegging countries.

Addressing all issues raised above, we carefully defined the local currency or currencies for each country. Notwithstanding the difficulty of defining the local currency, there are two noteworthy points in the use of currencies. First, the actual use of invoicing currencies concentrated on a smaller number of currencies. The invoicing currency list prepared by the Ministry of Finance of Japan includes 93 currencies with 3-letter ISO codes. Note that this number is much smaller than the existing currencies recognized by the IBAN. By scrutinizing invoicing currencies in 41 million transactions of the Japanese exporters between 2014 and 2022, only 70 currencies were, in fact, used.

Second, the list of destination countries prepared by the MOF consists of 243 countries. In contrast to the concentrated use of only selected currencies as invoicing currency, Japan exports to almost all countries. In fact, Japan exports to 241 countries, covering 99 percent of the countries in the list. However, the shares in terms of transactions are less than 0.01 percent for 89 countries.

[5]These countries/areas are (1)Anguilla, (2)Antigua and Barbuda, (3)Aruba, Kingdom of the Netherlands, (4) Bahamas, (5)Barbados, (6)Belize, (7)Bermuda, (8)Bolivia, (9)Curaçao and Sint Maarten, (10)Curaçao, Kingdom of the Netherlands, (11)Dominica, (12)Ecuador, (13)El Salvador, (14)Grenada, (15)Jordan, (16)Lebanon, (17)Micronesia, Federated States of, (18)Montserrat, (19)Oman, (20)Palau, Rep. of, (21)Panama, (22)Qatar, (23)Saudi Arabia, (24)Sint Maarten, Kingdom of the Netherlands, (25)St. Kitts and Nevis, (26)St. Lucia, (27)St. Vincent and the Grenadines, (28)Timor-Leste, Dem. Rep. of, (29)United Arab Emirates, (30)Bahrain, Kingdom of, (31)Djibouti

	The traditional exchange rates used in the literature
JPY/LC	Japanese yen / local currency
JPY/USD	Japanese yen / USD
USD/LC	USD / local currency
	The invoicing currency exchange rates
JPY/IC	Japanese yen / invoicing currency
USD/IC	USD / invoicing currency

Figure 2: The invoicing currency exchange rates

2.2.3 The list of local currencies and the associated exchange rates

Accordingly, we define 44 countries as those using the US dollar as local currency. We checked whether our classifications are consistent with the IMF's AREAER. The AREAER contains information on the exchange rate arrangements for the 190 member countries and five special districts and territories. 11 countries on our list are not covered by the AREAER. Therefore, at least for these countries/territories, our approach reinforces the AREAER. The only questionable country on our list is Haiti.

According to the 2022 AREAER, Haiti does not have multiple currencies. The currency of Haiti is the Haitian gourde. However, Haiti uses the US dollar as another legal tender[6]. In the note, the AREAER states that the US dollar circulates freely and is generally accepted in Haiti. Under the 'Controls on the use of domestic currency' category, there is no restriction. However, the AREAER notes that there are no limitations on the use of domestic currency in international payments for current or capital transactions; the domestic currency has not yet been used for such purposes.

As the countries using the Euro as local currency, we include 56 countries. Both country lists adopting the US dollar and Euro as local currency are shown in appendix tables C.1 and C.2.

[6]The following are binary classifications for Haiti. Exchange Measures: Restrictions and/or multiple currency practices, NO. Exchange Arrangement: Other legal tender, Yes.

2.3 Exchange Rates

We apply five different exchange rate series in the following ERPT estimations. To maintain consistency across all exchange rate series, we define them so that an increase in exchange rate implies either a depreciation of the Japanese yen or an appreciation of local currency whenever applicable. The original monthly bilateral exchange rates are obtained from the IMF's IFS in January 2024. Exchange rates are domestic currency per US dollar, monthly average (IFS code = ENDA_XDC_USD_RATE). First, We apply Japanese yen per US dollar, **JPY/USD**, regardless of destinations and invoicing currency. JPY/USD is not destination-varying. Second, We take the reciprocals of IMF official exchange rates and label them as **USD/LC**. An increase in this exchange rate indicates an appreciation of a local currency. USD/LC is destination-varying.

Third, the bilateral exchange rates between Japan and the destination countries are then calculated as the product of the Japanese yen per US dollar and the inverse of the destination currency per US dollar, where an increase implies a depreciation of the Japanese yen. This exchange rate series is defined as **JPY/LC**.

Fourth and fifth, these exchange rate series are made applicable in the empirical work only when the dataset contains information on the invoicing currency. These variables are constructed by selecting the corresponding invoicing currency for each firm-product-destination-invoicing unit. These are denoted as **JPY/IC** and **USD/IC**. These exchange rate series are invoicing-currency-varying but not necessarily destination-varying.

2.4 Statistical Summary

The statistical summary of invoicing strategies is shown in Table 1. In the top panel, the number of export transactions and the value between 2014 and 2022 are 42.9 million and 729 trillion Japanese yen. These total exports can be decomposed mutually exclusively into three invoicing strategies: PCP, LCP, and VCP. The likelihood of three choices is relatively equal in terms of values, whereas the Japanese yen invoicing, PCP, is overwhelming regarding the number of transactions.

Recent attention in the invoicing currency literature, including exchange rate pass-through studies, focuses on the dominant currency pricing. Consistent with the evidence in the dominant currency paradigm literature, the DCP share, 51 percent, dominates other invoicing strategies. The evidence on these four categories can be found in the previous studies; however, we further decompose LCP and VCP into USD invoicing and non-USD invoicing. These subgroups are mutually exclusive. By definitions, $LCP_{USD} \cap LCP_{NOUSD} = \emptyset$ and $LCP = LCP_{USD} \cup LCP_{NOUSD}$. Similarly, $VCP_{USD} \cap VCP_{NOUSD} = \emptyset$ and $VCP = VCP_{USD} \cup VCP_{NOUSD}$. DCP consists of

Table 1: Statistical Summary: Invoicing Strategy

	(share, %)		(number)	(billion Japanese yen)
	transactions	values	transaction	value
ALL			42,875,212	728,834
PCP	59.5	36.2	25,512,235	264,085
LCP	16.5	28.5	7,057,730	207,820
VCP	24.0	35.3	10,305,247	256,928
DCP	29.2	51.0	12,499,903	371,944
LCP_{USD}	6.8	17.7	2,898,172	128,922
LCP_{USA}	5.7	16.3	2,435,936	118,846
LCP_{usdpeg}	1.1	1.4	462,236	10,076
VCP_{USD}	22.4	33.3	9,601,731	243,022
non-DCP non-PCP				
LCP_{NOUSD}	9.7	10.8	4,159,558	78,898
VCP_{NOUSD}	1.6	1.9	703,516	13,907

Note: ALL represents all export declarations reported to the Japan Customs between January 2014 and December 2022. PCP (producer currency pricing) is Japanese yen invoicing. LCP (local currency pricing) is exports with invoicing currency defined in section 2.2.2. VCP (vehicle currency pricing) is invoicing neither PCP nor LCP. DCP (dominant currency pricing) is US dollar invoicing and is equal to the sum of LCP_{USD}, US dollar invoicing for US and USD-pegging countries, and VCP_{USD}, US dollar invoicing for countries that use non-USD currency as local currency. LCP_{NOUSD} is LCP minus LCP_{USD} and VCP_{NOUSD} is VCP minus VCP_{USD}.

two subsets of invoicing currency strategies: US dollar invoicing for US dollar-adopting countries, LCP_{USD} and US dollar invoicing for non-USD countries, VCP_{USD}. In the third panel, it shows that VCP_{USD} share is 33.3 percent of all Japanese exports and exceeds that of dollar invoicing for the US and USD-pegging countries.

At the bottom panel, the compliment subgroups, LCP_{NOUSD} and VCP_{NOUSD} are shown. Local currency invoicing is substantial even when the US dollar use is excluded whereas vehicle currency invoicing by non-USD is only two percent.

3 Exchange Rate Pass-through Empirical Model

Proposition 3 of Amiti, Itskhoki, and Konings (2014) states that the first-order approximation to the exchange rate pass-through elasticity into *producer-currency* export price of the firm is given by

$$\Psi_{k,i} \equiv E\left\{\frac{d\log P^*_{k,i}}{d\log E_k}\right\} = \alpha_{s,i} + \beta_{s,k}\phi_i + \gamma_{s,k}S_{k,i}. \tag{1}$$

where ϕ_i is firm i's import intensity and $S_{k,i}$ is firm i's market share in destination country k. Following Amiti, Itskhoki, and Konings (2014) for the specification of our empirical model, we will estimate the following regression equation.

$$lnP^c_{i,j,k,t} = \alpha + (\beta_0 + \beta_1 ImportIntensity_{i,k,t} + \beta_2 MarketShare_{i,k,t}) \times lnER_{k,t} + \epsilon_{i,j,k,t}, \tag{2}$$

where $P^c_{i,j,k,t}$ represents export price in currency,c, of firm i's product j to destination country k in month t. $ImportIntensity_{i,k,t}$ and $MarketShare_{i,k,t}$ are at the firm-destination level at annual frequency. Exchange rates are bilateral between Japan and the destination country k at monthly frequency. We also examine equation (2) by replacing the exchange rate with JPY/IC, JPY/LC, JPY/USD, USD/IC, and USD/LC.

For exports invoiced in destination currencies, We can reformulate equation (1) in terms of *local-currency* export price;

$$(1 - \Psi_{k,i}) \equiv E\left\{\frac{d\log P_{k,i}}{d\log E_k}\right\} = 1 - \alpha_{s,i} - \beta_{s,k}\phi_i - \gamma_{s,k}S_{k,i}. \tag{3}$$

Note that the expected signs of coefficients will be opposite between the Japanese yen price, i.e., producer currency price, and the invoicing currency price, i.e., local currency price.

3.1 Market Share

The market share of an exporter is shown to be one of the determinants for invoice currency choice as well as for exchange rate pass-through. Precedding to the idea of strategic comple-

mentary,Goldberg and Tille (2008) suggested the market share of an exporting country is also important as the coalescing effects in the choice of invoicing currency and found supporting evidence with the Canadian import data.

Market share variable is the value-weighted average of market shares at HS 4-digit industries: $MShare_{i,t} = \sum_j w^j(\sum_{c,k} val(c,i,j,k,t)/\sum_{c,i,k} val(c,i,j,k,t))$. For each 4-digit industry (across all destination countries) in which firm i exports, the market share is calculated. Then, these market shares are taken average with firm i's export share at HS 4-digit industries,w^j, as weights. We also use three alternative definitions for market share. Two alternatives use HS 2-digit and HS 6-digit levels instead of HS 4-digit level. The last definition uses the market share in the destination country.

3.2 Import Intensity

Amiti, Itskhoki, and Konings (2022) construct the Belgian firm's import intensity as the ratio of total imports from outside the eurozone to total variable costs. They use this variable as a proxy for the firm's marginal cost sensitivity to the exchange rate. The underlying implicit assumption is that these imports are not invoiced in euros.[7] If, as an extreme example, all imports from non-Euro countries are invoiced in euros, the Belgian firms are unaffected by a change in the exchange rate, at least from the importing side.

Theoretical models of exchange rate pass-through and currency invoicing explicitly considered the imported inputs in the international finance literature.[8] Chung (2016) is one of the first empirical studies that highlighted the link between imported inputs and exporters' decisions on invoicing currency. Chung (2016) introduced the ratio of imported inputs invoiced in the exporter's currency to its total imported inputs at the UK firm level to consider the role of exporter's operational hedging behavior.[9]

Our approach to constructing an import intensity variable is to consider the invoicing currency choice in imports, similar to Crowley, Han, and Son (2021) and following Yoshida, Shimizu,

[7]Therefore, Amiti, Itskhoki, and Konings (2022) further breaks the import intensity index into euro-invoiced import intensity and non-euro-invoiced import intensity for alternative specifications.

[8]The role of imported inputs in exporting firms has also been well examined in the international trade literature. Imported inputs can be used to measure the degree of participation in global value chains as surveyed in Johnson (2018). Imported inputs can be a source of growth engine for multinational firms (Halpern, Koren, and Szeidl 2015).

[9]Operational hedge is also found essential even in domestic transactions in the dollarization economy of Uruguay (Licandro and Mello 2019). On the other hand, Lyonnet, Martin, and Mejean (2022) found that large EU firms are more willing to use non-euro invoicing if financial hedging tools are available.

Ito, Sato, Yoshimi, and Yoshimoto (2024). The new contribution of this study is to introduce three indices that are complementary to each other. The first is a straightforward extension of the currency choice variable to the import side. The dollar used on the import side is matched with the export side at the firm-country level. Note that this variable has two dimensions, in firms and destinations, whereas the import intensity index in Amiti, Itskhoki, and Konings (2022) varies only over firms.[10] The currency matching variable is formulated as the following with an asterisk indicating the importing side:

$$\phi^{*\text{USD}}_{i,k,t} = IC^{*}_{c=\text{USD},i,k,t} = \frac{\sum_{c=\text{USD},j} val^{*}(c,i,j,k,t)}{\sum_{c,j} val^{*}(c,i,j,k,t)} \tag{4}$$

3.3 Marginal Cost

The marginal cost is the essential determinant of the price. An increase in marginal cost pushes the price; otherwise, the profit of the corresponding firm diminishes. The marginal cost varies across industries, partly due to different set of variety of inputs and different intensities of inputs in each industry. Even within the same industry, the different input sourcing strategies affect firms' marginal costs differently. In this study, we construct the firm-level marginal cost based on the Japan customs's import declaration data. The marginal cost is the average unit price of imported products at the firm level. The marginal cost is denominated in Japanese yen. Implicitly, we exclude those exporters which do not import at all from the sample.

3.4 The estimation models with market share, import intensity, and marginal cost

The empirical specification closely follows equation 2. We add the market share variable as a control and the firm-product-destination-invoice fixed effect. It is important to emphasize that there are three types of exchange rate series in terms of variations. The first group includes JPY/LC and USD/LC, and they vary at the destination-month as in equation 5. The second group is JPY/USD, and it varies only at month, see equation 6. The third group consists of JPY/IC and USD/IC, varying at the invoice-month level as in equation 7.

[10] In fact, the import intensity index in Amiti, Itskhoki, and Konings (2022) is also time-invariant, whereas our indices change by year.

$$lnP^{c}_{i,j,k,t} = \alpha + (\beta_0 + \beta_1 ImportIntensity_{i,k,t} + \beta_2 MarketShare_{i,k,t}) \times lnER_{k,t} + \beta_3 MarginalCost_{i,t} + \lambda_{i,j,k,c} + \epsilon_{c,i,j,k,t}, \quad (5)$$

$$lnP^{c}_{i,j,k,t} = \alpha + (\beta_0 + \beta_1 ImportIntensity_{i,k,t} + \beta_2 MarketShare_{i,k,t}) \times lnER_{t} + \beta_3 MarginalCost_{i,t} + \lambda_{i,j,k,c} + \epsilon_{c,i,j,k,t}, \quad (6)$$

$$lnP^{c}_{i,j,k,t} = \alpha + (\beta_0 + \beta_1 ImportIntensity_{i,k,t} + \beta_2 MarketShare_{i,k,t}) \times lnER_{c,t} + \beta_3 MarginalCost_{i,t} + \lambda_{i,j,k,c} + \epsilon_{c,i,j,k,t}, \quad (7)$$

4 Invoicing-currency exchange rate pass-through results

In Table 2 through Table 8, the estimated results are shown by invoicing strategy. In each invoicing strategy, we estimated the models with five different exchange rates: JPY/IC, JPY/LC, JPY/USD, USD/IC, and USD/LC. An increase in these exchange rates implies either a depreciation of the Japanese yen or an appreciation of local/invoice currency. Across invoicing strategies, we find three results.

First, the estimated coefficient for the exchange rate is negative and statistically significant for all specifications, regardless of invoicing strategies and exchange rates, except for one out of 29 [11]. This confirms that the invoice price is lowered when the exchange rate moves toward a depreciation of the producer's currency and/or an appreciation of the local currency.

Second, the positive effect of a marginal cost increase on invoice price is consistently captured regardless of invoicing strategies and exchange rates. The estimated coefficients are positive for all specifications and statistically significant for all but VCP_{NOUSD}. An increase in the average imported prices, specifically for each two-way exporter, raises the export price.

Third, the effects of interaction terms of exchange rate with market share and US dollar import ratio are different across invoicing strategies and exchange rates.

[11] We will come back later to this particular case in subsection 4.2 because this is not just a statistical artificial outlier.

4.1 The invoicing-currency ERPT of PCP, LCP, and VCP

Table 2 lists results for only three exchange rates because the exchange rate in the first column is constant at one for Japanese yen invoicing exports, and the exchange rate in the fourth column is reciprocal of the exchange rate in the third column. We are interested in finding which exchange rate export price invoiced in Japanese yen is more likely to respond. As will be clear when we discuss other invoicing currencies, the responsiveness of export prices invoiced in Japanese yen are small to any of them. In terms of the fitness of the regressions, it is less than four percent for JPY/USD and less than one percent for JPY/LC and USD/LC. The estimated elasticity is 12 percent for the JPY/LC exchange rate, implying 112 percent ERPT at the destination markets. This is consistent with the earlier findings that the invoice currency prices are rigid.

Table 3 presents the estimation results for local currency invoicing. As clearly discussed in section 2.2.2, this definition also includes the use of currency a country pegs to. Interestingly, only the JPY/USD exchange rate lacks the explanatory power for the regression model. For local currency invoicing, as shown in Figure 3, the elasticity directly represents the ERPT. The ERPT at the destination markets is 46 percent for JPY/IC and JPY/LC and 40 percent for USD/IC and USD/LC, respectively. The R-squared is substantially larger than those for other invoicing currencies and is about 24 percent.

Table 4 shows the results for vehicle currency invoicing. At first glance, the results seem sensitive to the corresponding exchange rates. The estimated elasticity of the exchange rate varies between 0.01 and 0.36. It is consistent with our prior expectation that exchange rates associated with local currency in specifications (2) and (5) have the least explanatory power. This is the point raised in this study in contrast with the work of (Gopinath, Boz, Casas, Díez, Gourinchas, and Plagborg-Møller 2020), in which compared the explanatory power of bilateral exchange rate, JPY/LC in (2), and dollar exchange rate, USD/LC in (5).

Comparing the result of the invoicing-currency exchange rates between specifications (1) and (4), the difference in the estimated elasticity of the exchange rate is substantial. Export price in invoicing currency, or vehicle currency, declines 36 percent for the JPY/IC and 18 percent for the USD/IC, respectively, when the invoicing currency appreciates.

The results in Table 4, in fact, represent the mixed results of the underlying different components. The results for vehicle currency pricing become much clearer when we decompose the VCP into those associated with the US dollar and those associated with the non-USD currencies in the following subsection.

Table 2: JPY invoicing

	(1) JPY/IC	(2) JPY/LC	(3) JPY/USD	(4) USD/IC	(5) USD/LC
ln ER		-0.115***	-0.0439***		-0.139***
		(0.00349)	(0.00521)		(0.00421)
ln ER× MarketShare$_{i,k,year}$		0.0313**	0.0220**		-0.00298
		(0.0132)	(0.00909)		(0.0121)
ln ER× USDRatio		0.00149***	0.00222***		-0.00205***
		(0.000478)	(0.000321)		(0.000355)
ln MC$_{i,year}$		0.00225***	0.00238***		0.00222***
		(0.000232)	(0.000232)		(0.000232)
Constant		9.309***	9.332***		8.693***
		(0.00604)	(0.0246)		(0.0135)
Observations		12,605,740	12,608,161		12,605,740
Number of FPDI_id		1,816,431	1,817,006		1,816,431
invoicing currency		JPY	JPY		JPY
Overall R-squared		0.00296	0.0388		0.00321

Note: The dependent variable is the export unit-value price at the firm-product(HS9)-destination-invoice-month. The sample is restricted to exports with Japanese yen as invoicing currency. 'ln ER' is the natural log of the corresponding exchange rate, indicating either a depreciation of the Japanese yen or an appreciation of local/invoicing currency when it increases. These models are estimated by a fixed-effect model where the number of the cross-sections is shown in the row 'Number of FPDI_id.' Standard errors are in parenthesis. ***, **, * represent one, five, and ten percent significance level.

Table 3: LC invoicing

	(1) JPY/IC	(2) JPY/LC	(3) JPY/USD	(4) USD/IC	(5) USD/LC
ln ER	-0.462***	-0.462***	-0.340***	-0.406***	-0.404***
	(0.00713)	(0.00713)	(0.00883)	(0.00924)	(0.00924)
ln ER × MarketShare$_{i,k,year}$	-0.0358***	-0.0350**	-0.0673***	0.300***	0.0962***
	(0.0139)	(0.0148)	(0.0135)	(0.0484)	(0.0250)
ln ER × USDRatio	0.000315	0.000266	-0.000138	-0.000310	-0.000679
	(0.000783)	(0.000809)	(0.000701)	(0.00148)	(0.00145)
ln MC$_{i,year}$	0.00244***	0.00243***	0.00283***	0.00262***	0.00266***
	(0.000420)	(0.000420)	(0.000420)	(0.000420)	(0.000420)
Constant	7.371***	7.354***	7.163***	5.239***	5.224***
	(0.0284)	(0.0281)	(0.0418)	(0.00893)	(0.00921)
Observations	4,103,998	4,103,998	4,103,998	4,103,998	4,103,998
Number of FPDI_id	431,454	431,454	431,454	431,454	431,454
invoicing currency	LC	LC	LC	LC	LC
Overall R-squared	0.251	0.241	0.0128	0.251	0.242

Note: The dependent variable is the export unit-value price at the firm-product(HS9)-destination-invoice-month. The sample is restricted to exports with local currency as invoicing currency. Local currency includes the USD and Euro for dollar-pegging and euro-pegging countries. 'ln ER' is the natural log of the corresponding exchange rate, indicating either a depreciation of the Japanese yen or an appreciation of local/invoicing currency when it increases. These models are estimated by a fixed-effect model where the number of the cross-sections is shown in the row 'Number of FPDI_id.' Standard errors are in parenthesis. ***, **, * represent one, five, and ten percent significance level.

Table 4: VCP invoicing

	(1) JPY/IC	(2) JPY/LC	(3) JPY/USD	(4) USD/IC	(5) USD/LC
ln ER	-0.363***	-0.112***	-0.353***	-0.180***	-0.0110**
	(0.00762)	(0.00417)	(0.00769)	(0.0276)	(0.00476)
ln ER × $\text{MarketShare}_{i,k,year}$	0.0149	0.132***	0.0135	0.191	0.0161
	(0.0101)	(0.0141)	(0.0102)	(0.248)	(0.0115)
ln ER × USDRatio	-0.00213***	0.000644	-0.00214***	-0.000701	0.00331***
	(0.000510)	(0.000750)	(0.000510)	(0.0142)	(0.000584)
ln $\text{MC}_{i,year}$	0.00338***	0.00313***	0.00342***	0.00334***	0.00333***
	(0.000369)	(0.000369)	(0.000369)	(0.000369)	(0.000369)
Constant	5.685***	4.115***	5.642***	3.973***	3.944***
	(0.0360)	(0.00678)	(0.0364)	(0.00427)	(0.0167)
Observations	6,368,541	6,368,199	6,368,543	6,368,541	6,368,199
Number of FPDI_id	754,554	754,478	754,556	754,554	754,478
invoicing currency	VCP	VCP	VCP	VCP	VCP
Overall R-squared	0.0112	0.00868	0.0184	0.0209	0.00008

Note: The dependent variable is the export unit-value price at the firm-product(HS9)-destination-invoice-month. The sample is restricted to exports with the vehicle invoicing currencies. The vehicle currency is defined as not Japanese yen and not local currencies (including USD-pegging and euro-pegging countries). 'ln ER' is the natural log of the corresponding exchange rate, indicating either a depreciation of the Japanese yen or an appreciation of local/invoicing currency when it increases. These models are estimated by a fixed-effect model where the number of the cross-sections is shown in the row 'Number of FPDI_id.' Standard errors are in parenthesis. ***, **, * represent one, five, and ten percent significance level.

4.2 Breaking down the VCP and LCP

4.2.1 VCP_{USD} versus VCP_{NOUSD}

We decomposed VCP into VCP_{USD} and VCP_{NOUSD} as shown in Figure 1. These subsets are mutually exclusive and the former is linked to the dominant currency pricing. Table 5 represents the estimation results for the US dollar invoicing exports by the Japanese exporters to destinations excluding the US and the US dollar-peg countries. Specifications (1) and (4) are not estimated because IC is equivalent to the US dollars. Specification (1) is equivalent to (3), and specification (4) is meaningless because the exchange rate is invariant for the entire sample. Table 6 represents the estimation results for non-USD invoicing, which is neither Japanese yen nor local currency.

Comparing specification (3) in Tables 4, 5, and 6, it is clear that the result of VCP with respect to JPY/USD exchange rate is driven by US dollar invoicing, in which the number of observations is more than ten-folds of those of non-USD invoicing.

For specification (4), the estimated elasticity of exchange rate is almost identical between VCP in Table 4 and VCP_{NOUSD} in Table 6. This holds despite the relatively larger size of VCP_{USD} because the exchange rate is invariant for the subsample of VCP_{USD} in VCP. The contribution of individuals with constant values is null for the panel data. This point is crucial to all studies investigating the dominant currency paradigm because it can be easily overlooked for analysis using an extremely large size of customs data.

Specification (5) in Table 5 is the only case out of 29 specifications in which the elasticity of the exchange rate is positive. This is not inconsistent with other results because an increase in exchange rate indicates an opposite valuation of the US dollar in specifications (3) and (5). An increase in the exchange rate is an appreciation of the US dollar in (3) and a depreciation of the US dollar in (5). Nonetheless, the magnitude of elasticity of the exchange rate is negligent, only one percent, implying the invoice price is rigid if invoiced in the US dollar. So is the specification (5) of VCP in Table 4, reflecting the net effect of positive elasticity of VCP_{USD} and negative elasticity of VCP_{NOUSD}.

So returning to the results of Table 4, we should interpret the VCP results as vehicle currency price responds more to the Japanese yen exchange rate than to the US dollar exchange rate for non-USD vehicle currency. This result is convincing because the Japanese exporters could have chosen the US dollar as vehicle currency if they were more concerned about the US dollar exchange rate.

Table 5: VCP_{USD} invoicing

	(1) JPY/IC	(2) JPY/LC	(3) JPY/USD	(4) USD/IC	(5) USD/LC
ln ER		-0.103***	-0.356***		0.0133***
		(0.00450)	(0.00800)		(0.00511)
ln ER × MarketShare$_{i,k,year}$		0.136***	0.0275**		-0.0229*
		(0.0165)	(0.0132)		(0.0127)
ln ER × USDRatio		-2.94e-05	-0.00269***		0.00342***
		(0.000787)	(0.000533)		(0.000600)
ln MC$_{i,year}$		0.00325***	0.00349***		0.00344***
		(0.000383)	(0.000383)		(0.000384)
Constant		4.039***	5.602***		3.974***
		(0.00685)	(0.0378)		(0.0184)
Observations		5,961,875	5,962,190		5,961,875
Number of FPDI_id		691,197	691,261		691,197
invoicing currency		VCP_{USD}	VCP_{USD}		VCP_{USD}
Overall R-squared		0.00792	0.0174		0.0215

Note: The dependent variable is the export unit-value price at the firm-product(HS9)-destination-invoice-month. The sample is restricted to exports with US dollar as invoicing currency to the destination countries excluding the US and the USD-peg countries. 'ln ER' is the natural log of the corresponding exchange rate, indicating either a depreciation of the Japanese yen or an appreciation of local/invoicing currency when it increases. These models are estimated by a fixed-effect model where the number of the cross-sections is shown in the row 'Number of FPDI_id.' Standard errors are in parenthesis. ***, **, * represent one, five, and ten percent significance level.

Table 6: VCP_{NOUSD} invoicing

	(1) JPY/IC	(2) JPY/LC	(3) JPY/USD	(4) USD/IC	(5) USD/LC
ln ER	-0.440***	-0.210***	-0.307***	-0.181***	-0.191***
	(0.0235)	(0.0112)	(0.0269)	(0.0232)	(0.0119)
ln ER × MarketShare$_{i,k,year}$	-0.00191	0.0722***	-0.00809	0.199	0.195***
	(0.0132)	(0.0241)	(0.0137)	(0.209)	(0.0244)
ln ER × USDRatio	0.00575***	0.00711***	0.00605***	-0.000757	-0.00462*
	(0.00169)	(0.00231)	(0.00168)	(0.0119)	(0.00260)
ln MC$_{i,year}$	0.00144	0.000678	0.00231*	0.00200	0.00118
	(0.00132)	(0.00132)	(0.00132)	(0.00132)	(0.00132)
Constant	6.849***	5.345***	6.217***	4.779***	4.411***
	(0.112)	(0.0347)	(0.128)	(0.0163)	(0.0283)
Observations	406,351	406,324	406,353	406,351	406,324
Number of FPDI_id	63,293	63,281	63,295	63,293	63,281
invoicing currency	VCP_{NOUSD}	VCP_{NOUSD}	VCP_{NOUSD}	VCP_{NOUSD}	VCP_{NOUSD}
Overall R-squared	0.0635	0.00003	0.0141	0.0662	0.00004

Note: The dependent variable is the export unit-value price at the firm-product(HS9)-destination-invoice-month. The sample is restricted to exports with the vehicle invoicing currencies, but excluding the USD. The vehicle currency is defined as not Japanese yen and not local currencies (including USD-pegging and euro-pegging countries). 'ln ER' is the natural log of the corresponding exchange rate, indicating either a depreciation of the Japanese yen or an appreciation of local/invoicing currency when it increases. These models are estimated by a fixed-effect model where the number of the cross-sections is shown in the row 'Number of FPDI_id.' Standard errors are in parenthesis. ***, **, * represent one, five, and ten percent significance level.

4.2.2 LCP_{USD} versus LCP_{NOUSD}

We begin by noting that we do not have estimates for specifications (4) and (5) for LCP_{USD} because the exchange rates in these specifications are invariant throughout the sample. Another caveat is that the difference between IC and LC is negligent. The results between specifications (1) and (2) and between (4) and (5) are almost identical. One noteworthy feature in the result of local currency pricing in Table 3 is that export price is least responsive to the JPY/USD exchange rate, i.e., in specification (3). We can confirm from the decomposed analysis for LCP that this result comes from two sources. One is that the exchange rate elasticity of local currency, i.e., US dollar, for the US and US dollar-peg countries in Table 7 is relatively smaller than that of local currencies in the non-US dollar countries. This fact lowers the exchange rate elasticity of the first three specifications. The other one is that the export price of LCP_{NOUSD} is least responsive to the JPY/USD exchange rate.

By decomposing the local currency pricing into US dollar and non-USD, we find that exchange rate elasticity is much higher for non-USD when exchange rates are between the Japanese yen and local currency. These results imply that export prices in the US and the US dollar-peg countries are relatively rigid when invoiced in local currency.[12] Lastly, export prices in local currency invoicing respond more to the Japanese yen than the US dollar movements for non-USD countries.

[12] In the following section on dynamic ERPT, in fact, US dollar-peg countries show much less response to exchange rate fluctuations than the US.

Table 7: LCP_{USD} invoicing

	(1) JPY/IC	(2) JPY/LC	(3) JPY/USD	(4) USD/IC	(5) USD/LC
ln ER	-0.307***	-0.307***	-0.307***		
	(0.0132)	(0.0132)	(0.0132)		
ln ER $\times MarketShare_{i,k,year}$	-0.0134	-0.00814	-0.0111		
	(0.0187)	(0.0209)	(0.0187)		
ln ER $\times USDRatio$	-0.00196*	-0.00236**	-0.00202*		
	(0.00112)	(0.00120)	(0.00112)		
ln $MC_{i,year}$	0.00211***	0.00210***	0.00211***		
	(0.000623)	(0.000622)	(0.000623)		
Constant	6.365***	6.341***	6.366***		
	(0.0625)	(0.0615)	(0.0625)		
Observations	1,901,756	1,901,756	1,901,756		
Number of FPDI_id	196,541	196,541	196,541		
invoicing currency	LC_{USD}	LC_{USD}	LC_{USD}		
Overall R-squared	0.0124	0.000197	0.0152		

Note: The dependent variable is the export unit-value price at the firm-product(HS9)-destination-invoice-month. The sample is restricted to exports with local currency as invoicing for US and US dollar-peg countries. 'ln ER' is the natural log of the corresponding exchange rate, indicating either a depreciation of the Japanese yen or an appreciation of local/invoicing currency when it increases. These models are estimated by a fixed-effect model where the number of the cross-sections is shown in the row 'Number of FPDI_id.' Standard errors are in parenthesis. ***, **, * represent one, five, and ten percent significance level.

Table 8: LCP_{NOUSD} invoicing

	(1) JPY/IC	(2) JPY/LC	(3) JPY/USD	(4) USD/IC	(5) USD/LC
ln ER	-0.534***	-0.534***	-0.370***	-0.406***	-0.406***
	(0.00828)	(0.00828)	(0.0118)	(0.00886)	(0.00886)
ln ER $\times MarketShare_{i,k,year}$	-0.0690***	-0.0675***	-0.143***	0.318***	0.321***
	(0.0212)	(0.0212)	(0.0199)	(0.0465)	(0.0461)
ln ER $\times USDRatio$	0.00180	0.00181*	0.00107	-0.000415	-0.000414
	(0.00110)	(0.00110)	(0.000888)	(0.00142)	(0.00142)
ln $MC_{i,year}$	0.00273***	0.00273***	0.00349***	0.00294***	0.00295***
	(0.000568)	(0.000568)	(0.000568)	(0.000568)	(0.000568)
Constant	7.847***	7.846***	7.864***	5.525***	5.524***
	(0.0276)	(0.0276)	(0.0561)	(0.0147)	(0.0147)
Observations	2,202,242	2,202,242	2,202,242	2,202,242	2,202,242
Number of FPDI_id	234,913	234,913	234,913	234,913	234,913
invoicing currency	LC_{NOUSD}	LC_{NOUSD}	LC_{NOUSD}	LC_{NOUSD}	LC_{NOUSD}
Overall R-squared	0.347	0.347	0.00934	0.348	0.348

Note: The dependent variable is the export unit-value price at the firm-product(HS9)-destination-invoice-month. The sample is restricted to exports with local currency as invoicing currency, except for the US dollar. 'ln ER' is the natural log of the corresponding exchange rate, indicating either a depreciation of the Japanese yen or an appreciation of local/invoicing currency when it increases. These models are estimated by a fixed-effect model where the number of the cross-sections is shown in the row 'Number of FPDI_id.' Standard errors are in parenthesis. ***, **, * represent one, five, and ten percent significance level.

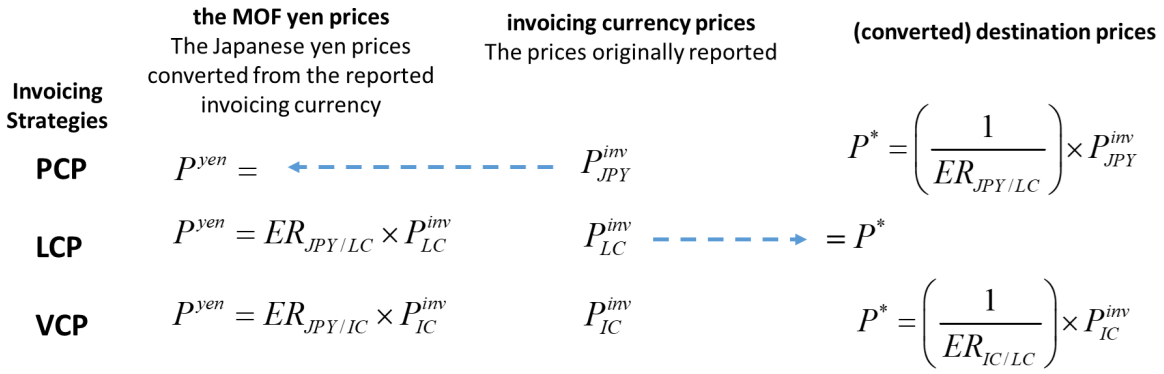

Figure 3: The link between the invoicing currency price and destination price

4.3 Destination ERPT

From Figure 3, export price denominated at the local market can be shown as follows if the invoicing currency is the Japanese yen. Note that all variables are in the logarithmic form.

$$lnP^* = lnP^{inv}_{JPY} - lnER_{JPY/LC} \tag{8}$$

Taking the partial derivative of this equation with respect to an exchange rate shows that ERPT at the destination country is the invoicing-currency ERPT minus the correlation between two exchange rates.

$$\frac{\partial lnP^*}{\partial lnER} = \frac{\partial lnP^{inv}_{JPY}}{\partial lnER} - \frac{\partial lnER_{JPY/LC}}{\partial lnER} \tag{9}$$

For the special case when an exchange rate in concern is JPY/LC, destination ERPT is invoice ERPT minus 1, i.e., $\beta^* = \beta - 1$, where β^* is destination ERPT, and β is invoice ERPT we estimated in the previous section. The same analogy applies to the case of vehicle currency invoicing. Obviously, the invoicing ERPT and destination ERPT are equivalent for the local currency invoicing.

4.3.1 Destination ERPT for Japanese yen invoicing

The estimated results for export prices denominated in the local currency for those invoiced in the Japanese yen are shown in Table 9. The difference between Table 2 and 9 is the denomination of export prices. Export prices are shown in Japanese yen as reported to the MOF in Table 2, whereas they are shown in local currency after dividing the original Japanese yen price by the JPY/LC exchange rates in Table 9.

The second column is the clear case for confirming the relationship in equation 9. The estimated elasticity of the exchange rate in column (2) in Table 9 is equal to the estimate in column (2) in Table 2 minus one. Everything else, including estimates and standard deviation of other variables, is exactly the same, except the size of R-squared.[13]

In columns (3) and (5), the relationship in equation 9 still holds, but the exchange rates are different. The elasticity of the exchange rate in this case, in which export prices are denominated in the currency of the destination country, represents the exchange rate pass-through. The results indicate that ERPT at the destination is close to complete pass-through if invoiced in the Japanese yen. This is in contrast to relatively lower ERPT, i.e., about 30-40 percent, at the destination for local currency invoicing in Table 3.

4.3.2 Destination ERPT for vehicle currency invoicing

Conforming to the previous results of Japanese yen invoicing, which show that the ERPT is complete, the destination ERPT of vehicle currency invoicing is also close to complete for exchange rates involving local currency, i.e., JPY/LC and USD/LC, see Table 10. However, destination ERPT is substantially incomplete for JPY/IC, JPY/USD, and USD/IC exchange rates.

Noting from Table 1 that the US dollar consists 93 percent of vehicle currency invoicing, the correlation between IC/LC and USD/LC is close to one. Therefore, destination ERPT should hold that it is equal to the invoice ERPT minus one. In fact, the invoice ERPT of VCP in column (5) of Table 4 is -0.0110 and the destination ERPT is -0.979. The small discrepancy arises due to the inclusion of non-US dollar invoicing in VCP.

[13] This nominal increase in R-squared is superficial, well-known to empirical researchers, and is driven by the same variable appearing on both sides of the estimation model.

Table 9: Destination ERPT, Japanese yen invoicing

	(1) JPY/IC	(2) JPY/LC	(3) JPY/USD	(4) USD/IC	(5) USD/LC
ln ER		-1.115***	-0.899***		-1.044***
		(0.00349)	(0.00523)		(0.00422)
ln ER $\times MarketShare_{i,k,year}$		0.0313**	0.0379***		-0.00729
		(0.0132)	(0.00917)		(0.0121)
ln ER $\times USDRatio$		0.00149***	0.00128***		-0.00144***
		(0.000478)	(0.000322)		(0.000356)
ln $MC_{i,year}$		0.00225***	0.00327***		0.00230***
		(0.000232)	(0.000232)		(0.000232)
Constant		9.309***	11.79***		4.285***
		(0.00604)	(0.0247)		(0.0135)
Observations		12,605,740	12,605,740		12,605,740
Number of FPDI_id		1,816,431	1,816,431		1,816,431
invoicing currency		JPY	JPY		JPY
Overall R-squared		0.483	0.00164		0.482

Note: The dependent variable is the export unit-value price in terms of local currency at the firm-product(HS9)-destination-invoice-month. The sample is restricted to exports with Japanese yen as invoicing currency. Prices in local currency are obtained as dividing export price in Japanese yen invoicing by the JPY/LC exchange rate. 'ln ER' is the natural log of the corresponding exchange rate, indicating either a depreciation of the Japanese yen or an appreciation of local/invoicing currency when it increases. These models are estimated by a fixed-effect model where the number of the cross-sections is shown in the row 'Number of FPDI_id.' Standard errors are in parenthesis. ***, **, * represent one, five, and ten percent significance level.

Table 10: Destination ERPT, vehicle currency invoicing

	(1) JPY/IC	(2) JPY/LC	(3) JPY/USD	(4) USD/IC	(5) USD/LC
ln ER	-0.291***	-0.840***	-0.284***	-0.151***	-0.979***
	(0.00765)	(0.00417)	(0.00772)	(0.0277)	(0.00476)
ln ER $\times MarketShare_{i,k,year}$	0.179***	-0.0720***	0.181***	0.582**	-0.00244
	(0.0101)	(0.0141)	(0.0103)	(0.249)	(0.0115)
ln ER $\times USDRatio$	-0.00234***	0.000876	-0.00235***	0.00954	0.00305***
	(0.000512)	(0.000750)	(0.000512)	(0.0143)	(0.000584)
ln $MC_{i,year}$	0.00544***	0.00383***	0.00547***	0.00547***	0.00330***
	(0.000371)	(0.000369)	(0.000371)	(0.000371)	(0.000369)
Constant	8.765***	8.472***	8.733***	7.394***	4.054***
	(0.0362)	(0.00678)	(0.0365)	(0.00428)	(0.0167)
Observations	6,368,197	6,368,197	6,368,197	6,368,197	6,368,197
Number of FPDI_id	754,476	754,476	754,476	754,476	754,476
invoicing currency	VCP	VCP	VCP	VCP	VCP
Overall R-squared	0.00147	0.443	0.00124	0.00674	0.443

Note: The dependent variable is the export unit-value price in terms of local currency at the firm-product(HS9)-destination-invoice-month. The sample is restricted to exports with vehicle currency invoicing. Prices in local currency are obtained as dividing export price in vehicle currency invoicing by the IC/LC exchange rate. 'ln ER' is the natural log of the corresponding exchange rate, indicating either a depreciation of the Japanese yen or an appreciation of local/invoicing currency when it increases. These models are estimated by a fixed-effect model where the number of the cross-sections is shown in the row 'Number of FPDI_id.' Standard errors are in parenthesis. ***, **, * represent one, five, and ten percent significance level.

Table 11: VCP invoicing with IC/LC exchange rates

	(1)	(2)	(3)	(4)	(5)	(6)
dep. var.	inv. price	dest. price	inv. price	dest. price	inv. price	dest. price
ln $ER_{IC/LC}$	-0.00529	-1.005***	-0.187***	-1.187***	-0.168***	-1.168***
	(0.00483)	(0.00483)	(0.0139)	(0.0139)	(0.0163)	(0.0163)
$\text{Dummy}_{VCP_{USD}} \times lnER_{IC/LC}$					0.177***	0.177***
					(0.0169)	(0.0169)
ln $ER_{IC/LC}$× $\text{MarketShare}_{i,k,year}$	0.0126	0.0126	0.180***	0.180***	0.0117	0.0117
	(0.0115)	(0.0115)	(0.0235)	(0.0235)	(0.0115)	(0.0115)
ln $ER_{IC/LC}$× USDRatio	0.00326***	0.00326***	-0.00464*	-0.00464*	0.00315***	0.00315***
	(0.000584)	(0.000584)	(0.00261)	(0.00261)	(0.000584)	(0.000584)
ln $MC_{i,year}$	0.00335***	0.00335***	0.00156	0.00156	0.00332***	0.00332***
	(0.000369)	(0.000369)	(0.00132)	(0.00132)	(0.000369)	(0.000369)
Constant	3.964***	3.964***	4.415***	4.415***	3.990***	3.990***
	(0.0169)	(0.0169)	(0.0318)	(0.0318)	(0.0171)	(0.0171)
Observations	6,368,197	6,368,197	406,322	406,322	6,368,197	6,368,197
Number of FPDI_id	754,476	754,476	63,279	63,279	754,476	754,476
invoicing currency	VCP	VCP	VCP_NOUSD	VCP_NOUSD	VCP	VCP
Overall R-squared	0.0205	0.441	0.00402	0.329	0.00579	0.442

Note: The dependent variable is the export unit-value price at the firm-product(HS9)-destination-invoice-month. The sample is restricted to exports with vehicle currency as invoicing currency. 'ln ER' is the natural log of the IC/LC exchange rate, indicating a depreciation of invoicing currency and/or an appreciation of local currency when it increases. These models are estimated by a fixed-effect model where the number of the cross-sections is shown in the row 'Number of FPDI_id.' Standard errors are in parenthesis. ***, **, * represent one, five, and ten percent significance level.

4.3.3 Vehicle currency invoicing with IC/LC exchange rate

The discussion on the results of Table 10 leads us to use exchange rate based on the invoicing currency against the local currency. In Table 10, we utilized invoicing currency exchange rates, JPY/IC in column (1) and USD/IC in column (4). However, the most relevant invoicing exchange rate is IC/LC for vehicle currency invoicing.

The estimated results for the IC/LC exchange rates for VCP are shown in Table 11. The first and second column show the invoicing currency ERPT and destination ERPT. The null hypothesis of invoicing currency ERPT being equal to zero cannot be rejected at any traditional statistical significance levels in column (1). This implies that the export prices invoiced in vehicle currency is rigid with respect to changes in the invoicing currency exchange rate to local

currency. Consequently, the destination ERPT is 100 percent in column (2).

As we discussed previously, the share of US dollars in vehicle currency exceeds 90 percent. As the US dollar being the dominant currency of the world, the results may be greatly driven by the US dollar invoicing and the price response of vehicle currency of non-US dollars may be different. We check this possibility by estimating VCP excluding US dollar invoicing against the IC/LC exchange rates. The results are shown in column (3) and (4). As expected, the invoicing ERPT is no longer statistically insignificant and the ERPT is about 19 percent in column (3), indicating that an depreciation of invoicing currency lowers the invoicing currency price. Note that the magnitude of column (3) is greater than those of JPY/LC or USD/LC in Table 4. We reaffirm the pricing-invoicing behavior that the invoicing currency price reponds the most to the invoicing currency exchange rates. The destination ERPT, reflecting the relationship described in equation (8) and (9), is 119 percent.

Finally, we test whether the dominant currency is different from other vehicle currencies in terms of exchange rate pass-throughs in column (5) and (6), by including the interaction term between the exchange rate and the dummy variable which takes one for US dollar invoicing and zero otherwise. The results indicate that the exchange rate pass-through are diminished by 18 percent if vehicle currency is the US dollar.

4.3.4 Discussion of the destination ERPT results

We have examined the invoice ERPT in sections 4.1 and 4.2 to measure the degree of rigidity at the level of invoicing currency price. The assumption of price rigidity, or sticky price, is crucial in many theoretical models to derive testable hypotheses for the responses of prices to exchange rates. We found that PCP is relatively rigid, and both LCP and VCP demonstrate substantial price responses, i.e., 30-40 percent.

In this subsection, we investigated how this difference at the invoicing currency level transmits to the ERPT measured at the destination countries. The findings are summarized in the following by invoicing strategy.

For the producer currency invoicing, the destination ERPT is complete, reflecting the rigidity of the invoicing price of Japanese yen invoicing. For this invoicing, for example, a ten percent depreciation of the Japanese yen lowers the price in terms of the destination currencies.

For the local currency invoicing, the destination ERPT is about 30-40 percent. The destination ERPT and invoicing currency ERPT must be equivalent in this case: The export price is not rigid at the invoicing currency and at the destination country. However, the price response to the exchange rate is milder for LCP than PCP.

The destination ERPT varies by corresponding exchange rates for vehicle currency invoicing. As pointed out in section 4.1, the variation of invoicing currency ERPT is substantial, ranging from -0.011 for USD/LC and -0.363 for JPY/IC, see Table 4. Partially reflecting that, the destination ERPT also varies by exchange rates. When measured with exchange rates involving local currency, namely JPY/LC and USD/LC, the destination ERPT is close to complete. The destination ERPT is -0.840 for JPY/LC and -0.979 for USD/LC. However, the destination ERPT is small for JPY/IC, JPY/USD, and USD/IC.

Official data for international trade provided by customs and central banks were denominated in the reporting country's currency or US dollars. Researchers were aware that the original prices were invoiced in various currencies, and the government agency converted them to the reporting country's currency by concurrent exchange rates. However, without any means to retrieve the original invoicing currency prices, the previous studies were only accessible to the publicly available prices, consisting of various prices originally invoiced in different currencies.

Once the original invoicing currency prices became available to researchers, as in this study, we can confirm our prior expectations that invoicing currency prices respond differently to exchange rate fluctuations. Now, we have accumulated evidence for each invoicing strategy of exchange rate pass-through by studies utilizing the granular customs data of countries adopting the open data policy. However, as we emphasize in this study, the previous studies only consider exchange rates among the producer's currency, local currency, and the dominant currency. Exchange rates were not yet prepared to take advantage of the availability of invoicing currency information.

This study tackled this issue and suggested using an exchange rate against the invoicing currency, as we coin the terms 'invoicing currency exchange rate' and 'invoicing currency ERPT'. It is natural to assume that an exporter pays more attention to the exchange rate with the currency its exports are invoiced. Excluding the cases of producer's currency and local currency because invoicing currency exchange rates are equal to the standard notions, invoicing currency exchange rates matter for VCP. Because VCP for many countries relies on the use of the US dollar, we should clearly distinguish the dominant currency effect from the vehicle currency effect.

5 Dynamic evolution of ERPT

One way to analyze the dynamic property of time series is to apply an ARMA-type regression model in which the explanatory variables include lagged dependent variables and independent variables. This approach is difficult to apply to the panel data with many missing observations. Alternatively, we suggest estimating the ERPT regressions for each of the differences between the current time t and the n-th previous period $t-n$. This approach is similar to the lifelong pass-through of Gopinath, Itskhoki, and Rigobon (2010), where the difference is taken between the last observed new price and the first price in the sample, see also Amiti, Itskhoki, and Konings (2022).[14]

$$\begin{aligned}\Delta_n lnP^c_{i,j,k,t} = \alpha + \beta^n_0 \Delta_n lnER_{i,j,k,t} + \beta^n_1 \Delta_n lnER_{i,j,k,t} \times \Delta_n ImportIntensity_{i,k,t} \\ + \beta^n_2 \Delta_n lnER_{i,j,k,t} \times \Delta_n MarketShare_{i,k,t} + \beta^n_3 \Delta_n MarginalCost_{i,t} \epsilon_{i,j,k,t}, \quad (10)\end{aligned}$$

where Δ_n is the mathematical operation that takes a difference between t and $t-n$. We choose n for 1, 2, 3, 4, 5, 6, 12, 24, 36, and 48 months. $P^c_{i,j,k,t}$ represents export price in invoicing currency,c, of firm i's product j to destination country k in month t. Exchange rates are JPY/IC, JPY/LC, JPY/USD, USD/IC, or USD/LC at monthly frequency.

The important assumption of the model in section 4 is that β^n are implicitly assumed to be invariant to n. The estimated results are summarized in Figures 4 through 7. All figures show the estimated results as the point estimates of β^n_0 with the two standard deviation bands. The estimated results of the full model for each regression are shown in the bottom panel of Appendix Tables B.1 through B.28. In the top panel of Appendix tables, the regression results without control variables are shown for comparison.

5.1 Producer Currency and Local Currency Pricing

We start with the producer and local currency pricing. They use the currencies of the sellers and buyers as the natural choices of invoicing currency. Figure 4 shows the dynamic ERPT for the Japanese yen invoicing and local currency invoicing for three alternative exchange rates.

[14] In their study, the price data is collected directly as a survey from US importers. Unlike the unit price, in which several factors generate noises to cause prices to remain constant unlikely in consecutive months, their import price data remain the same unless firms intend to change the price.

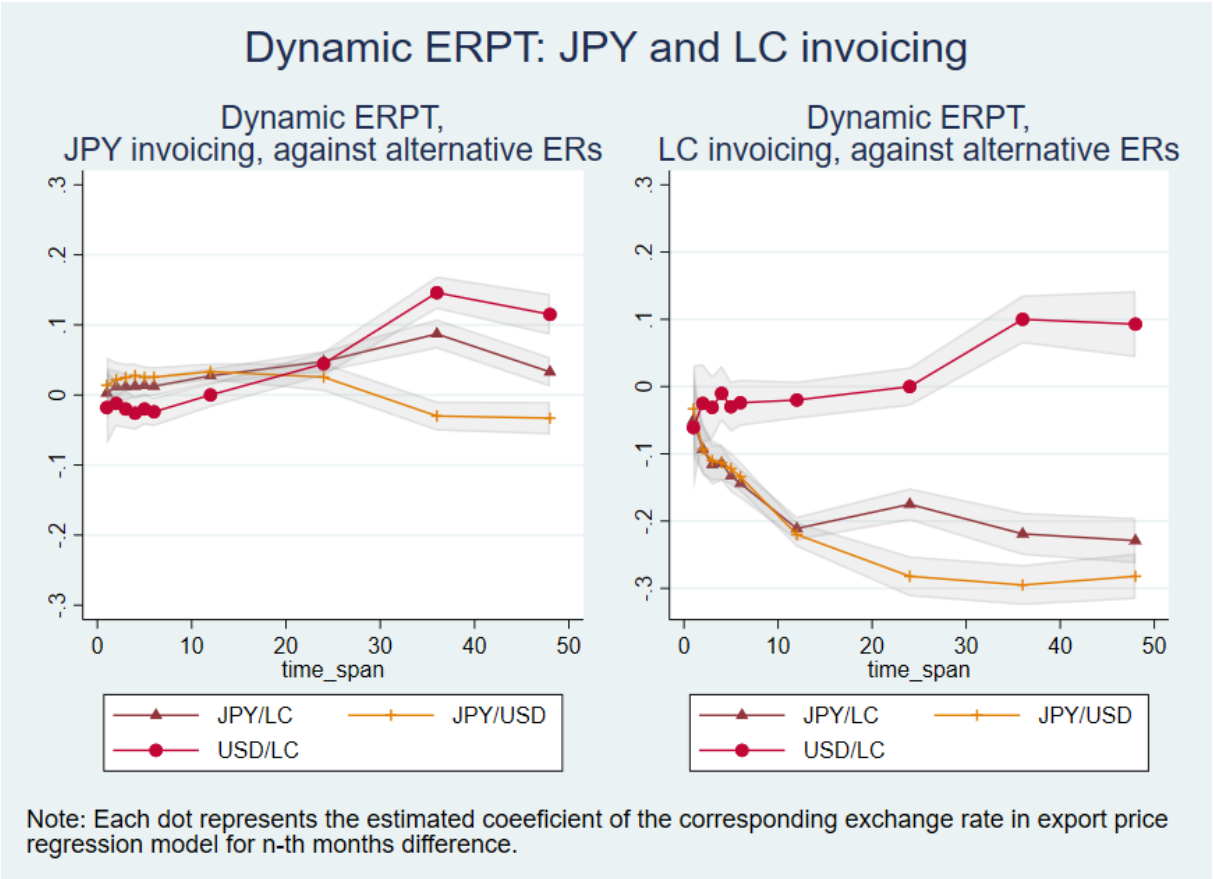

Figure 4: Dynamic ERPT: JPY and LC invoicing

PCP

For producer currency invoicing, it is clear from the left panel of Figure 4 that the prices are insensitive to all three exchange rates for up to two years. Only for changes in the 36 and 48 months, the Japanese yen invoiced prices show a small response to the exchange rates, i.e., about ten percent in absolute value. Compared to other invoicing strategies in the following subsections, it will be apparent that the response of the JPY invoicing price is the least. We reaffirmed with the nonlinear dynamic model that the invoice ERPT of PCP is close to zero, and therefore, the assumption of invoice price being rigid for the Japanese yen is acceptable.

LCP

For local currency invoicing on the right panel of Figure 4, invoice ERPT for USD/LC exchange rate is not statistically significant for two years. The irrelevance of the USD/LC role seemingly suggests that the exporters are concerned more with the autonomous movement of the Japanese yen.

For JPY/USD and JPY/LC, the dynamic ERPT for both exchange rates demonstrates almost the same magnitude and the same pattern for up to one year. Beyond the one-year difference, the JPY/USD ERPT is greater than that of the JPY/LC. It should be kept in one's mind when we interpret this result that the JPY/LC exchange rate is equivalent to the JPY/USD for the US and the US dollar-peg countries.

A depreciation of the Japanese yen lowers the prices of local currency invoicing products, whereas the response of the Japanese yen is negligible. Putting both of them in terms of the same currency prices, because of incomplete pass-through, a depreciation of the Japanese yen leads to lower local prices regardless of PCP or LCP. However, the degree of ERPT on local currencies in a four-year term is more than 90 for PCP and about 30 percent for LCP, respectively; see the discussion in section 4.3.

5.1.1 Decomposing LCP

This section is the dynamic version of section 4.2.2, in which local price invoicing is decomposed into LCP_{USD} and LCP_{NOUSD}. In this section, we further decompose LCP_{USD} for two groups of countries: (i) the US and (ii) the USD-peg countries with respect to the JPY/USD exchange rates, see Figure 5. The dynamic ERPT result for LCP is also plotted again for comparison. It shows that the invoicing ERPT dynamics for LCP are mainly driven by the local currency invoicing in the US. For the USD-peg countries, invoicing ERPT is only 15 percent at the peak in the 48-month difference.

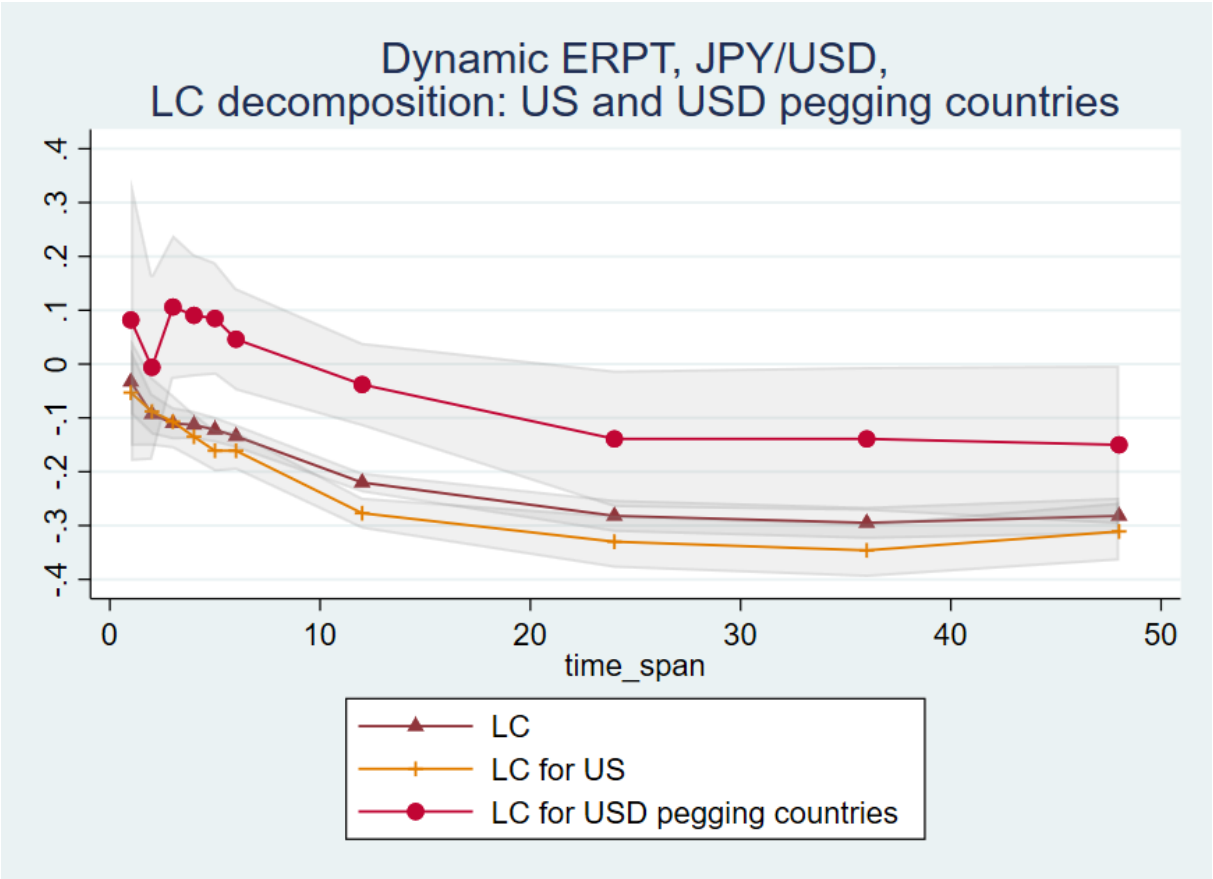

Figure 5: Dynamic ERPT: LC Decomposition

5.2 Vehicle Currency Pricing

Unlike PCP and LCP, the candidates for vehicle currencies are as many currencies as there are in the world. A vehicle currency can be any currency except the Japanese yen and the corresponding local currency. However, the evidence in the literature indicates that only a few currencies are chosen as the vehicle currency. The key currency is the US dollar, also known as the dominant currency in recent literature.

Reflecting the decomposition analysis of section 4.2.1, we estimated the dynamic invoicing ERPT for VCP, VCP_{USD}, and VCP_{NOUSD} with respect to five exchange rates, namely, JPY/LC, JPY/IC, JPY/USD, USD/LC, and USD/IC, see Figure 6.

First, the range of ERPT is the widest for vehicle currency invoicing in comparison to PCP or LCP in the preceding section. The magnitude of ERPT estimated in the constant β^n model in section 4 is modest because it reflects the average of dynamic ERPT estimated in this section. The largest ERPT are close to 50 percent in absolute values for VCP with JPY/IC, VCP and VCP_{USD} with USD/LC, VCP and VCP_{NOUSD} with USD/IC, and VCP and VCP_{USD} with JPY/USD.

Second, there is a stark difference between VCP and VCP_{NOUSD} with JPY/IC. A yen depreciation lowers the invoicing price of VCP, whereas it raises the invoicing price if the invoicing currency is not the US dollar. This seeming contradiction will disappear if we look at these results from the point of view of invoicing or local currency. For non-US dollar invoicing, exporters care less about the movements of the Japanese yen, and the invoicing currency is chosen so that it moves closely with the local currency. In fact, the VCP_{NOUSD} dynamics in the second panel are closer to those of dynamics with USD/LC in the fourth panel and with USD/IC in the fifth panel. On the other hand, the dynamics of VCP, over 90 percent of which is the US dollar invoicing, in the second panel follow closely to those dynamics of VCP against the JPY/USD in the third panel.

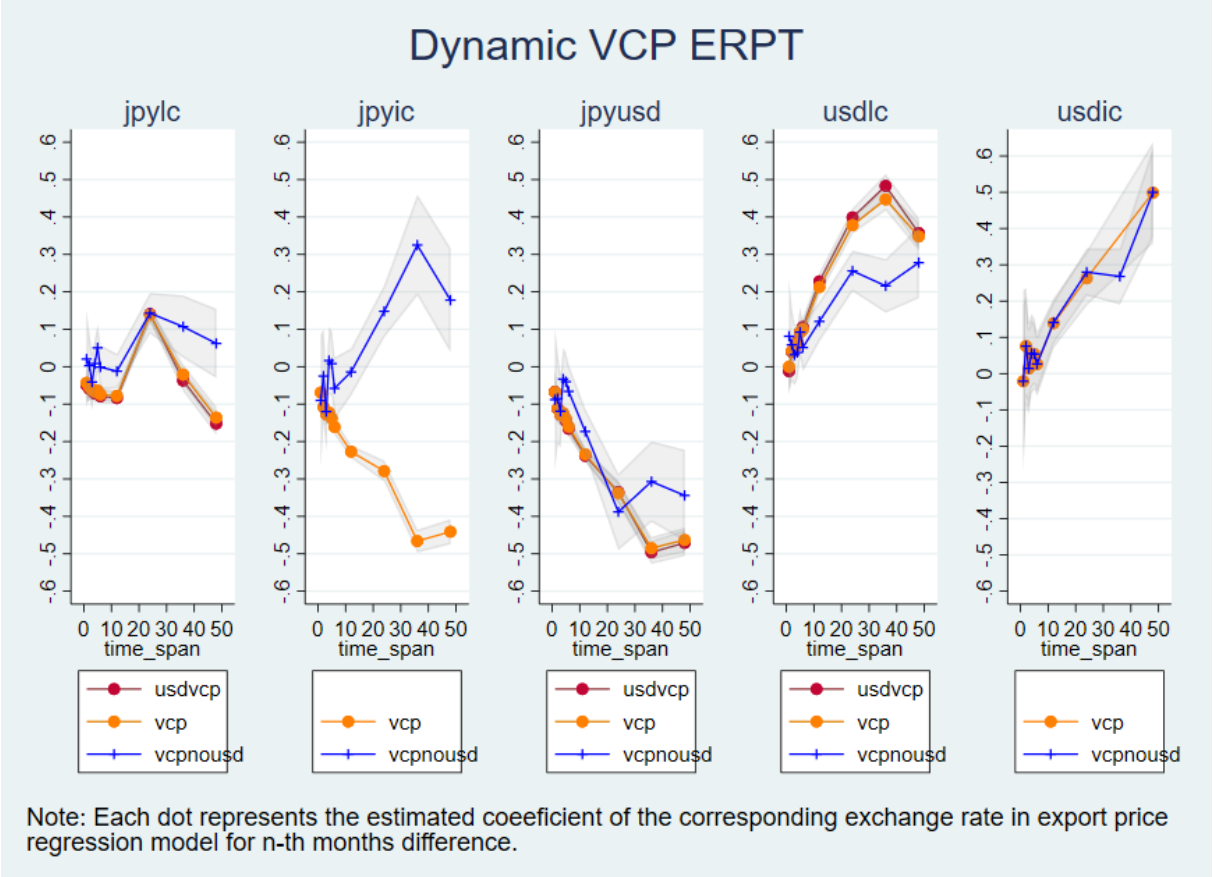

Figure 6: Dynamic VCP ERPT

5.3 Dominant Currency Pricing

The estimated results for the dominant currency pricing are shown in Figure 7. In the left panel, the invoicing currency price is regressed on three exchange rates, namely, JPY/LC, JPY/USD, and USD/LC.

First, as expected, the dominant currency price responds the least to changes in JPY/LC. The results are unreliable because the signs of response alter with the length of differences.

Second, the direction of dynamics is opposite between JPY/USD and USD/LC; however, their magnitude is similar, and the movements are symmetric. The invoicing ERPT reflects the valuation change of the dominant currency agaist other currencies.

On the right panel, we decompose the dominant currency invoicing by its roles. One is the local currency usage in the US and the US dollar-peg countries. The other is the vehicle currency usage in countries excluding the US and the US dollar-peg countries. Up to two years, their responses seem to be exact; however, the responses of vehicle currency invoicing become much larger, by more than 10 percent, after three years.

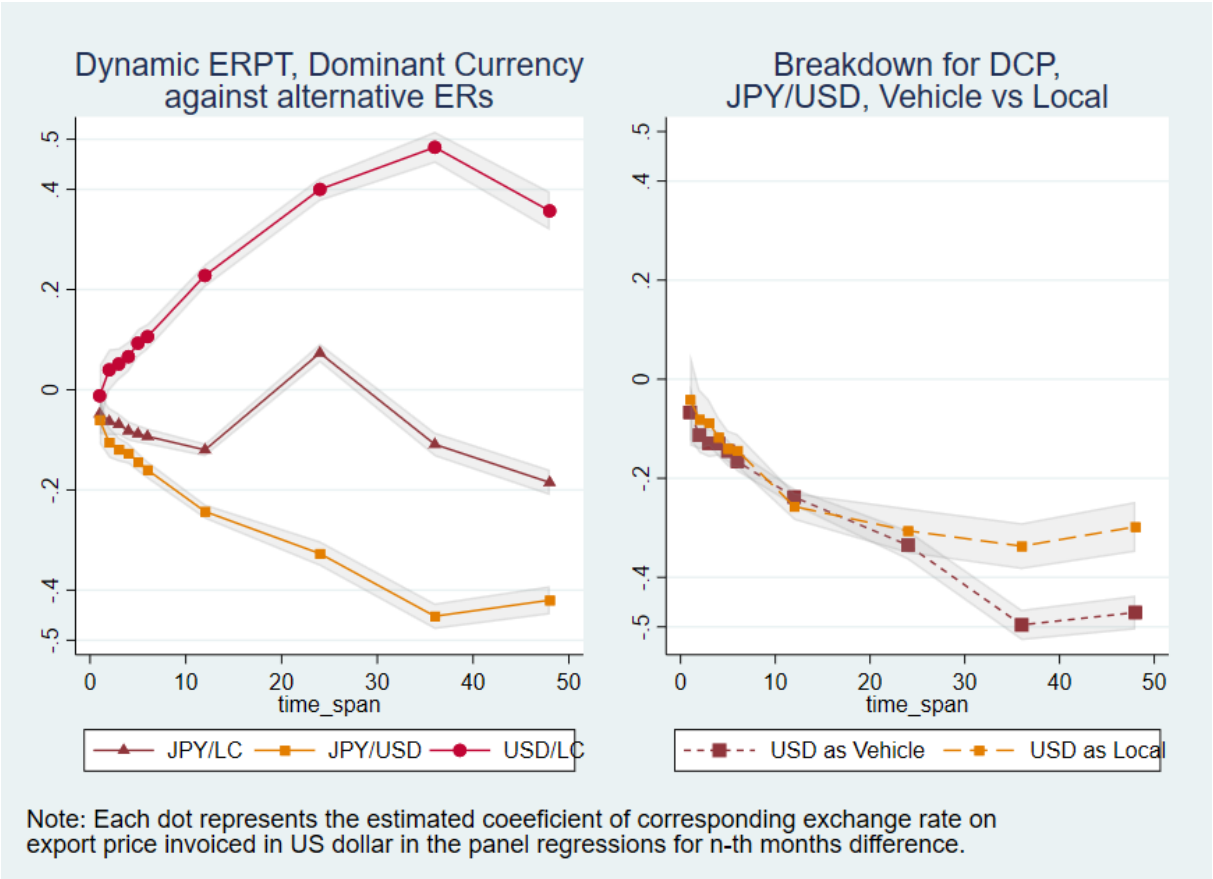

Figure 7: Dynamic DCP ERPT

6 Conclusion

We find that invoicing currency matters for the degree of exchange rates pass-through. More specifically, in this paper, we proposed two definitions of exchange rate pass-through: The invoicing ERPT is measured at the price of invoicing currency, and the destination ERPT is measured at the destination country's price.

First, Japanese exports invoiced in the Japanese yen demonstrate a small responsiveness to a change in the Japanese exchange rate. The invoicing ERPTs for this group start with zero elasticity and approach ten percent elasticity when the time span for measurement is extended to 48 months. Therefore, we conclude that producer currency invoicing price is sticky. Second, on the other hand, Japanese exports invoiced in destination currency or dominant/vehicle currency demonstrate substantial responses to exchange rate fluctuations. The ERPTs for these groups also start with zero but approach 40 percent elasticity at the 48-month difference.

We also confirm that an appropriate exchange rate must be carefully chosen for an exchange rate pass-through regression model. The exchange rate between the exporting country and the destination country must be chosen for exports invoiced in the destination country's currency. On the other hand, the exchange rate between the exporting country and the US must be chosen for those invoiced in US dollars, even for non-US countries. Otherwise, the estimated results will be biased toward finding a smaller response of export price to the exchange rate.

In terms of exchange rate pass-through at the destination country, we find that a choice of invoicing currency matters substantially. The ERPT is almost complete, i.e., 100 percent, for exports invoiced in the Japanese yen; however, the ERPT is only 30-40 percent for exports invoiced in local currency. This is consistent with the theoretical results in the literature of invoicing currency choice that exporters choose PCP if the desired ERPT is large and LCP, if the desired ERPT is small as in Amiti, Itskhoki, and Konings (2022). However, our results also indicate that prices are not fully rigid in the currency of invoicing as assumed in Gopinath, Boz, Casas, Díez, Gourinchas, and Plagborg-Møller (2020). The responses of export prices to exchange rate fluctuations widely differ by which invoicing strategy is used and by which exchange rate is considered.

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A Alternative specifications for the regression model in section 3

See the appendix tables A.1 through A.29 in the separate supplemental material.

B Estimation results for Dynamic ERPT

See the appendix tables B.1 through B.28 in the separate supplemental material.

C The lists of US dollar and Euro adopting countries

Table C.1: List of countries adopting US dollar

Country name	ISO code	US &Dollaraized	Dual	Dollar peg
American Samoa	AS	✓		
Anguilla	AI			✓
Antigua and Barbuda	AG			✓
Aruba, Kingdom of the Netherlands	AW			✓
Bahamas, The	BS			✓
Bahrain, Kingdom of	BH			✓
Barbados	BB			✓
Belize	BZ			✓
Bermuda	BM			✓
Bolivia	BO			✓
Bonaire, Sint Eustatius & Saba	BQ	✓		
The British Indian Ocean Territory	IO	✓		
Curacao and Sint Maarten	CW			✓
Curacao, Kingdom of the Netherlands	CW2			✓
Djibouti	DJ			✓
Dominica	DM			✓
Ecuador	EC	✓		✓
El Salvador	SV		✓	✓
Grenada	GD			✓
Guam	GU	✓		
Haiti	HT		✓	
Jordan	JO			✓
Lebanon	LB			✓
Marshall Islands	MH	✓		
Micronesia (Federated States of)	FM	✓		✓
Montserrat	MS			✓
Northern Mariana Islands	MP	✓		
Oman	OM			✓
Palau	PW	✓		✓
Panama	PA		✓	✓
Puerto Rico	PR	✓		
Qatar	QA			✓
Saudi Arabia	SA			✓
Sint Maarten, Kingdom of the Netherlands	SX			✓
St. Kitts and Nevis	KN			✓
St. Lucia	LC			✓
St. Vincent and the Grenadines	VC			✓
Timor-Leste	TL	✓		✓
Turks & Caicos Islands	TC	✓		
United Arab Emirates	AE			✓
United States Minor Outlying Islands	UM	✓		
United States of America	US	✓		
Virgin Islands (British)	VG	✓		
Virgin Islands (US)	VI	✓		

Table C.2: List of countries adopting Euro

Country name	ISO code	Euro & Euroization	Fran Regions	EUR peg
ALAND ISLANDS	AX	✓		
ANDORRA	AD	✓		
AUSTRIA	AT	✓		
BELGIUM	BE	✓		
BENIN	BJ		✓	✓
BURKINA FASO	BF		✓	✓
CAMEROON	CM		✓	✓
Central African Rep.	CF		✓	✓
CHAD	TD		✓	✓
Comoros, Union of the	KM			✓
Congo, Rep. of	CG		✓	✓
COTE D'IVOIRE	CI		✓	✓
CROATIA	HR	✓		
CYPRUS	CY	✓		
EQUATORIAL GUINEA	GQ		✓	✓
ESTONIA	EE	✓		
FINLAND	FI	✓		
FRANCE	FR	✓		
FRENCH GUIANA	GF	✓		
FRENCH POLYNESIA	PF		✓	✓
FRENCH SOUTHERN TERRITORIES	TF	✓		
GABON	GA		✓	✓
GERMANY	DE	✓		
GREECE	GR	✓		
GUADELOUPE	GP	✓		
GUINEA-BISSAU	GW		✓	✓
HOLY SEE (THE)	VA	✓		
IRELAND	IE	✓		
ITALY	IT	✓		
LATVIA	LV	✓		
LITHUANIA	LT	✓		
LUXEMBOURG	LU	✓		
MALI	ML		✓	✓
MALTA	MT	✓		
MARTINIQUE	MQ	✓		
MAYOTTE	YT	✓		
MONACO	MC	✓		
MONTENEGRO	ME	✓		✓
NETHERLANDS (THE)	NL	✓		
NEW CALEDONIA	NC		✓	✓
Niger	NE		✓	✓
PORTUGAL	PT	✓		
REUNION	RE	✓		
SAINT BARTHELEMY	BL	✓		
SAINT MARTIN (FRENCH PART)	MF	✓		
SAINT PIERRE AND MIQUELON	PM	✓		
SAN MARINO	SM	✓		✓
SENEGAL	SN		✓	✓
SLOVAKIA	SK	✓		
SLOVENIA	SI	✓		
SPAIN	ES	✓		
TOGO	TG		✓	✓
WALLIS AND FUTUNA	WF		✓	