Micro, Macro, and Strategic Forces in International Trade Invoicing

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Abstract

The use of different currencies in the invoicing of international trade transactions plays a major role in the international transmission of economic fluctuations. We use a new highly disaggregated dataset covering every import transaction for Canada for seven years to test the strengths of alternative explanations for choices of currencies in invoicing transactions. First, we uncover a novel link between transaction shipment size and invoicing, with larger transactions more likely to be invoiced in the importer's currency. We then argue that one potential explanation is that strategic forces, stemming from negotiations between importers and exporters, can be an important feature of determinants of invoice currency choice. Econometric analysis tests the importance of strategic considerations, as well as microeconomic and macroeconomic ones, showing how the strength of these explanations vary across exporters to Canada.

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1. Introduction

The currency in which exporters set the price of their goods – the so-called "invoicing" currency – has long been recognized as a central feature of international economics. Specifically, it determines who among the exporter or the customer is exposed to exchange rate risk, and whether exchange rate fluctuations lead to a switching of demand between goods produced in different countries. An extensive theoretical and empirical literature has identified complementary drivers of invoicing. A first category of drivers reflects microeconomic and structural features of the industry in question, such as the price-sensitivity of demand and exporters' market shares. A second category of drivers reflects macroeconomic considerations, such as the need of producers to hedge against unforeseen movements in marginal costs, for instance due to exchange rate volatility or the presence of imported inputs priced in foreign currencies.[2] In addition to choosing among the currencies of the exporter or the importer, the literature has also explored the use of "vehicle" currencies that are neither the exporter's nor the customer's.[3]

In this paper we address two important empirical limitations from which the existing literature suffers. First, and importantly, existing studies that attempt to explain invoice currency selection rely mainly on aggregate data, and thus cannot capture any impact of individual importer and exporter's characteristics on invoicing.[4] For instance, in a given country the firms in an industry where demand is very sensitive to prices have an incentive to choose an invoicing currency that is the same as their competitors, where firms whose products are more differentiated are less subject to this "coalescing" effect (Goldberg and Tille 2008). The existence of similar degrees of heterogeneity in invoicing data would improve our ability to test different theories. Second, as we develop further below, existing studies focus exclusively on the exporter's decision making, without taking into account the possibility of strategic interactions between exporters and importers. Recognizing the possibility of strategic interactions opens the

[2] A non-exhaustive list of recent contributions includes Bacchetta and van Wincoop (2005), Devereux, Engel, and Storgaard (2004), Friberg (1998), Novy (2006), Goldberg and Tille (2008).
[3] Goldberg and Tille (2008, 2009).
[4] An exception is Gopinath, Itskhoki and Rigobon (2010) who use BLS data to study the frequency of price adjustment in U.S. imports and the relationship to currency of invoicing. Donnenfeld and Haug (2003) provide an early look at a subsample of Canadian data for an earlier period. Goldberg and Tille (2008) survey other prior research.

door to a range of additional driving forces in any empirical analysis of invoice currency selection.

We address the first limitation by using a new highly disaggregated dataset for Canadian imports. Our data cover all Canadian import transactions between February 2002 and February 2009 (45 million observations), with information on the disaggregated industry, the invoicing currency, and the country of origin for each transaction. Within this data, imports from the United States account for a little more than half of total imports and are broadly invoiced in U.S. dollars, while imports from other countries have more substantial use of other currencies. The Canadian dollar, a local currency pricing (LCP) option, is present both in U.S. and other country exports to Canada. An interesting new finding is that the local currency is used more extensively for larger shipments than smaller ones, so that LCP will be more apparent in international trade measured by value compared with by actual transaction counts. This link between shipment size and invoicing, which we are the first to document to our knowledge, is observed across all industries. Another interesting finding is that invoicing currency patterns differ with the concentration of importers in the industry. Industries that are dominated by a few concentrated importers make more use of local currency pricing in import transactions.

The existing theoretical literature is ill-equipped to account for these links between transaction size, importer concentration, and invoicing. Existing contributions mostly treat invoicing choice as decided solely by the exporter.[5] The only role of the customer is to provide the exporter with the downward-sloping demand that it takes into account. A range of theoretical studies has established the determinants of currency choice within this setting (Devereux et al. 2004, Bacchetta and van Wincoop 2005 and Goldberg and Tille 2008). The assumption of unilateral invoicing is, however, at odds with the evidence provided by Friberg and Wilander (2008) from a survey of Swedish exporters, and more recently by Ito et al. (2010) based on surveys of Japanese exporters. In an accompanying paper,[6] we address this theoretical limitation by developing a model of invoicing through a bargaining game between the exporter and the

[5] An exception is Viane and De Vries (1992).

[6] The working paper version of this paper included a section with a sample theoretical model of negotiation between exporters and importers. In response to feedback received on the working paper version, we have further expanded the econometric work and data analysis in the current paper, and further expanded the theoretical exposition in a separate paper, Goldberg and Tille (2011).

customer.[7] Two main results emerge. First, a bargaining allocation is likely to make more use of the destination currency than the unilateral invoicing choice by the exporter. Intuitively, the exporter has an incentive to use its own currency to insulate its unit revenue from exchange rate movements, whereas the customer prefers to stabilize the price stabilized in her own currency. Second, the use of the customer's currency is more pronounced for large sales and in the context of more concentrated importer structures. This reflects the fact that the exporter's alternative option is worse when negotiating with a large customer, leading it to be more accommodating to the use of destination currency. Interestingly, the impact of size on invoicing is more pronounced when the exporter has a large bargaining power in splitting the surplus. Intuitively, size represents an alternative source of bargaining strength for the customer, which she needs to rely on only if her direct bargaining power is limited.

Our tests of the importance of the macroeconomic, microeconomic, and strategic drivers of invoicing through formal econometric exercises matched to a range of the alternative hypotheses (and variable interactions) implied by theory. The econometrics takes the form of multinominal logit (MNL) specifications applied to the individual transactions in Canadian imports. Variables that reflect industry features include proxies for whether demand is price-sensitive, the market share of imports from that country in the specific industry, and the reliance on commodity inputs in production. Macroeconomic considerations in currency selection include exchange rate volatility, dummy variables that capture the ability of various currencies to hedge aggregate shocks to marginal costs, transaction costs in foreign exchange markets, and the exchange rate regime of the country of origin. We introduce strategic considerations through variables that reflect transaction size, the concentration of importers in industries, and the structure of foreign or government ownership in industries to capture potential related party effects or constraints on pricing behavior that might be associated with government sales. Throughout our empirical analysis we distinguish between Canadian imports from the United States and its' imports from other countries.

Our analysis generates three broad sets of results. First, we confirm via this more detailed analysis the roles of microeconomic and macroeconomic determinants of invoicing choices: exporters in industries where demand is more price-sensitive tend to use the U.S. dollar or and

[7] Gopinath and Itskhoki (2009) provide an alternative approach to pricing, pass-through and by extension to invoice currency choice by using a dynamic menu-cost model and a variable markup channel generate significant variation in the frequency of price adjustment by exporters.

also the Canadian dollar (for some non-U.S. exporters) relatively more than exporters in other industries; exporters from countries with a volatile exchange rate use their own currency to a lesser degree; exporters (from outside the U.S.) have greater use of currencies that offer a hedge against movements in production cost; exporters in industries with greater use of commodities and energy as inputs are more likely to invoice in U.S. dollars, as these inputs are predominantly invoiced in dollars; finally, there is a strong tendency for exporters in countries with a peg to the euro to make more use of producer currency pricing.

Second, strategic interactions in international trade matter for invoice currency selection. A more standard component of this motive is that exporters in a country with a dominant share of imports in a particular industry tend to use their own currency more. Our newer insights are that large shipments are more likely to be invoiced in Canadian dollars than smaller ones, especially when the exporter has a high market share. When the structure of importers is more concentrated, the role of transaction size is reinforced and greater use of LCP and less PCP occurs.

Third, the relative importance of the micro, macro and strategic variables is not uniform across exporters. For exporters from the United States, the strategic variables explain most of the deviation from dollar pricing observed. For exporters from outside of the United States, macroeconomic variables play a large role, and exchange rate regime choice is particularly important.

The rest of this paper is structured as follows. Section 2 presents a non-technical review of the theoretical determinants of invoicing, including a broad discussion of a bargaining model. In section 3 we present the new invoicing data set and document some features of the invoice currencies used across regions, over time, by currency peg regime, and in relation to transaction shipment size. We also introduce the range of measures used in the econometric analysis and present some stylized patterns of invoicing choice depending on these measures. The formal econometric analysis is undertaken in Section 4, where decisions on invoicing export transaction are explored using a multinomial logit approach over the options of producer currency pricing, local currency pricing, and vehicle currency pricing. Section 4 also provides a range of results on the effects on the likelihood of currency use in invoicing conditional on values of the strategic variables. Section 5 concludes with a discussion of the broader implications of our findings.

2. The determinants of invoicing: theory

This section reviews the various determinants of invoicing from a theoretical perspective. Instead of developing a formal model, we first review considerations linked to the industry structure and macroeconomic conditions identified in earlier studies. We then focus on a framework where invoicing is set as the result of bargaining between the importer and the exporter. Such a framework is in line with the empirical evidence of Friberg and Wilander (2008) and Ito et al. (2010). We do not provide a detailed model[8] and instead show how the dominant position of a counterparty in an international trade transaction can tilt the choice of invoice currency. In particular, there is a non-linear relation between importer and exporter size and invoicing. Throughout the section, we summarize the various determinants in a brief series of testable implications that serve as the basis for the ensuing econometric analysis on transaction level data for imports.

2.1 Market structure and macroeconomic conditions

The literature has identified several elements of the particular structure of markets and industries that impact the invoicing decision. Goldberg and Tille (2008) stress a "coalescing effect" that is most pronounced when competition is higher and marginal costs are sensitive to output. Intuitively, firms set prices in proportion to marginal costs (actual or expected). Firms that use a technology with decreasing returns to scale have an incentive to keep their own price in line with that of their competitors in order to limit costly fluctuations in output. This is particularly important in an industry where the limited differentiation of goods makes demand sensitive to prices. Firms then coalesce around a dominant invoicing currency.

> *Implication 1:* Industries with more homogenous goods are more prone to a coalescing of invoicing around a single currency.

While the coalescing effect points to the presence of a central currency for invoicing a particular type of export, it does not indicate which particular currency should play this role. This specific selection instead reflects a broad range of other determinants.

The first determinant is the relative size of the exporting and importing countries. Firms in any country have some preference for invoicing in their own currency to reduce their

[8] Goldberg and Tille (2010) provide a more extensive exposition of the model.

exchange rate exposure. Invoicing is then tilted towards the currency of the country which accounts for a dominant share of the market (Bacchetta and van Wincoop 2005). This can be the importer's currency in the case of small foreign exporters facing competition from many domestic firms, or the exporter's currency of a country with a dominant share. The size effect is reinforced when firms serving many markets only invoice in a handful of prominent currencies to save on the cost of computing prices in currencies with limited use.

> *Implication 2:* The currency of a country with a dominant market share in the industry is more likely to emerge as the dominant invoicing currency.

The next determinant of a currency's use in invoicing international trade is its ability to stabilize exporters' margin by hedging production costs. This can reflect the use of specific currencies in invoicing of production inputs (Novy 2006). If a large share of exporters' costs are denominated in U.S. dollars, due for instance to the use of oil and other exchange traded commodities, then invoicing exports in dollars also provides a natural hedge as unit revenue and cost move in tandem. Even when all inputs are in the exporter's currency, as wages are, an invoicing currency other that the exporter's provides a hedging benefit if it strengthens vis-a-vis the exporter's currency in states where costs are high.

> *Implication 3:* Invoicing is tilted towards currencies that provide a profit hedge by appreciating against the exporter currency when the exporter's costs are high. Exporters that use imported inputs invoiced in a specific currency get a hedging benefit by invoicing in that currency.

Macroeconomic volatility is the third determinant of a currency' usefulness in invoicing. The currency of a country with volatile macroeconomic conditions is unappealing for the invoicing of international trade, as its value against other currencies experiences large fluctuations (Devereux et al. 2004). These fluctuations are more limited when the exporter's currency is pegged to a currency with broad adoption, such as the euro or the dollar. The exporter's currency and the reference one then have similar volatility properties as invoicing currencies. However, invoicing in the reference currency is likely to be a better option as transaction costs in that currency are likely to be smaller.

Implication 4: Exporters in a country with a more volatile exchange rate relative to the destination country are less likely to use their own currency for invoicing. Exporters from countries whose currency is pegged to a major currency are more likely to use the anchor currency, and less likely to use their own.

Another determinant is the cost of hedging exchange rate fluctuations. An exporter who can hedge exchange rate movements against the importer's currency at low cost is more likely to accept invoicing in the importer's currency. Ito et al. (2010) find supporting evidence, as Japanese exporters are more likely to invoice in the destination currency when the cost of hedging the yen against that currency through a forward contract is low.

Implication 5: Exporters from a country with a currency that has low hedging costs are more likely to use another currency than their own in their invoicing decision.

Finally, linkages between exporters and importers, with one being the affiliate of the other for instance, matter for invoicing. For example, a large fraction of international trade takes within multinational companies, such intra-firm transactions account for 40 percent of U.S. imports (Hellerstein and Marsh, 2006). The choice of invoicing currency then simply determines which part of the entity bears the exchange rate risk in its profits, with no impact of the overall profits of the company. Concentrating risk at the parent company can be beneficial as it nets out offsetting exposures by different affiliates, and allows for the management of exchange rate risk to be done by a single entity instead of being dispersed among affiliates. Ito et al. (2010) document such a transfer of exchange rate risk to the headquarters among Japanese firms. Exports to affiliates are then more likely to be invoiced in the destination currency than sales to importers that have no organizational link to the exporter.

Implication 6: Imports in an industry with a larger share of intra-firm transactions are more likely to be invoiced in the importer's currency.

2.2 Strategic considerations

The determinants of invoicing outlined above were derived under the assumption that the exporters unilaterally choose the currency in which a transaction is invoiced. Yet, this standard assumption is not consistent with some recent survey evidence. Friberg and Wilander (2008)

show that for the majority of Swedish exporters the invoicing currency is set through a bargaining with the importer. The invoicing choice is then also affected by the importer's interests, and reflects the relative bargaining power of the two parties. Moreover, while we emphasize the potential for the importing counterpart to matter for the invoicing currency choice, in other areas of international trade research there also is an increasing emphasis on the characteristics of individual participants in the market, both on the exporter and importer sides (Blum et al. 2010).

In order to establish the main implications of strategic considerations for invoicing, we start with a general description of the interaction between the two parties. Consider the bargaining between an importer indexed by *i* and an exporter indexed by *e*. Both the importer and the exporter value profits using a CRRA function, possibly with different coefficients of risk aversion.

The expected surplus that the importer gets from a successful bargain is:

$$Sur^{i} = \frac{1}{1-\gamma^{i}} E\left(\Pi^{i(e)} + \Pi^{i(other)}\right)^{1-\gamma^{i}} - \frac{1}{1-\gamma^{i}} E\left(\Pi^{i(other)}\right)^{1-\gamma^{i}}$$

where $\gamma^{i} > 1$ is the coefficient of risk aversion, $\Pi^{i(other)}$ are the profits that the importer makes from dealing with all exporters other than *e*, *E* is the expectation operator, and $\Pi^{i(e)}$ are the profits the importer makes by dealing with *e*. Similarly, the expected surplus for the exporter is:

$$Sur^{e} = \frac{1}{1-\gamma^{e}} E\left(\Pi^{e(i)} + \Pi^{e(other)}\right)^{1-\gamma^{e}} - \frac{1}{1-\gamma^{e}} E\left(\Pi^{e(other)}\right)^{1-\gamma^{e}}$$

where $\gamma^{e} > 1$ is the coefficient of risk aversion, $\Pi^{e(other)}$ are the profits that the export makes from dealing with all importers other that *i*, and $\Pi^{e(i)}$ are the profits she makes by dealing with *i*.

The invoicing decision consists of picking the sensitivity of the ex-post price paid by the importer to the exchange rate.[9] We denote the degree of exchange rate pass-through β, with the case of $\beta = 1$ consisting of exchange rate risk borne solely by the importer (full exchange rate pass through or producer currency pricing). The exchange rate pass-through is chosen to maximize:

$$\delta^{i} \ln\left(Sur^{i}\right) + \left(1-\delta^{i}\right)\ln\left(Sur^{e}\right)$$

[9] As shown by Engel (2006), the determinants of exchange rate pass-through under flexible prices are the same as the determinants of invoicing currency under sticky prices.

where δ^i is the bargaining weight of the importer.

The first order condition for the invoicing is:

$$\chi^i E\left[\frac{\Pi^i}{E\Pi^i}\varepsilon^{i(e)}\right]+\left(1-\chi^i\right)E\left[\frac{\Pi^e}{E\Pi^e}\varepsilon^{e(i)}\right] \tag{1}$$

where $\varepsilon^{i(e)}$ and $\varepsilon^{e(i)}$ are the elasticity of profits from the match with respect to the exchange rate pass-through:

$$\varepsilon^{i(e)}=\frac{\partial\Pi^{i(e)}}{\partial\beta}\frac{\beta}{\Pi^{i(e)}} \qquad\qquad \varepsilon^{e(i)}=\frac{\partial\Pi^{e(i)}}{\partial\beta}\frac{\beta}{\Pi^{e(i)}}$$

Π^i and Π^e are the importer's and exporter's profits from dealing with all their counterparts. χ^i is the effective bargaining weight of the importer, which is detailed below.

Equation (1) shows that the invoicing balances the needs of importers and exporters. If the exporter sets the invoicing currency unilaterally she brings the elasticity of her expected profits with respect to the invoicing share to zero. A realistic assumption is that the exporter prefers a higher exchange rate pass through than the importer, to pass exchange rate risk on to the importer. The optimal pass-through in (1) falls between the unilateral choices of the importer and the exporter, so:

$$E\left[\frac{\Pi^i}{E\Pi^i}\varepsilon^{i(e)}\right]<0 \qquad\qquad E\left[\frac{\Pi^e}{E\Pi^e}\varepsilon^{e(i)}\right]>0$$

The importer's expected payoff would be higher with a lower pass through than the chosen one, with the opposite being true for the exporter.

A measure of exporter *e* size is the share of the importer's profits that stem from working with that particular exporter: $sh^e=\Pi^{i(e)}/\Pi^i$. Similarly, the importer's size is measured by the share of the exporter's profits that are linked to him: $sh^i=\Pi^{e(i)}/\Pi^e$. $g(\cdot)$ is a function of the share that is positive and decreasing:

$$g\left(sh^e\right)=\frac{sh^e}{\left(1-sh^e\right)^{1-\gamma^i}-1} \qquad\qquad g\left(sh^i\right)=\frac{sh^i}{\left(1-sh^i\right)^{1-\gamma^e}-1}$$

$$g>0,\ g'<0,\ g(1)=0$$

The effective bargaining weight in (1) is:

$$\chi^i = \frac{g\left(sh^e\right)\left(\gamma^i - 1\right)\delta^i}{g\left(sh^e\right)\left(\gamma^i - 1\right)\delta^i + g\left(sh^i\right)\left(\gamma^e - 1\right)\left(1 - \delta^i\right)} \tag{2}$$

The effective weight χ^i is larger when the formal weight δ^i is large or when the importer is more risk averse (γ^i is larger). It is also increasing with the importer's size sh^i, and decreasing with the exporter's size sh^e. Intuitively, the role of size reflects the concave valuation of profits. An importer is more concerned about failing to reach an agreement with an exporter that is a major supplier than with a small exporter, as its marginal utility of income should the agreement fail would be very high. The role of concavity can be seen by setting γ^i and γ^e to zero. The function *g* is then equal to one, and size disappears from the bargaining solution.

As an example of the potential importance of bargaining for invoicing outcomes, the impact of size on the effective importer's weight (2) is shown in Figure 1. For this illustration, we assume that the exporter is less risk averse than the importer by setting γ^i = 3 and γ^e = 2. Both panels show the value of the effective weight χ^i, with the top panel illustrating the impact of importer's size sh^i, for various values of the exporter's size sh^e, and the bottom panel showing the impact of exporter's size. The figure clearly shows that the importer is in a stronger position when it is large or the exporter is small.

The sensitivity of the importer's effective weight to sizes is quite contrasted. The top panel shows that increasing the importer's size from low values only has a moderate impact on its bargaining weight, especially when the exporter is large. Intuitively, the importer already has a substantial weight when the exporter is small, so increasing importer's size adds little to the weight. Similarly, increasing the size of a small importer has little impact when the exporter has a dominant position. In addition, the sensitivity to importer size is increasing with size itself, as shown by the convexity of the curves. Increasing the importer's size only has a large impact when both the importer and the exporter are large. This is because a small importer is dominated by the exporter, and the importer needs to reach a critical size to meaningfully counterbalance this dominance. The bottom panel similarly shows that a higher exporter's share substantially reduces the weight of the importer only when both the importer and the exporter are large. When the importer is small, the exporter already dominates the bargaining and being bigger only adds

little to her power. While both panels show that the marginal effect of size is increasing with size, this is more pronounced for the importer size (top panel).

When the importer has a stronger preference for invoicing in her currency than the exporter, invoicing is tilted towards the importer's currency for shipments to large importers. This is especially the case when the exporter is also large. While we do not have direct data on sh^i and sh^e, we can proxy the latter by the market share of a specific country of origin within a specific industry. The sensitivity of invoicing with respect to the importer share is then larger for exports coming from countries with a dominant market share in the industry, and especially so for large shipments indicating a large importer.

> *Implication 7:* Assuming that shipment size indicates a large importer, large shipments are more likely to be invoiced in the importer's currency within an industry. This size effect is stronger vis-à-vis exporters from a country with a dominant market share in the industry. The marginal size effect increases with shipment size, especially for transactions involving exporters from a country with a dominant market share.

A dominant position by a specific importer, or exporter, is more likely in a market with a high concentration of firms, instead of a large number of small firms. For instance, imports to a market dominated by a few importers are more likely to be invoiced in the importer's currency, reflecting the lack of alternative buyers. Gopinath and Itskhoki (2010) find some evidence for this link in U.S. imports, as exchange rate pass-through is lower in markets with a high concentration of importers, even though the statistical significance of the effect is limited.

Importer concentration also affects the size effect. In markets with high importer's concentration, large transactions are most likely to take place with one of the few large importers with the most power, who are able to tilt the invoicing towards the importer's currency. By contrast, a large transaction in a market with limited importer concentration can take place with one of many importers that, while relatively big in the market, do not have a substantially dominant position. Their ability to tilt the invoicing in their favor is thus relatively limited.

> *Implication 8:* Invoicing in the importer's currency is larger in markets with a high concentration of importers. The transaction size effect is more pronounced in markets with a high concentration of importers.

When invoicing is set through bargaining, the importer's perspective is taken into account in addition to the exporter's perspective. This introduces another channel through which industry characteristics matter. Consider for instance the degree of substitutability between different exporter's brands as perceived by the importer. If the importer can easily switch between brands, failing to reach an agreement with a particular exporter carries little cost. The importer is then in a stronger bargaining position.

Implication 9: Transactions in industries with differentiated goods are more likely to be invoiced in the importer's currency.

3. The invoicing of Canadian imports

We undertake a rich assessment of the various drivers of invoicing by using a novel detailed database of Canadian imports. The data cover 45 million individual import transactions, spanning all imports from 2002 to 2009.

The data are based the records of individual import transactions by the Canada Border Services Agency (CBSA). Each transaction is accompanied by a customs invoice with detailed information on the contents' exporting country of origin, currency of settlement, industry code (up to HS10), quantity, and value of transaction.[10] The original dataset, obtained from Statistics Canada (StatCan) in conjunction with CBSA, contains the full roster of 44.5 million transactions spanning the period from February 2002 through February 2009. We apply filters to the database,[11] bringing the sample to 41.9 million observations. For tractability, we focus on imports from 47 countries of origin that account for 95.9 percent of imports by count, and 97.1 by value.

3.1 Sectoral and geographical breakdown of Canadian imports

In this section, we decompose Canadian import transactions into sixteen broad product categories and six regions of origin in order to gain insights into their sectoral and geographical

[10] The Customs Coding form can be referenced at http://www.cbsa-asfc.gc.ca/publications/forms-formulaires/b3-3.pdf

[11] Transactions are dropped if there is missing information for invoicing currency, industry code, country of origin, or value. We drop the months of February and March 2002 because of incomplete sampling. We drop Canadian imports that record Canada as the country of origin, since these imports are most likely prior Canadian exports being returned to producers, or are goods re-imported for the purpose of repairs.

concentrations. We undertake the exercise both in terms of *counts* of transactions (counting each transaction as one observation, Table 1) and in terms of the *value* of transactions (weighting transaction by their value in Canadian dollar, Table 2).[12]

Three features emerge from this sectoral and geographical breakdown. First, while the United States is, unsurprisingly, the main country of origin (59 percent of transactions by count and 57 percent by value), a substantial share of imports come from other countries. The next-largest source regions are Asia (including East and South East Asia and China, 14 percent by count and 13 percent by value) and the eurozone (12 percent by count and 9 percent by value).

Second, industry concentration of imports is lower than the geographical concentration. The sectoral breakdown also shows more contrast between shares by counts and shares by value. The dominant import industries are machinery and equipment (23 percent by count and 26 percent by value), metal (13 percent by count, but only 7 percent by value), and transportation (only 3 percent by count, but 21 percent by value reflecting the high value added of this industry).

Third, the presence of particular countries or regions in Canadian imports varies by industry. The United States share ranges from a low of 40 percent for footwear/headgear (by count, 5 percent by value) to a high of 84 percent for mineral products (by count) and 77 percent for plastics/rubber (by value). Eurozone countries are most prevalent in chemicals, leather/furs/hides, and foodstuffs. While Asia accounts for only 14 percent of total imports by count, its role is concentrated in specific sectors such as textiles (24 percent by count and 45 percent by value), footwear/headgear (23 percent by count and 77 percent by value) and leather/furs/hides (22 percent by count and 59 percent by value).

3.2 A broad assessment of invoicing

We now turn to the use of different currencies in the invoicing of overall Canadian imports. We first consider the shares of the U.S. dollar (USD), Canadian dollar (CAD), euro (EUR), and other currencies in the invoicing of imports. These are shown in Figure 2, both by transaction count (left panel) and transaction value (right panel). Three striking points emerge. First, the USD is the dominant currency, being used in over 85 percent of Canadian import

[12] Appendix Table 1 gives the share of the 47 countries in terms of counts and value.

invoices between 2002 and 2009 by count. By contrast, the CAD, EUR, and other currencies each are used in less than 5 percent of imports.

Second, the pattern of currency use is very different in terms of transactions values than in terms of counts. While the USD remains the dominant invoicing currency in terms of value, its only accounts for 75 percent of imports. This is mirrored entirely by the share of the CAD which reached between 20 and 25 percent of imports by value, well above its share by counts. The shares of the EUR and other currencies are even smaller by values than by counts. The larger role of the CAD in terms of value terms indicates that its use is concentrated among large value transactions. Finally, the shares of the various currencies have been quite stable over time.

A complementary presentation of invoicing patterns considers whether invoicing is done in the exporter's currency – "producer currency pricing" (PCP), in the destination currency – "local currency pricing" (LCP) here the CAD, or in a third "vehicle currency pricing" (VCP). The shares of PCP are shown across various countries or regions of origin in Figure 3 in terms of counts (left panel) and value (right panel). Two points emerge. First the United States is an outlier with a dominant use of the PCP option, both in terms of counts and currency. Second, the use of PCP by exporters in the eurozone, the United Kingdom, and Japan, is concentrated in transaction with relatively low values, as shown by higher PCP shares by counts than by values.

Local currency pricing is the least prevalent pricing practice by count, regardless of whether transactions are for exports from the United States or other regions. For non-U.S. exporter transactions, VCP is the dominant option, with the USD the dominant selection. Exporters from countries which are pegged to the dollar are significantly more likely to use dollars in invoicing compared with countries that are not pegged at all (either to the dollar or the euro). A further examination of the data shows that the euro is mainly used on invoices for countries in the geographic proximity of the euro area: the euro share in VCP is 23 percent for Eastern Europe and the FSU, 19 percent for Switzerland, 14 percent for Scandinavia, and 9 percent for Britain. In terms of transaction values, PCP and the role of PCP shrink to the benefit of LCP reflecting the more prominent use of the CAD in large transactions than in small ones. The change from PCP to LCP is strongest for non-U.S. exporters of larger value transactions.

One of the main novel findings is that the invoicing choice varies between transactions of high and low values in a given industry. This is illustrated in Table 3, which shows the use of the LCP option (i.e. the Canadian dollar) across sixteen industries. Given the prominent role of the

USD in trade with the United States, we distinguish between imports from the United States (left panel) and from all other countries (right panel). In each panel the first two columns show the median transaction size measured in Canadian dollars. We contrast transactions in the lower 95th percentile with transactions in the top 5th percentile in terms of size, which shows that the size difference between the two categories is substantial. The invoicing is illustrated in the last three columns of each panel. The first shows the fractions of transactions (by count) in the lower 95th percentile invoiced in Canadian dollar, while the second column shows this fraction for transactions in the top 5th percentile. The ratio between the two invoicing shares is given in the third column.

The Canadian dollar is clearly more intensively used for the larger transactions than for the smaller ones. This is the case for all industries, with substantial heterogeneity, as well as for imports from the United States and from other countries. The magnitude of the difference is sizeable. The use of the Canadian dollar in large transactions is at least twice as large for most industries, and much larger is many cases with the unweighted ratio across industries being around three. There are only a handful of industries where the ratio is between 1.3 and 2.0, and no instance of it being smaller than one. The use of the Canadian dollar is four to five times as big for larger transactions as for smaller ones in foodstuffs, wood products and transportation. Interestingly, this heterogeneity is similar for imports from the United States and from other countries, with the correlation of the invoicing ratio for imports from the United States (last column of the left panel) and the ratio for other countries of origin (last column of the right panel) equal to 0.55.

3.3. Explanatory variables linked to micro, macro, and strategic forces

Deeper insights into the underlying invoicing determinants discussed in section 2 require a formal economic analysis going beyond the broad descriptions presented above. In this section we introduce the variables that we use in econometric analysis as proxies for the microeconomic, macroeconomic, and strategic influences on invoice currency choice. Superscript i is used to indicate a variable differentiated by industry, usually at the HS4 level; e is used to indicate each of the 47 exporting countries in the sample; t is a time subscript; and j is a transaction-specific superscript.

The specific forces and variables introduced are grouped along the following categories:[13]

- Industry characteristics
  - We distinguish between differentiated and homogeneous goods by using the Rauch index. It distributes industries into three categories: reference-priced or exchange traded, Walrasian, or differentiated. Walrasian and reference-priced goods are viewed as more highly substitutable within industries, while differentiated products include the bulk of manufacturing and have more limited substitutability. Ref^i and $Walras^i$ take the respective values of 1 if goods are reference-priced or Walrasian (respectively) and zero otherwise for all other goods that are differentiated, with the industry index i defined at the HS4 level.[14]
  - We proxy for the use of commodities in production, likely to be priced in USD, by relying on input-output tables. We generate a measure $Intensity^i$ at the HS4 level, which is (a lower bound on) the share of commodities inputs – such as hydrocarbons and metals – in total costs (sum of producer value plus employee compensation) from the Standard Use Table of the United States 2002 Benchmark Input-Output tables.[15] While ideally this measure would be constructed for exporters in different countries using country-specific I-O tables, we opted to apply the U.S. I-O table to all exporting countries.
  - We caputre the extent of foreign ownership in Canadian industry by annual data for 2002-2007 from Statistics Canada.[16] These data give the shares of foreign owners for twenty-one broad Canadian NAICs categories, but include only a single aggregate for all of manufacturing.[17] For some of these categories, there is a separate breakdown for all

[13] Appendix Table 2 provides descriptive statistics for the respective explanatory variables.
[14] While the index is originally constructed for SITC codes, we used an SITC-HS concordance to match the variables. While Rauch provided a "conservative" and a "liberal" classification, we use the conservative index. An alternative approach could be to use the Broda and Weinstein (2006) on low, medium, or high demand elasticities or Feenstra, Obstfeld and Russ (2010) for a more continuous set of estimates, although with low precision.
[15] The specific commodity categories are: oil and gas extraction, coal mining, metal ores mining, non-metallic mineral mining and quarrying, petroleum and coal products, plastic and rubber products, nonmetallic mineral products, primary ferrous metal products, primary nonferrous metal products, and foundry products. Since the detailed I-O codes are aggregates of NAICS codes, the intensity measure is a simple weighted average over the categories.
[16] Table 179-0004 Corporations Returns Act (CRA), major financial variables.
[17] Since we are missing data for 2008 and 2009, we assume that these observations are identical to the 2007 shares. All of the HS codes basically fall into just a few categories: agriculture/forestry/fishing/hunting, oil and gas extraction and support activities, mining and quarrying, and manufacturing. There is time variation in the foreign

foreign versus U.S. and euro area owners. We use this variable $Fowners_t^{us,eu,or\ other}$ to proxy the degree to which there are related parties in the transactions by industries (very broadly defined) with U.S., or E.U., or other foreign owners.

- Macroeconomic considerations
  - We proxy for currency instability, which makes the exporter's currency unappealing, by the variability of the exchange rate of the exporter's currency with the CAD, USD, and euro. Specifically, we construct two relative exchange rate volatility measures for each exporting country. The first is the coefficient of variation of the exporter's currency relative to the CAD (the LCP option), $CoefLCP_t^e$, computed over a rolling lagged five-year window using monthly exchange rate data.[18] The second measure is the coefficient of variation on the exporter's currency relative to the VCP alternative, $CoefVCP_t^e$, which is assumed relative to the euro for U.S. exports or relative to the dollar for non-U.S. exporters.
  - Exchange rate pegs and monetary unions with the USD or the EUR are captured by the dummy variables $Dollarpeg_t^e$ and $Europeg_t^e$, which are country and time specific. The peg classifications come from Ilzetski, Reinhart and Rogoff (2009).[20] In the case of the United States, we also construct a measure that reflects the prevalence of different peg arrangements across the competitors in each industry. $DpegROW_t^i$ is the share of all rest of world exporters within industry *i* (HS level) that are pegged to the U.S. dollar within that quarter, and a similarly defined variable $EpegROW_t^i$ is for euro peggers.
  - We construct proxies of the hedging benefits of the USD, CAD and EUR, denoted by $USDhedge_t^e$, $CADhedge_t^e$, and $EURhed_{g\ t}^{e\ e}$, by assessing the co-movements between exchange rates and production cost. Following Goldberg and Tille (2008), these dummy variables reflect which currency (the USD, CAD, or EUR) is significantly better for hedging the volatility of the exporter's costs and demand uncertainty by date. The series

ownership to exploit, but no government ownership data for agriculture and manufacturing, and only one observation (of 0% ownership) for oil/gas and mining government ownership.

[18] IMF's International Financial Statistics series *rf*, the period-average nominal exchange rate.

[20] Since these classifications extend only through the end of 2007, we applied the end 2007 values to the 2008 and 2009 import transactions. The only country outside of the formal euro area also included is Denmark, whose currency closely tracked the euro over this period.

are constructed based on a rolling quarterly sample of destination market demand, captured by Canadian consumption and exporter production costs.[22]

- We proxy for foreign exchange transaction costs using data on volumes of currency transaction, which we assume to be inversely to transaction costs.[23] The shares in daily global foreign exchange market turnover for up to 35 currencies in 2001, 2004, 2007 and 2010 are from the BIS Triennial Central Bank Survey of Foreign Exchange and Derivatives (Annex Table 3). We interpolate among the dates to create continuous share variables. Currencies not included in the Triennial survey are given 0 shares. Relative transaction costs are proxied by the ratios of volumes of the producer currency and the LCP and VCP alternatives, yielding $FXLCP_t^e$ and $FXVCP_t^e$. A rise in this variable is assumed to indicate that the transaction cost of the exporter's currency is falling relative to transaction costs in the LCP or VCP alternatives.[25] While the LCP option always is the CAD, the VCP option is assumed to be the euro for U.S. exporters or the dollar for non-U.S. exporters.

- Strategic considerations
  - The first strategic variable is the market share of exporters from country *e* in all Canadian imports in industry *i*, at the HS4 level, at each quarter *t*. Denoted by $Importshare_t^{i,e}$, it proxies the bargaining power of an exporter from country *e* in the industry.
  - The size of the specific transaction is measured by $Top5ind_t^i$, which is equal to one if the particular transaction falls in the top 5th percentile of sized transactions within any HS4 industry, and zero otherwise. While we cannot definitively assess whether large transaction reflect a large size of the importer or the exporter, we take this measure as one proxy for the size and bargaining power of the importer.
  - The final strategic variable is a measure of concentration of Canadian importers in industry *i*, measured at the HS4 level. Specifically, $Imp10C^i$ is the share of imports in the

[22] CanSim Table 380-0002, Personal expenditure on consumer goods and services. Production costs are proxied by respective PPI series from IFS.

[23] While bid-ask spreads are a more direct measure of costs (which remains problematic), they are available for only a narrow group of currencies.

[25] While we introduce this variable as a proxy for transaction costs, it raises some problems with interpretation. First, the share variable is highly correlated with exporter size. Second, extensive use of currencies in international trade leads to more extensive use of currencies in foreign exchange markets. While trade use is only a fraction of overall use of currencies in foreign exchange market turnover, this consideration nonetheless raises the possibility of co-determination with the import volumes.

particular industry that is accounted for by the top 10 importers in 2009, using data from Statistics Canada.[26]

Before turning to the formal econometric analysis in the next section, Table 4 illustrates how invoicing shares are contrasted depending on the variables presented above. The table shows the shares of the three invoicing options vary in relation to the values of the explanatory variables, both in terms of transaction counts (top panel) and values (bottom panel). Given the prominence of U.S. dollar use in imports from the United States, the table shows prevalence on imports from countries other than the United States. As the exchange rate regime of the exporter's currency plays a sizable role in the invoicing decisions, we distinguish transactions for which the exporting country's currency is pegged to the U.S. dollar (left data columns), transactions for which the exporting country's currency is pegged to the euro (middle columns), and transactions from other countries (right columns).

Several patterns are evident from Table 4. First, exchange rate regimes are important indicators of invoicing patterns. Exporters from a country that pegs to the USD predominantly choose the VCP option, i.e. invoicing in USD. Exporters in the euro area make more use of PCP, but still opt for VCP to a significant extent. Exporters from countries without a peg to the dollar or the euro tend toward VCP. Second, exports of a country that does not peg to the dollar make more use of VCP, and less use of PCP, for Walrasian and reference priced goods, confirming the "coalescing motive" for firms in industries with little differentiation.

Third, large transactions make more use of the Canadian dollar. The more prominent use of LCP for transactions in the top 5 percent in terms of size is clearly observed across exports of all countries. Fourth, imports in industries where importers are more concentrated also tend to be invoiced in LCP to a larger extent, although the pattern lacks robustness.

Finally, no clear patterns of invoicing are associated with differences in import shares, reliance on commodity inputs, exchange rate volatility, or the extent of foreign ownership. This of course does not imply that these variables play no role. Instead, capturing any role requires going beyond the simple "stylized fact" approach of Table 4.

[26] We also purchased data on concentration of the top 5 and top 20 importers. All measures are highly correlated.

4. Econometric analysis

4.1 Approach

We divide the full (cleaned) sample of Canadian imports described above (about 42 million observations) between imports from the United States (25 million observations), for which the econometric results are reported in Table 5 and discussed in Section 4.2, and imports from other countries (17 million observations), for which the econometric results are reported in Table 6 and discussed in Section 4.3. The dependent variables are dummy variables indicating whether a given transaction is invoiced in the producer's currency (PCP=1, LCP=VCP=0), the destination currency CAD (LCP=1, PCP=VCP=0), or a vehicle currency (VCP=1, PCP=LCP=0). The regression specifications applied over each data group are multinomial logit procedure (MNL) which imposes the constraint that the three invoicing alternatives are mutually exclusive and exhaustive.

Our approach considers how each of the factors contributes to the probability of the invoicing outcome attached to individual export transactions. We take PCP as the default option for imports from the U.S. (i.e. USD use) and VCP as the default option for imports from other countries (i.e. USD use also). Given a baseline selection as a default choice, statistical significance in MNL specifications shows the direction in which the variables shift the pricing likelihood. Tables 5 and 6 report the maximum likelihood estimates of coefficients with two columns per regression – for the respective invoicing choices-- with the standard errors provided in brackets. The coefficient estimates are not marginal effects of each of the variables: marginal effects or elasticities are not constant and need to be constructed conditional on levels of each of the variables in the multinominal logit specification. While, the statistical significance and signs of coefficient estimates are meaningful, the elasticities will be "state contingent" and are addressed separately for specific variables in section 4.4.

Tables 5 and 6 also report the number of observations used in the regressions and the associated Akaike Information Criteria (AIC) statistics.[27] In separate specifications (unreported), we introduce sets of explanatory variables sequentially and examine AIC criteria to order those

[27] This statistic equals -2ln (L)+2k where k is the number of parameters being estimated and L is the log likelihood. Smaller values indicate that a model explains the data better (less information is lost in fitting the model to the data) than larger values.

explanatory variables in importance for the two respective exporter groups (from the United States and elsewhere). The results from this exercise are summarized in Table 7.

The baseline estimating equations for U.S. and then non-U.S. exports to Canada are given by (3).

$$\begin{aligned}\Pi_t^{i,e,j}(PCP) &= MNL\left(X_t^e, X_t^{i,e}, X^i, X_t^i, X_t^{i,j}\right) \text{ for U.S. exporters} \\ \Pi_t^{i,e,j}(VCP) &= MNL\left(X_t^e, X_t^{i,e}, X^i, X_t^i, X_t^{i,j}\right) \text{for non U.S. exporters}\end{aligned} \tag{3}$$

where the alternative outcomes are VCP or LCP in the case of imports from the United States, and PCP or LCP for imports from other countries. In regressions for imports from the United States, we cluster residuals by HS4 industry to absorb unexplained correlations among industry residuals. In regressions for imports from other countries, the residuals are clustered by exporting country. The respective variables included in specifications are summarized in the grid below, where we list variables that are exporter-time specific (X_t^e), exporter-industry-time specific ($X_t^{i,e}$), industry specific (X^i), industry-time specific (X_t^i) and transaction-industry-time specific ($X_t^{i,j}$). Within regression specifications, estimated coefficients β_k represent the effects of the X variables on the probability of choosing the k^{th} alternative over the PCP alternative for the U.S. exporters, or over the VCP alternative for non-U.S. exporters to Canada.

Regression Sample	X_t^e	$X_t^{i,e}$	X^i	X_t^i	$X_t^{i,j}$
United States Exports	$USDhedge_t^e$, $CADhedge_t^e$, $EURhedge_t^e$ $CoefLCP_t^e$ $CoefVCP_t^e$ $FXLCP_t^e$ $FXVCP_t^e$	$Importshare_t^{i,e}$	$Imp10C^i$ $Intensity^i$ Ref^i $Walras^i$	$DpegROW_t^i$ $EpegROW_t^i$ $Fowners_t^{us}$	$Top5ind_t^{i,j}$
Non-U.S. Exports	$USDhedge_t^e$, $CADhedge_t^e$, $EURhedge_t^e$ $Dollarpeg_t^e$ $Europeg_t^e$ $CoefLCP_t^e$ $CoefVCP_t^e$ $FXLCP_t^e$ $FXVCP_t^e$	$Importshare_t^{i,e}$	$Imp10C^i$ $Intensity^i$ Ref^i $Walras^i$	$Fowners_t^{eu,or\,other}$	$Top5ind_t^{i,j}$

4.2 Invoicing of United States Exports to Canada

Table 5 indicates the results for imports from the United States, for which PCP is the default option. The MNL specifications reported have different sets of variables included that are intended to capture the various implications spelled out in section 2. For brevity, we only report a subset of a much broader group of tests that introduce implications sequentially or individually in order to get information on the relative explanatory power of different forces driving invoice currency selections.

In the discussion below, we first present the results across the various specifications in Table 5, and then discuss them in context of the testable implications discussed in section 2. Including only the constant term (specification 1) leads to negative and significant coefficients for both LCP and VCP. This result is robust and observed in all specification, denoting the extra prominence of PCP – in this case U.S. dollar use.

The results including the full set of variables are presented in specification 2. Invoicing of goods in industries with little differentiation is tilted away from the VCP option, indicating a more prominent use of the USD (the PCP option). This result is robust to grouping the two categories of non-differentiated goods (specification 3). Transactions in industries where production is more commodity-intensive tend to be invoiced in USD to a larger extent, at the expense of the CAD (the LCP option). The ownership of importers matters. In industries with a larger share of U.S. ownership, transactions make more use of the LCP and, especially, the VCP options. U.S. exporters in these industries are thus less likely to insulate their prices from exchange rate risk through the PCP option when they face importers that are also U.S.-owned (and could be related to the exporting parent company).

Turning to macroeconomic considerations, we find evidence of invoicing tilted away from more volatile currencies. Specifically, invoicing is tilted towards the VCP option when the USD-CAD exchange rate is more volatile, and towards the LCP option when the USD-vehicle currency exchange rate is more volatile. We also find that shipments in industries where a large share of imports are from countries with pegs to the USD or the Euro tend to make more use of the USD through the PCP option. We do not find support of invoicing reflecting the hedging benefits of the various currencies. We find some evidence for transaction costs in foreign exchange markets, with invoicing tilted away from the LCP option when the USD transactions are cheaper.

We find solid evidence for strategic considerations. First, transactions in industries where U.S. firms have a higher market share make more use of the USD at the expense of the other two alternatives. Second, there is more use of the CAD in industries where a few importers have a dominant market share. Third, larger transactions are more heavily invoiced in CAD. We also interact the transaction size with the importer concentration and market share variables. Larger transactions in industries dominated by a few importers tend to make more use of vehicle currencies, while large transactions in industries dominated by U.S. firms make less use of the VCP option.

In specification 4-5 we provide a series of robustness tests which do not materially affect our results. As the measure of transaction costs in foreign exchange markets is a fairly indirect proxy, we drop it in specification 4. Specification 5 focuses on the strategic considerations.

The econometric results of Table 5 shed light on the various implications from the theoretical literature, so we now articulate our results along these lines.

Implication 1 predicts that U.S. exports of more homogenous goods are likely to make more use of the USD. The negative coefficients on Walrasian goods, which are the most homogeneous products in the sample, support this proposition. The coefficients on reference priced goods are less robustly supportive of the implication, with the USD use increased only at the expense of VCP.

Implication 2 argues that the currency of a country with a dominant market share in an industry is more likely to emerge as the dominant invoicing currency. This result is supported as the higher the market share of the United States in an industry, captured by $Importshare_t^{i,e}$, the lower the use of LCP and VCP. A higher presence of dollar peggers or euro peggers in an industry, $DpegROW_t^i$ and $EpegROW_t^i$, reduces the use of VCP and raises that of LCP.

Implication 3 contends that invoicing is tilted towards currencies that provide a profit hedge. We find no evidence for this aspect. LCP use is marginally lower when the CAD hedge is a good hedge ($CADhedge_t^e = 1$), and hedging benefits of the euro ($EURhedge_t^e = 1$) do not raise the VCP use. Another variable that could matter for profit hedges is the share of commodity intensive in production across industries, as these tend to be invoiced in USD. This implication is supported.

Implication 4 maintains that exporters from a country with a more volatile exchange rate relative to the destination country would be less likely to invoice in their own currency. A related

point is *Implication 5*, whereby exporters from a country with a volatile currency are more likely to use a currency other than their own. The coefficients on $CoefLCP_t^e$ and $CoefVCP_t^e$ do not consistently support this motive as a large or even correctly signed as an influence on U.S. exporter invoice currency choices.

Foreign exchange transaction costs also can influence the desirability of using a particular currency. We find some support for this consideration from our proxies based on transaction volumes of U.S. dollars versus volumes of transactions in CAD ($FXLCP_t^e$) or in euros ($FXVCP_t^e$). Higher U.S. volumes in FX markets relative to either of these currencies are correlated with lower invoicing use of both CAD and vehicle currencies.[28] However, interpreting results from this set of variables is not straightforward. While one interpretation is that higher currency transaction costs mean lower currency usage, it also may be the case that these shares may rise as U.S trade shares in aggregate rise and may be endogenous to the other macroeconomic considerations for the United States and other economies.

Implication 6 held that imports in industries with a larger share of intra-firm transactions are more likely to be invoiced in the importer's currency. This result is supported in all specifications as the probability of LCP is higher when $Fowners_t^{us}$ is bigger. This result is in line with the findings of Ito et. al (2010) from surveying Japanese exporters.

Implication 7 indicates that larger shipments within an industry, if indicating larger importers, are more likely to be invoiced in the importer's currency. This size effect is stronger vis-à-vis exporters from a country with a dominant market share in the industry. The marginal size effect increases with shipment size, especially for transactions involving exporters from a country with a dominant market share. The results for imports from the U.S. support this implication. The coefficient on $Top5ind_t^{i,j}$ shows that the probability of LCP is higher and the probability of VCP lower for the larger shipments in an industry. The interaction of $Top5ind_t^{i,j}$ with $Importshare_t^{i,e}$ shows that, while VCP is reduced even more when the U.S. exporters are more pervasive, this consideration does not enhance the amount of LCP done by U.S. exporters.

Implication 8 predicts a higher use of LCP when imports are concentrated among a few firms. We find support for this implication as the coefficients on $Imp10C^i$ indicate more use of

[28] This may seem to be a circular and even jointly determined relationship. If more dollars are used in trade, more trade transactions are settled in foreign exchange markets and the relative volumes of dollars increase. While this certainly is true, trade in goods and services is only a fraction of the volume in foreign exchange markets.

LCP in industries with more highly concentrated importers. Moreover, the transaction size effect becomes more pronounced in industries with a higher concentration of importers.

Our analysis so far indicates whether a particular driver has a statistically significant impact on invoicing. This however does not necessarily mean that a particular driver accounts for a large share of the observed variation in invoicing patterns. We therefore turn to assessing the relative importance of the industry, macroeconomic, and strategic motives for explaining invoicing choice of U.S. exporters relative to the USD baseline. Since the multinomial logit expressions do not provide a direct variance decomposition mapping, we conduct a range of MNL specifications from which the resulting Akaike information criteria (AIC) values enable us to compare explanatory power of alternative combinations of regressors. According to this ranking (left panel of Table 7), the most prominent driver of deviations from dollar pricing among U.S. export transactions is the collection of strategic considerations. The next most significant drivers are the prevalence of currency pegs for competing exporters and whether exports are differentiated or highly homogeneous goods.

4.3 Invoicing of Non-U.S. Exports to Canada

We now turn to the determinants of the invoicing of imports from countries other than the United States, with the results given in Table 6. These specifications take the VCP option (which in practice corresponds to invoicing in USD) as the benchmark. The specifications then inform the direction of influence of drivers on the likelihood deviating from VCP and instead choosing PCP or LCP.

Specification 1 simply considers the constant terms, with significant negative signs for both LCP and PCP. This finding is robust across specifications, and shows the unexplained prominence of VCP use.

All explanatory elements are considered in specification 2. We find evidence of more LCP use in industries with reference priced goods, as well as industries with Walrasian goods although the coefficients for the latter are not significant. Industries where commodities play a larger role in production are characterized by a more limited use of LCP and PCP, and more use of the USD. Invoicing is also tilted towards the VCP option in industries with a higher extent of ownership of Canadian firms by European Union parent companies.

Turning to macroeconomic considerations, a higher volatility of the exchange rate between the exporter's currency and the vehicle currency shifts invoicing towards the LCP option. While imports from countries with a peg to the euro make higher use of the LCP option, there is no incremental impact of being pegged to the USD beyond the baseline. While we find some support for a reduction of the VCP option when the USD is a better hedge, this finding is not robust. Similarly, the role of transaction costs in foreign exchange market is limited and lacks robustness.

Strategic considerations also matter. First, there is less use of the LCP option in industries where firms from the exporter's country have a larger market share. Second, a higher concentration of importers is associated with a larger use of the LCP option. Third, large transactions are more heavily invoiced in CAD. The interaction terms show that larger transactions in industries with more concentrated importers make more use of the PCP option. Intuitively, the concentration of importers already tilts the invoicing towards the LCP option. Finally, larger transactions in industries where exporters have a high market share are more heavily invoiced in CAD. In these industries the dominance of exporters from a given country tilts invoicing towards the PCP option, and only large importers (associated with larger transactions) can tilt back towards the LCP option.

The results are broadly robust to dropping the proxies for transaction costs in foreign exchange markets, which are computed very indirectly (specification 3). While these proxies are significant in the absence of other regressors (specification 4), the coefficients change and lose significance as alternative groups of variables enter the specifications.

As for the results in the previous section, the econometric results of Table 6 can be structured along the various implications from the theoretical literature.

Implication 1 predicts a larger role of VCP for more homogenous goods. This is supported by the coefficients on Walrasian and reference-price goods which show a coalescing on the CAD with higher LCP use. As in *Implication 2*, the currency of a country with a dominant market share in the industry is more likely to emerge as the dominant invoicing currency. In many Canadian industries, this dominant exporter was either the United States (U.S. dollar pricing) or China (also USD pricing).

Implication 3 predicts more use of currencies with hedging benefits. We do not find support for this consideration, as the coefficients on the three hedging variables -- $USDhedge_t^e$,

$CADhedge_t^e$ and $EURhedge_t^e$ – are not significant. We do observe some hedging however as industries with higher shares of commodities in production inputs (as indicated by $Intensity^j$) make more use of the USD.

Implication 4 points out that exporters from a country with a more volatile exchange rate relative to the destination country are less likely to use their own currency. We find some evidence for this consideration. The coefficients on $CoefLCP_t^e$ and $CoefVCP_t^e$ show a larger use of the VCP option for exporters whose currency is more volatile with respect to CAD, and conversely. Exchange rate peg arrangements play a very important role in explaining deviations from the benchmark of USD pricing. Particularly robust is the higher use of LCP for countries that are part of the euro area. We do not find a robust role for transaction costs in foreign exchange markets, with the coefficients on $FXLCP_t^e$ and $FXVCP_t^e$ being mostly insignificant.

Implication 6 indicates that imports in an industry with a larger share of intra-firm transactions are more likely to be invoiced in the importer's currency. This is not supported by our admittedly coarse data, as a larger share of EU ownership in Canada is associated with more use of VCP.

We find strong support for strategic considerations. The higher the market share of an exporting country in any industry, captured by $Importshare_t^{i,e}$, the less likely is LCP, and the more likely is VCP, and with little consequence for PCP. Large shipments make more use of the LCP option. When importers are more concentrated, the focus on LCP is even more pronounced, but now at the expense of PCP. Among the largest transactions, the role of export country size in shifting pricing from LCP to USD is reduced and PCP is stronger. We explore these interactions further in section 4.4.

We assess the relevance of the various drivers for the overall MNL fit in Table 7 which compares AIC scores across a broad range of specifications. This importance of strategic considerations is quite different for the non-U.S. exporter transaction group as compared with that for U.S. export transactions, where these considerations are the most important explanation for deviations from USD invoicing. By contrast, the ranking column in Table 7 shows that macroeconomic variables are the most important drivers of departures from USD invoicing among imports from non-U.S. countries. Specifically, exchange rate regimes, a currency's "importance" in FX markets (which more likely should be taken as a reflection country size and grouped with implication 9), and exchange rate volatility clearly stand out as primary drivers of

deviations from USD pricing. While the strategic interactions between exporters and importers are lower in importance, these interactions dominate the influence of foreign ownership share, intensity of commodity input use, and even dominate the direct importance of whether an export is classified as homogeneous or differentiated.

4.4 Quantitative effects of strategic forces

The marginal effects of regression coefficients from MNL specifications in Table 5 and 6 are non-linear and conditional on the values of the various drivers. We thus illustrate the role of strategic variables through a series of computations of how such marginal effects change depending on their own values and the values of other variables. In particular, we focus on the roles of $Importshare_t^{i,e}$ and $Imp10C^i$ depending on whether 1) a transaction is $Top5ind_t^{i,j}$, 2) exporters are from the United States or other countries, and 3) whether the exporter's currency is pegged to the euro, the U.S. dollar, or neither. These computations are done for differentiated goods and assuming the median values of other regression variables.[29]

Figure 4 illustrates the impact of transaction size and the exporting country's market share in an industry. The first panel depicts the results for U.S. exporters, with the other three panels being for non-U.S. exporters depending on whether the country of origin has an exchange rate peg to the USD, the EUR, or no peg to either. The market share of the exporter's country, $Importshare_t^{i,e}$, is on the horizontal axis. The vertical axis shows the use of PCP, LCP and VCP among transactions in the bottom 95th percentile (solid line) and the top 5th percentile (dotter lines).

A number of results are apparent from Figure 4. First, a higher exporting country market share is clearly associated with less use of the LCP option, especially among large transactions. Second, a higher market share tends to increase the use of PCP in small transactions. Third, the lines for LCP are steeper for imports from countries other than the United States. Thus, the effects from changing exporter market share are thus quantitatively much larger for countries other than the United States. This set of graphics on quantitative results is useful for putting the economic importances of Tables 5, 6, and 7 into context. Even though the AIC criteria indicate a higher relative importance of strategic interactions for United States exporters in explaining the

[29] The specification used includes *FXLCP* and *FXVCP*. The coefficients on the strategic variables are largely unchanged in specifications with or without these terms so the computed marginal effects are unlikely to be influenced much by excluding or including those terms.

fit of the regression, the absolute size of consequences for currency probabilities are much bigger outside of the United States.

Figure 5 is built along the same lines as Figure 4, but instead has the concentration of importers in the industry in question, $Imp10C^i$, on the horizontal axis. A higher concentration of importers is associated with a higher use of LCP, especially for imports coming from countries other than the United States. The use of LCP is also more pronounced for large transactions, and its sensitivity to the concentration (the slope of the blue lines) is similar for small and large transactions. The higher use of LCP comes somewhat at the expense of PCP for countries with either no exchange rate peg or a USD peg, but mostly at the expense of VCP (i.e. USD use) especially in countries with a peg to the euro.

5. Concluding Remarks

This paper addresses two major limitations of the extensive literature on international trade invoicing, its reliance on aggregate data for testing alternative hypotheses and its focus only on exporter considerations in invoice currency choice. We assess a broad range of possible determinants of invoicing, including factors at the individual transaction level, by using a new highly disaggregated dataset for 45 million Canadian import transactions. While the U.S. dollar is the dominant currency for imports from the United States, other currencies also play a substantial role in imports from other countries, which account for nearly half of overall imports by transaction counts.

Our analysis points to a significant direct influence of macroeconomic and exchange rate considerations, strategic interactions among exporters and importers, and factors such as use of commodity inputs in production. We document the novel aspect of a connection between transaction size and invoicing, showing that larger transactions use a variety of currencies in invoicing, and are more likely to follow local currency pricing than would otherwise be the case. The link between transaction size and invoicing, and the related role that we identify which is associated with the degree of competition of importers in the destination market, call into question the standard approach that treats invoicing decisions as unilaterally set by exporters. The empirical results support an interplay between customers and exporters in the selection of invoicing currencies. A bargaining solution calls for a larger use of the destination currency than under unilateral decision making, as the importer also wants to limit its exchange rate exposure.

The use of the customer's currency is more pronounced for large sales, especially when the direct bargaining power of exporters is high, as only large importers can counterbalance the exporter's might by threatening to pull out of the transaction unless a more acceptable outcome is achieved.

This rich data analysis sheds light on the respective importance of the different drivers of invoicing currency use, and, by extension, on the types of forces that might lead to changes in the status quo of currency usage. For instance, a shift from a large number of relatively small importers to a handful of larger ones, such as large retail chains, could boost the use of the importers' currency and lead to more price rigidity in local currency terms and more limited exchange rate pass-through into import prices. Another implication of our findings is that a shift away from dollar pegs towards floating exchange rates or the euro could lower the use of the dollar as an invoicing currency, as could reduced dollar use as the pricing currency on specific commodities in global markets. Such a reduction in the global role of the dollar could have implications for the international transmission of economic fluctuations and policy effectiveness.

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Table 1. Regional Exporter Presence in Canadian Imports by Broad Industry Group, by Count

Percent Share in Import Transaction Counts							
Broad Industry Category	United States	Eurozone	East and SE Asia	China	Other Americas	All Other Countries	Percent of Total
Animal Products	68.2	5.0	9.9	4.6	3.0	9.3	1.0
Vegetable Products	60.6	7.9	7.5	5.9	3.8	14.3	3.1
Foodstuffs	61.7	11.8	7.8	3.5	1.6	13.5	3.2
Mineral Products	84.0	4.6	1.5	3.2	0.7	6.1	1.5
Chemicals	70.3	11.5	2.8	3.3	0.4	11.6	9.8
Plastics/Rubbers	63.7	11.2	7.8	3.3	0.9	13.2	7.0
Leather/Furs/Hides	44.2	14.3	13.1	9.3	1.9	17.2	1.0
Wood Products	66.3	9.8	8.2	4.7	1.0	9.9	7.2
Textiles	42.8	13.6	14.6	9.2	1.4	18.4	9.3
Footwear/Headgear	39.7	12.9	18.2	15.1	1.9	12.1	1.2
Stone/Glass	52.9	13.3	9.7	6.8	1.7	15.7	4.6
Metals	61.7	11.4	7.3	4.6	0.8	14.2	13.2
Machinery/Electrical	56.3	13.4	8.8	3.5	0.9	17.1	23.2
Transportation	65.4	10.3	5.9	3.2	0.8	14.3	2.8
Miscellaneous	54.5	11.6	10.7	6.5	0.5	16.2	10.9
Service	67.2	8.9	7.1	2.9	0.7	13.1	0.8
Total	58.9	11.8	8.6	5.0	1.0	14.7	

Table 2. Regional Exporter Presence in Canadian Imports by Broad Industry Group, by Value

Percent Share in Import Transaction Value							
Broad Industry Category	United States	Eurozone	East and SE Asia	China	Other Americas	All Other Countries	Percent of Total
Animal Products	62.3	5.5	8.3	7.9	4.2	11.8	0.8
Vegetable Products	69.6	5.5	3.7	2.8	6.2	12.2	1.9
Foodstuffs	58.6	17.7	4.0	1.9	4.9	12.8	3.0
Mineral Products	26.9	4.6	0.3	0.4	1.3	66.5	10.9
Chemicals	59.0	19.3	1.3	2.0	1.2	17.2	7.8
Plastics/Rubbers	76.9	5.1	5.4	6.0	0.4	6.1	4.7
Leather/Furs/Hides	14.4	15.9	5.3	53.2	3.0	8.2	0.4
Wood Products	79.4	7.2	2.3	6.0	1.6	3.5	3.4
Textiles	32.2	6.7	11.4	33.2	0.9	15.6	2.7
Footwear/Headgear	4.9	11.0	11.9	64.8	3.9	3.6	0.5
Stone/Glass	55.5	8.7	2.7	8.0	11.3	13.8	2.2
Metals	64.5	7.6	4.9	9.4	3.7	9.8	6.8
Machinery/Electrical	54.5	7.9	9.0	11.1	0.3	17.2	25.7
Transportation	68.9	9.1	4.2	0.8	0.9	16.0	21.0
Miscellaneous	47.3	9.7	4.6	22.2	0.2	15.9	6.2
Service	59.6	24.0	0.7	0.9	0.1	14.7	2.0
Total	56.6	9.2	5.0	7.5	1.5	20.2	

Table 3. LCP Share and Import Transaction Size

	United States					Non-U.S. Countries				
	Median Size, CAD		LCP Share by Count			Median Size, CAD		LCP Share by Count		
Broad Industry Category	Lower 95th Percentile	Upper 5th Percentile	Lower 95th Percentile	Upper 5th Percentile	Ratio	Lower 95th Percentile	Upper 5th Percentile	Lower 95th Percentile	Upper 5th Percentile	Ratio
Animal Products	9,422	321,806	2.1	4.2	2.0	3,861	457,343	5.7	16.2	2.8
Vegetable Products	4,718	381,710	2.3	3.5	1.5	2,335	221,396	5.7	9.3	1.6
Foodstuffs	12,046	328,670	3.3	17.2	5.2	2,733	326,451	6.0	24.5	4.1
Mineral Products	4,882	694,664	2.5	6.9	2.8	764	27,059,727	5.2	7.0	1.3
Chemicals	2,641	257,238	3.5	11.7	3.3	1,462	262,860	6.6	19.3	2.9
Plastics/Rubbers	5,781	358,761	2.7	7.5	2.8	1,289	187,073	3.3	13.9	4.2
Leather/Furs/Hides	507	44,148	3.3	7.2	2.2	1,309	284,232	3.4	10.3	3.0
Wood Products	2,573	230,359	2.7	12.9	4.8	539	150,689	4.1	13.5	3.3
Textiles	802	120,959	3.4	5.5	1.6	1,030	180,142	4.0	10.7	2.7
Footwear/Headgear	246	25,006	4.3	8.7	2.0	1,014	375,026	4.7	7.7	1.6
Stone/Glass	2,024	191,971	3.1	5.9	1.9	1,307	183,740	4.0	8.7	2.2
Metals	2,577	258,173	2.9	5.4	1.9	925	211,080	3.7	13.2	3.6
Machinery/Electrical	5,070	472,596	2.7	6.6	2.4	2,861	560,843	3.3	10.9	3.3
Transportation	20,279	2,726,504	2.3	9.2	4.0	6,071	1,921,510	2.7	13.4	5.0
Miscellaneous	2,291	259,831	3.1	7.9	2.5	1,937	277,942	3.8	13.2	3.5
Service	2,897	554,463	4.8	13.2	2.8	1,929	545,826	6.4	20.6	3.2

Table 4. Distribution of LCP, PCP, and VCP by Explanatory Variables, Non-U.S. Exporters to Canada

		US Peg by count			EU Peg by count			No Peg by count		
		LCP	PCP	VCP	LCP	PCP	VCP	LCP	PCP	VCP
Goods	Differentiated	3.1	3.8	93.2	4.5	36.6	58.9	4.3	11.0	84.7
	Ref-Priced	5.2	3.2	91.6	7.7	31.4	60.9	6.7	8.8	84.5
	Walrasian	5.2	3.8	91.1	5.9	34.5	59.6	5.1	7.8	87.1
Transaction Size	Top 5%	10.8	0.3	88.9	21.3	39.6	39.1	14.6	8.0	77.4
	Lower 95%	2.9	3.9	93.2	4.1	35.7	60.2	4.1	10.8	85.1
Importer Concentration	Top 5%	5.3	2.9	91.8	7.8	33.8	58.4	7.9	11.1	81.0
	Lower 95%	3.2	3.7	93.1	4.7	36.2	59.1	4.4	10.6	85.0
Import Share	Above Median	2.1	2.2	95.6	3.8	39.0	57.2	3.5	11.7	84.8
	Below Median	4.5	5.2	90.4	6.0	32.8	61.2	5.6	9.7	84.7
Commodity Input	Above Median	3.3	2.5	94.2	4.6	33.6	61.8	4.4	10.7	84.9
	Below Median	3.3	4.9	91.9	5.3	38.4	56.3	4.8	10.6	84.6
ER Volatility	Above Median	3.5	4.2	92.4	5.0	36.3	58.7	4.5	9.9	85.6
	Below Median	3.1	3.2	93.6	4.8	35.5	59.6	4.6	11.5	83.9
Non-US Ownership	Above Median	2.8	3.5	93.7	4.6	34.4	61.0	4.3	9.4	86.2
	Below Median	3.7	3.8	92.6	5.2	37.4	57.4	4.7	11.7	83.6
		US Peg by Value			EU peg by Value			No Peg by Value		
Goods	Differentiated	13.2	0.2	86.6	29.4	25.7	44.9	29.2	5.9	64.8
	Ref-Priced	9.7	0.3	89.9	42.5	13.3	44.2	23.9	2.6	73.4
	Walrasian	1.4	0.2	98.4	8.7	12.6	78.7	16.2	0.2	83.5
Transaction Size	Top 5%	22.5	0.0	77.5	45.6	18.9	35.5	42.8	3.6	53.5
	Lower 95%	2.8	0.4	96.9	8.3	29.5	62.2	4.6	4.3	91.1
Importer Concentration	Top 5%	4.3	0.1	95.7	38.6	17.6	43.8	19.9	1.0	79.1
	Lower 95%	12.2	0.2	87.6	31.0	24.2	44.9	29.2	4.8	66.0
Import Share	Above Median	12.8	0.1	87.1	32.9	22.2	44.9	25.6	3.6	70.8
	Below Median	11.0	0.6	88.3	27.0	25.3	47.7	20.6	6.1	73.3
Commodity Input	Above Median	13.2	0.1	86.7	30.7	26.6	42.7	25.0	2.9	72.1
	Below Median	11.0	0.4	88.6	33.1	18.4	48.6	24.8	7.4	67.8
ER Volatility	Above Median	11.9	0.2	87.9	31.5	23.1	45.4	24.7	4.0	71.4
	Below Median	12.8	0.2	87.0	31.6	22.8	45.6	25.2	4.0	70.8
Non-US Ownership	Above Median	13.3	0.2	86.6	33.5	23.5	43.0	27.7	4.1	68.3
	Below Median	11.3	0.3	88.4	32.5	23.5	44.0	28.0	5.0	67.0

Table 5. Determinants of Invoicing Currency Choice: US Exports to Canada

	1		2		3		4		5	
	LCP	VCP	LCP	VCP	LCP	VCP	LCP	VCP	LCP	VCP
Intercept	-3.41*	-5.18*	-15.72*	-12.34*	-15.80*	-12.87*	-3.71*	-4.10*	-3.40*	-4.63*
	[0.01]	[0.10]	[1.03]	[3.72]	[1.00]	[3.69]	[0.09]	[0.48]	[0.04]	[0.30]
Ref^{i}			0.10*	-1.12*			0.07*	-1.13*		
			[0.03]	[0.23]	0.08*	-1.20*	[0.03]	[0.23]		
$Walras^{i}$			-0.11	-2.10*	[0.03]	[0.23]	-0.14*	-2.12*		
			[0.06]	[0.47]			[0.06]	[0.47]		
$Intensity^{i}$			-0.42*	0.15	-0.44*	0.16	-0.39*	0.17		
			[0.10]	[0.66]	[0.10]	[0.66]	[0.10]	[0.65]		
$Fowners_{t}^{us}$			1.60*	6.31*	1.65*	6.47*	0.65*	4.61*		
			[0.26]	[0.73]	[0.25]	[0.72]	[0.21]	[0.72]		
$CoefLCP_{t}^{e}$			-0.16	5.57*	-0.15	5.62*	-4.02*	4.00*		
			[0.14]	[1.09]	[0.14]	[1.09]	[0.27]	[1.04]		
$CoefVCP_{t}^{e}$			0.59*	0.49	0.61*	0.60	0.51*	0.59		
			[0.15]	[0.60]	[0.15]	[0.60]	[0.10]	[0.52]		
$DpegROW_{t}^{i}$			0.63*	-10.70*	0.63*	-10.60*	0.75*	-10.54*		
			[0.11]	[0.86]	[0.11]	[0.86]	[0.11]	[0.85]		
$EpegROW_{t}^{i}$			0.32*	-1.71*	0.34*	-1.61*	0.48*	-1.61*		
			[0.11]	[0.56]	[0.11]	[0.56]	[0.10]	[0.56]		
$CADhedge_{t}^{e}$			-0.02*	-0.08*	-0.02*	-0.08*	-0.05*	-0.06*		
			[0.00]	[0.03]	[0.00]	[0.02]	[0.01]	[0.03]		
$EURhedge_{t}^{e}$			0.07*	0.00	0.07*	0.00	0.08*	0.00		
			[0.00]	[0.02]	[0.00]	[0.02]	[0.00]	[0.02]		
$FXLCP_{t}^{e}$			-0.15*	-0.06	-0.15*	-0.07				
			[0.02]	[0.07]	[0.02]	[0.07]				
$FXVCP_{t}^{e}$			6.27*	3.88	6.31*	4.14*				
			[0.54]	[2.11]	[0.53]	[2.10]				
$Importshare_{t}^{i,e}$			-0.58*	-0.66	-0.57*	-0.65	-0.57*	-0.63	-0.58*	-0.12
			[0.05]	[0.35]	[0.05]	[0.35]	[0.05]	[0.35]	[0.05]	[0.26]
$Imp10C^{i}$			0.42*	-0.52	0.41*	-0.53	0.42*	-0.51	0.45*	-0.89
			[0.07]	[0.46]	[0.07]	[0.46]	[0.07]	[0.46]	[0.07]	[0.55]
$Top5ind_{t}^{i,j}$			1.31*	-1.31*	1.30*	-1.30*	1.30*	-1.31*	1.27*	-1.21*
			[0.19]	[0.48]	[0.19]	[0.48]	[0.19]	[0.48]	[0.19]	[0.46]
$Top5ind_{t}^{i,j} * Imp10C^{i}$			0.32	2.09*	0.32	2.09*	0.31	2.09*	0.31	2.12*
			[0.24]	[0.95]	[0.24]	[0.95]	[0.24]	[0.95]	[0.24]	[1.01]
$Top5ind_{t}^{i,j} * Importshare_{t}^{i,e}$			-0.28	-2.63*	-0.27	-2.63*	-0.27	-2.63*	-0.23	-2.67*
			[0.20]	[0.80]	[0.20]	[0.80]	[0.20]	[0.80]	[0.21]	[0.64]
Time FE	No		No		No		No		No	
Clustering	HS4		HS4		HS4		HS4		HS4	
Observations	23,340,626		23,340,626		23,340,626		23,340,626		23,340,626	
AIC	8,159,090		7,944,016		7,945,259		7,948,788		8,031,913	

Table 6. Determinants of Invoicing Currency Choice: Non-US Exports to Canada

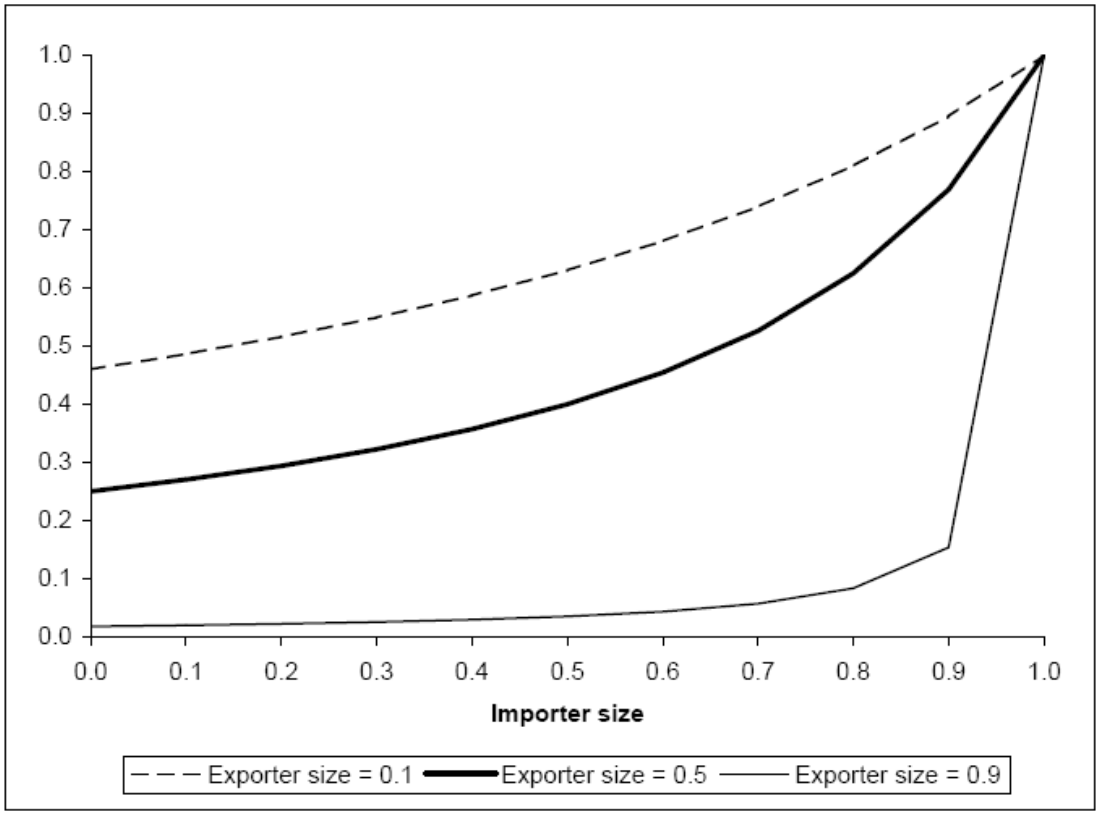
	1		2		3	
	LCP	PCP	LCP	PCP	LCP	PCP
Intercept	-2.88*	-1.51*	-3.26*	-1.63*	-3.25*	-0.72
	[0.10]	[0.27]	[0.13]	[0.36]	[0.14]	[0.52]
Ref^i			0.38*	-0.21*	0.37*	-0.18*
			[0.04]	[0.04]	[0.04]	[0.04]
$Walras^i$			0.10	-0.03	0.09	-0.10
			[0.07]	[0.09]	[0.07]	[0.09]
$Intensity^i$			-1.12*	-1.54*	-1.10*	-1.20*
			[0.15]	[0.37]	[0.15]	[0.36]
$Fowners_t^{eu}$			-4.10*	-4.93*	-4.00*	-2.04
			[1.52]	[2.34]	[1.59]	[3.54]
$Fowners_t^{other}$			5.71	1.84	5.02	-6.39
			[3.14]	[6.94]	[3.42]	[10.45]
$CoefLCP_t^e$			-1.37	-2.89	-1.44	-5.31
			[0.73]	[2.01]	[0.78]	[2.91]
$CoefVCP_t^e$			2.28*	1.99	2.37*	0.68
			[0.96]	[1.88]	[0.97]	[2.37]
$Dollarpeg_t^e$			-0.04	-0.43	-0.04	-1.29
			[0.24]	[0.68]	[0.23]	[0.80]
$Europeg_t^e$			0.33*	-1.59	0.35*	1.46*
			[0.16]	[0.90]	[0.12]	[0.35]
$USDhedge_t^e$			-0.02	-0.22*	-0.01	-0.24
			[0.05]	[0.09]	[0.05]	[0.13]
$CADhedge_t^e$			0.07	0.06	0.08*	0.00
			[0.04]	[0.07]	[0.04]	[0.11]
$EURhedge_t^e$			0.02	-0.03	0.03	-0.15
			[0.06]	[0.16]	[0.06]	[0.27]
$FXLCP_t^e$			0.06	0.18		
			[0.05]	[0.09]		
$FXVCP_t^e$			-1.12	5.46*		
			[0.84]	[2.44]		
$Importshare_t^{i,e}$			-6.69*	0.08	-6.83*	0.45
			[2.05]	[0.57]	[2.13]	[0.60]
$Imp10C^i$			1.10*	-0.86*	1.10*	-0.65*
			[0.10]	[0.08]	[0.10]	[0.10]
$Top5ind_t^{i,j}$			1.98*	-0.43	1.98*	-0.31
			[0.21]	[0.28]	[0.21]	[0.26]
$Top5ind_t^{i,j} * Imp10C^i$			-0.39*	0.97*	-0.39*	0.84*
			[0.20]	[0.39]	[0.19]	[0.37]
$Top5ind_t^{i,j} * Importshare_t^{i,e}$			2.99*	-1.48	3.11*	-1.81*
			[1.32]	[0.90]	[1.41]	[0.82]
Time FE	No		No		No	
Clustering	Country		Country		Country	
Observations	16,445,778		16,445,778		16,445,778	
AIC	20,810,887		17,794,608		18,562,960	

Table 7. Comparison of AIC Scores Across Specifications Containing Limited Groups of Variables

Implication	Description	U.S. Export Transactions			Non-U.S. Export Transactions		
		Relevant Variables	AIC	Rank	Relevant Variables	AIC	Rank
Implication 1	Herding prevalence	Ref^{i} $Walras^{i}$	8,139,951	3	Ref^{i} $Walras^{i}$	20,780,512	7
Implication 9 Implication 2	Higher use of exporter currency	$Importshare_t^{i,e}$	8,151,384	6	$Importshare_t^{i,e}$	20,679,706	6
	Higher use of dominant exporter currency	$DpegROW_t^{i}$ $EpegROW_t^{i}$	8,111,060	2			
Implication 3	Role of profit hedges	$CADhedge_t^{e}$, $EURhedge_t^{e}$	8,158,265	9	$USDhedge_t^{e}$, $CADhedge_t^{e}$, $EURhedge_t^{e}$	20,361,251	4
		$Intensity^{j}$	8,157,521	8	$Intensity^{j}$	20,804,476	8
Implication 4	Macroeconomic variability	$CoefLCP_t^{e}$ $CoefVCP_t^{e}$	8,156,984	7	$CoefLCP_t^{e}$ $CoefVCP_t^{e}$	20,105,075	3
	Currency pegs				$Dollarpeg_t^{e}$ $Europeg_t^{e}$	18,966,192	2
Implication 5	Hedging costs	$FXLCP_t^{e}$ $FXVCP_t^{e}$	8,150,891	5	$FXLCP_t^{e}$ $FXVCP_t^{e}$	18,419,508	1
Implication 6	Intra-firm transactions	$Fowners_t^{us}$	8,148,623	4	$Fowners_t^{eu}$ $Fowners_t^{other}$	20,806,634	9
Implication 7 Implication 8	Strategic interactions	$Top5ind_t^{i,j}$ $Importshare_t^{i,e}$ $Imp10C^{i}$ $Top5ind_t^{i,j} * Imp10C^{i}$ $Top5ind_t^{i,j} * Importshare_t^{i,e}$	8,031,913	1	$Top5ind_t^{i,j}$ $Importshare_t^{i,e}$ $Imp10C^{i}$ $Top5ind_t^{i,j} * Imp10C^{i}$ $Top5ind_t^{i,j} * Importshare_t^{i,e}$	20,398,790	5

Note: the AIC score is equal to $2k - \ln(L)$ where k is the number of parameters and L is the maximized value of the likelihood function. All specifications have constant terms and residuals clustered by industry (for United States exporters) or country (for non-U.S. exporters). While the variables used under implication 5 are included here as capturing hedging costs, they instead may be interpreted as capturing country size and fit better with implications 2 and 9

Figure 1: effective weight of the importer (χ i)
Formal weight δ i = 0.5, risk aversion: γ i = 3, γ e = 2.



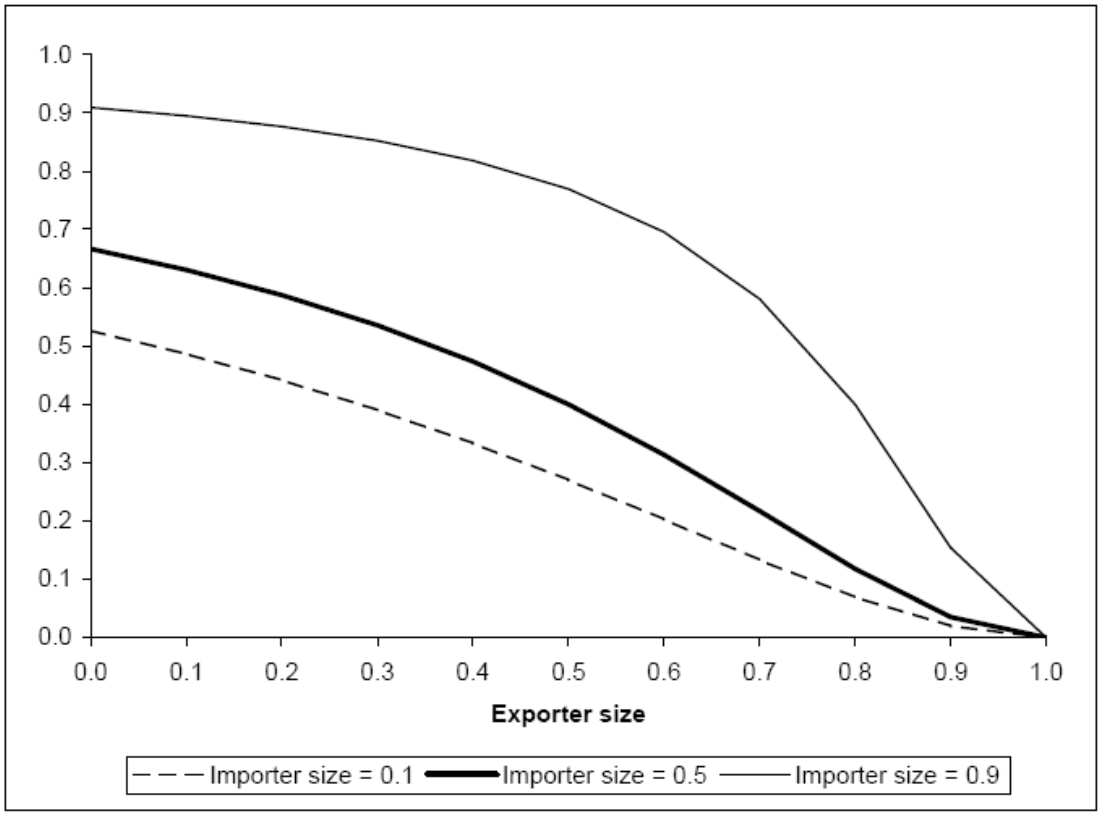
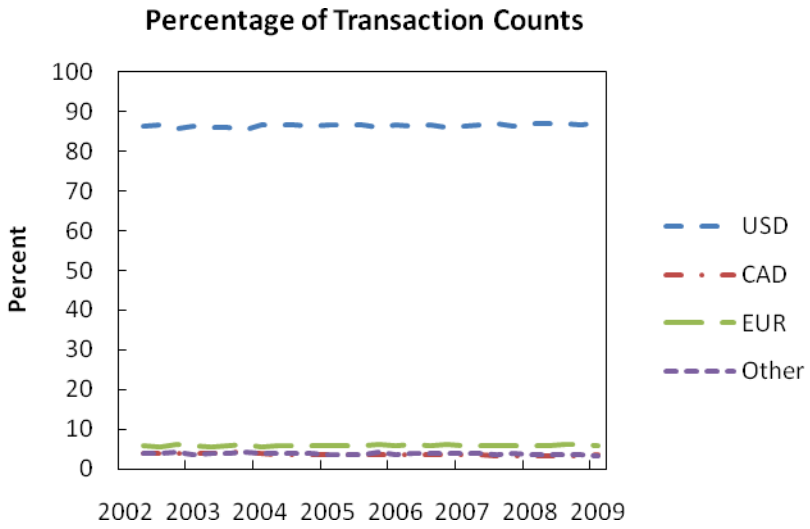


Figure 2. Currency Use in Invoicing Canadian Imports



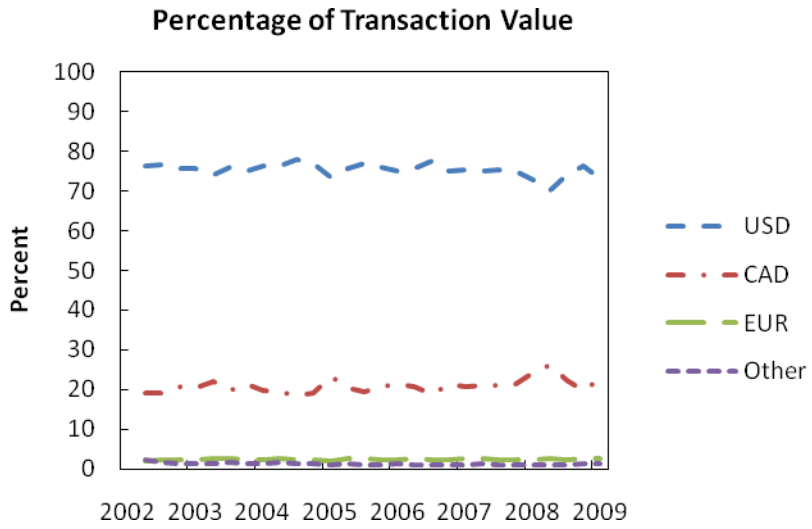
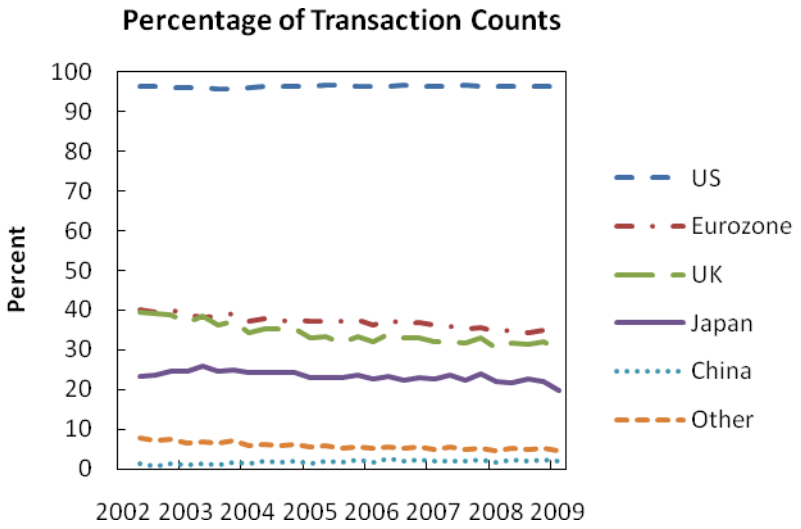


Figure 3. Prevalence of Producer Currency Pricing by Specific Exporters



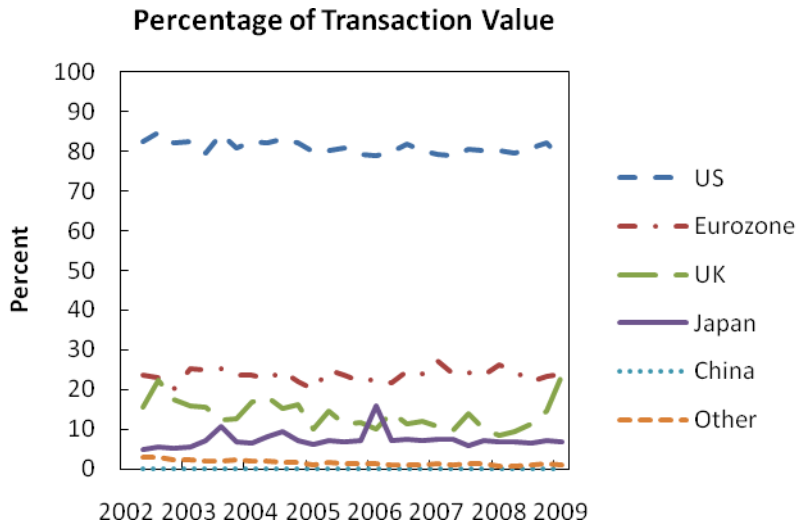


Figure 4. Exporter Market Share and Invoice Currency Selection

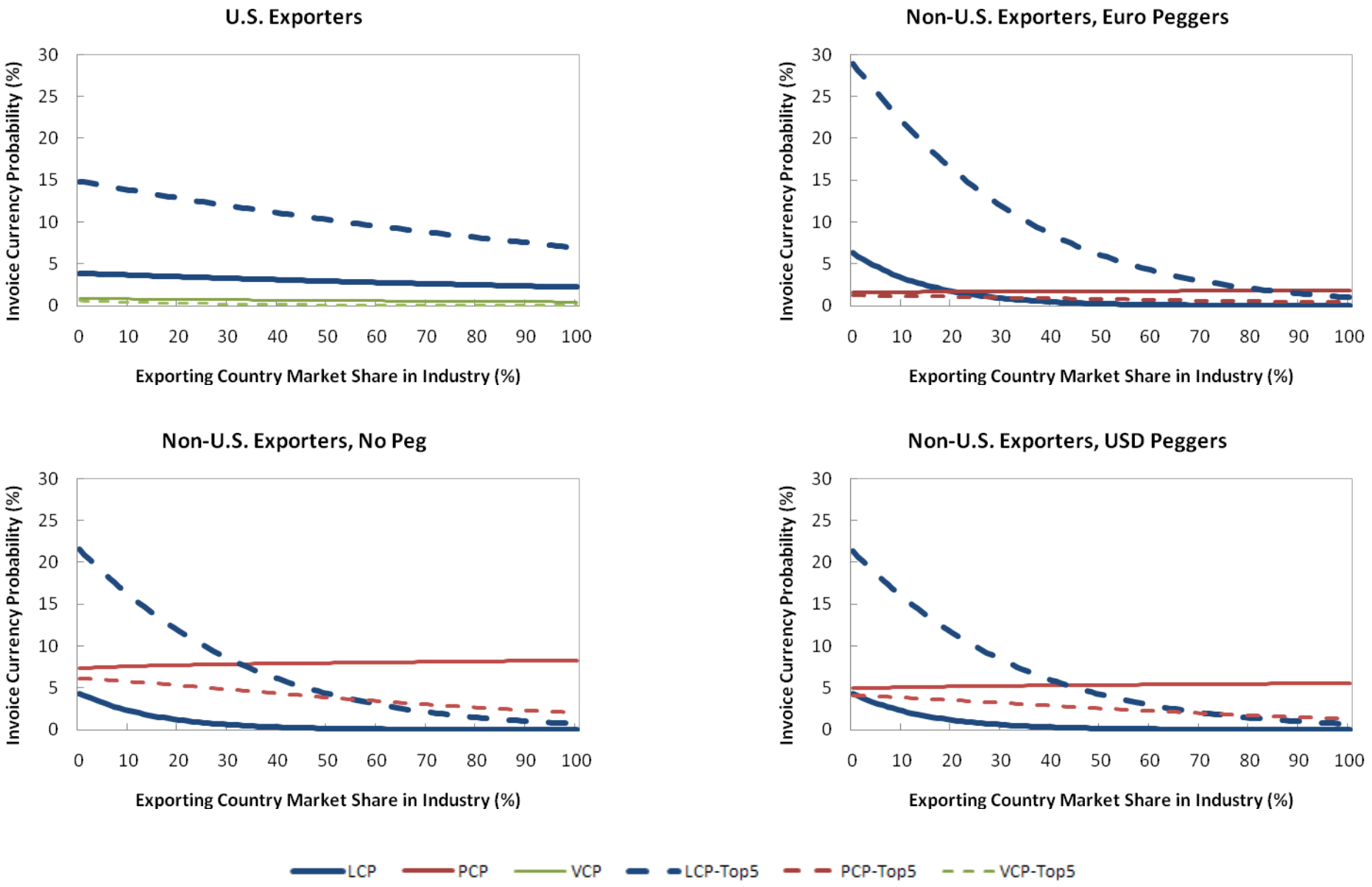
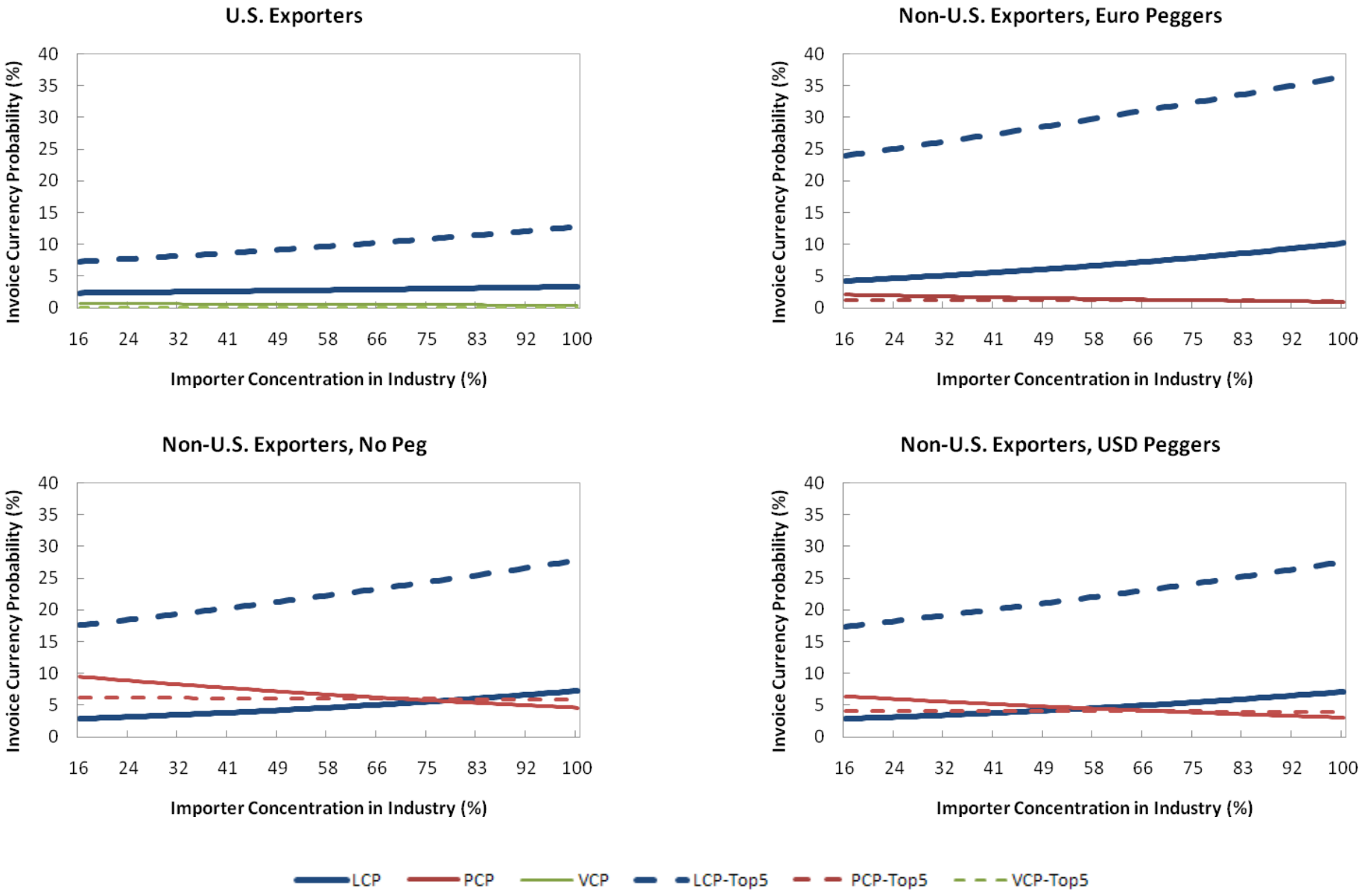


Figure 5. Importer Concentration and Invoice Currency Selection



Appendix: Constructing the hedging variable

As exposited in Goldberg and Tille (2008), the hedging motive for invoice currency selection reflects the covariances between exchange rates and producer marginal costs $\rho(m_{ed}, s_{ed})$ and $\rho(m_{ed}, s_{ev})$. The idea is that the producer should choose an invoicing currency so that revenues are highest when costs are highest, with this positive correlation helping to hedge producer profitability. Producer marginal costs are modeled as $m_{ed} = w_e + (1-\alpha)/\alpha \cdot c_d$ where w_e is the wage or producer price index representing the unit marginal cost of the exporter and c_d is the sensitivity of marginal costs to changes in demand, representing the shape of the production frontier.[30] We proxy for exporter marginal costs in each country by constructing quarterly values for m_{ed}, where the cost of inputs w_e are the logs nominal producer price indices in exporter's currency, α is set at 0.65, and c_d is the log of real consumption in Canada as the export destination market "*d*". The PPI values are more desirable than pure wages since they internalize the cost of imported inputs that can influence hedging decisions. (Even more desirable would be industry-specific production costs). s_{ev} is in units of currency *e* per unit of currency *v* so an increase is a depreciation of currency *e*.

We compute each m_{ed} and run a rolling correlation with three bilateral exchange rates, which are vis-à-vis dollars, euros, and CAD, over 8 prior quarters of data. A desirable hedging currency has a positive correlation and a higher correlation than the two alternative currencies. If no currencies have recent positive correlations with the m_{ed}, then all hedge dummies are given a zero value at a particular date. We construct rolling correlations of exporter bilateral exchange rates against the proxy for exporter costs over the prior 8 quarters and use the pattern of observed correlations in an exporter's recent past to determine his hedging preference in period *t*. In our data, the general trend is that the CAD is a good hedge early on in the period and late in the period. USD and EUR get some action in the middle.

[30] For the approximately 50 countries covered as exporters to Canada we have wage data and producer price index data. For the 26 countries across which both wage and PPI data are available, these series tend to be highly correlated in most cases except for France and Japan, and positively but less strongly correlated for parts of Asia. Wage data were nominal and in the home currency from the ILO : http://laborsta.ilo.org/ . PPI data are from the IMF's IFS database.

Appendix Table 1. Country Frequency in Canadian Import Transactions

		Percent of Observations	
Country	Frequency	By Count	By Value
Algeria	2,804	0.01	1.10
Angola	638	0.00	0.97
Australia	189,876	0.44	0.43
Austria	264,842	0.61	0.32
Belgium	283,294	0.65	0.43
Brazil	293,295	0.67	0.74
Chile	70,499	0.16	0.35
China	2,086,341	4.78	7.29
Czech Republic	166,495	0.38	0.07
Denmark	248,269	0.57	0.35
Finland	161,066	0.37	0.26
France	848,044	1.94	2.44
Germany	1,366,460	3.13	2.69
Hong Kong	379,889	0.87	0.16
Hungary	121,353	0.28	0.06
India	638,209	1.46	0.44
Indonesia	305,158	0.70	0.24
Iraq	239	0.00	0.45
Ireland	137,397	0.31	0.53
Israel	211,370	0.48	0.22
Italy	1,039,771	2.38	1.31
Japan	1,119,697	2.57	3.66
Malaysia	290,031	0.66	0.64
Mexico	804,077	1.84	3.67
Netherlands	361,875	0.83	0.51
Nigeria	5,889	0.01	0.65
Norway	90,394	0.21	1.36
Pakistan	133,013	0.30	0.07
Peru	63,036	0.14	0.33
Philippines	229,161	0.53	0.23
Poland	155,627	0.36	0.16
Portugal	133,610	0.31	0.10
Russia	59,141	0.14	0.44
Saudi Arabia	10,028	0.02	0.38
Singapore	159,667	0.37	0.32
South Africa	110,256	0.25	0.18
South Korea	593,440	1.36	1.65
Spain	336,599	0.77	0.36
Sweden	366,043	0.84	0.54
Switzerland	458,790	1.05	0.55
Taiwan	970,169	2.22	0.96
Thailand	467,332	1.07	0.52
Turkey	226,562	0.52	0.18
United Kingdom	1,027,244	2.35	3.34
United States	24,654,574	56.49	54.96
Venezuela	14,926	0.03	0.38
Vietnam	193,860	0.44	0.15
Total	41,850,350	95.89	97.12

Appendix Table 2. Descriptive Statistics for Explanatory Variables

		Non-US				US			
Name	Dimensionality	Min	Mean	Max	Std Dev	Min	Mean	Max	Std Dev
top5ind	HS4, Quarter		0.05				0.05		
intensity	HS4	0.00	0.10	0.78	0.09	0.00	0.11	0.78	0.10
top10share	HS4	0.16	0.48	1.00	0.18	0.16	0.52	1.00	0.20
fowner_eu	Industry, Year	0.00	0.13	0.15	0.02	0.00	0.13	0.15	0.02
fowner_us	Industry, Year	0.00	0.29	0.39	0.05	0.00	0.29	0.39	0.06
fowner_other	Industry, Year	0.00	0.04	0.05	0.01	0.00	0.04	0.05	0.01
fxshare	Currency, Year	0.00	69.22	89.27	29.77	0.00	84.08	89.27	15.26
coefvar	Country, Quarter	0.01	0.05	0.42	0.02	0.02	0.05	0.07	0.02
usdhedge	Country, Quarter		0.26						
eurhedge	Country, Quarter		0.27				0.38		
cadhedge	Country, Quarter		0.33				0.36		
dollarpeg	Country, Quarter		0.17						
europeg	Country, Quarter		0.30						
importshare	HS4, Country, Quarter		0.06				0.62		
ref	HS4		0.11				0.20		
walras	HS4		0.02				0.03		

Appendix Table 3. Shares of HS4 Industries with Levels of Importer Concentration

Percentile	***By Observation Counts***			***By Transaction Value***		
	Top 5	Top 10	Top 20	Top 5	Top 10	Top 20
0-25%	10.8	2.3	0.3	17.0	5.0	1.0
25-50%	39.6	24.1	10.2	34.3	23.4	15.9
50-75%	31.9	37.8	32.1	30.8	37.8	25.0
>75%	17.7	35.9	57.5	17.9	33.8	58.1