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Foreign Currency Invoicing of Domestic Transactions as a Hedging Strategy Theory and Evidence for Uruguay

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Abstract

In this paper we study the factors associated to the use of the US Dollar for the invoicing of domestic transactions, as a common practice of Uruguayan firms. We first build a basic model to understand the role that foreign currency invoicing might have as a financial hedging strategy in the case of a firm that exports in foreign currency, has imported imports and has both assets and liabilities in domestic and foreign currency. We show that risk averse firms might use their flows position in order to hedge currency mismatches in their stocks. Domestic invoicing of transactions is more likely the larger are negative financial positions of firms, the bigger the share of imported inputs and the smaller the share of exports. We then estimate several models for the fraction of domestic sales invoiced in foreign currency and find evidence that supports the intuition of the model.

JEL: G, G30, G31

Keywords: Hedging, Exchange Rate Risk, Dollarization, Uruguay

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I Introduction

Despite a long period of relative domestic stability and the deployment of a package of regulatory and market development initiatives starting in 2002, Uruguay continues to display unusually high and persistent levels of dollarization (see Licandro and Mello (2017)). The persistence of dollarization hinges on the prospects of peso denominated market growth, and thus has an effect on long term financial stability in the case of a small open economy like Uruguay due to the lack of insurance against the main source of shocks in a small open economy –i.e. real exchange rate shocks–.

Recent research has shown that Uruguayan firms not only have large degrees of asset and liability dollarization (Barón et al. (2017)) e.g. stock dollarization, but also show an intensive use of the dollar for the pricing and invoicing of domestic transactions. This research has also shown that, unlike most of the invoicing literature, the choice of invoicing currency is not dichotomic: most firms show invoicing shares different from zero or one.

The choice of invoicing currency is important for several reasons. The early literature (Baron (1976), Donnenfeld et al. (1991)) concentrates on the impact of invoicing choice on the pricing and volume of exports under alternative exchange rate systems. Ahtiala et al. (1999) show that giving the choice of invoicing to a client is equivalent to a price cut, and helps domestic firms to gain market share for their exports. Friberg (1998) shows that foreign currency invoicing has a role in stabilizing export demand, very much on the spirit of pricing to market (which he calls incomplete pass-through) and shows that the decision is important in floating exchange rates because it affects the level of exports that a country generates. Other authors have stressed that invoicing affects the short term pass-through from exchange rates to inflation and the empirical observance of the law of one price (Devereux et al.(2004), Engel (1999)) and the conduct and effectiveness of monetary policy (Kang (2015)), the optimal choice of exchange rate system and the micro adjustment of prices. While the economic literature has a long list of research that deals with the issue of the dollarization of invoicing in international trade, very few papers deal with the issue of the dollarization of prices or invoicing of domestic transactions.

Recently, Drenik and Perez (2017) have shown that dollar pricing of domestic sales might be a choice for firms that seek to hedge inflation risk absent other inflation-indexation mechanisms, particularly in the case of durable goods. Levina and Zamulin (2006) argue that, in the presence of price rigidities and in the absence of other indexation mechanisms, dollar pricing might be an optimal strategy for a firm. There are no papers, however on the hedging properties of domestic invoicing.

In this paper we investigate the financial risk hedging factors associated with the practice of the use of the dollar for the invoicing of domestic transactions. We first build a basic model to understand the role that foreign currency invoicing might play as a financial hedging strategy in the case of a firm that exports in foreign currency, has imported inputs

and has both assets and liabilities in domestic and foreign currency. We show that risk averse firms might use their flows position in order to hedge currency mismatches in their stocks. Domestic invoicing of transactions is more likely the larger are negative financial positions of firms, the bigger the share of imported inputs and the smaller the share of exports. We then estimate several models to the fraction of domestic sales invoiced in foreign currency and find evidence that supports the intuition of the model.

The rest of the paper proceeds as follows: section II makes a brief discussion of related literature, section III presents a very simple model of the choice of invoicing currency as a hedging device, section IV studies the determinants of the share of foreign currency invoicing of domestic sales and section V concludes.

A Literature Review

This work is part of the research agenda about the phenomenon of dollarization carried out by the Central Bank of Uruguay. Therefore, from the point of view of the existing literature, this work draws on two main sources, on the one hand the literature on the choice of the currency in which companies invoice; and on the other side, literature about dollarization, particularly related to the Uruguayan case.

The literature on Currency Invoicing has been developed within the framework of international trade and finance. In this context, there is a vast literature mainly for Japan, since its large firms are mainly exporters and with subsidiaries outside of Japan, so several currencies come into play, the currency of the country receiving the exports, the currency of the country in which the production and the Japanese currency are related, since it is the relevant currency for the shareholder of the firm. From these works, they were developed for works for Europe and Canada mainly.

Donnenfeld, and Haug (2003) empirically test the optimal choice of currency of invoice for imports into Canada. Their results support the hypothesis that there is a positive relationship between the extent of invoicing in the importer's national currency and exchange rate risk, and a negative relationship between invoicing in the exporter's currency as well as invoicing in a third currency and exchange rate risk.

Chung (2016) modeled theoretically and empirically how exporters' dependence on imported inputs affects their choice of invoicing currency, for a large set of trade transactions of UK firms with non-EU countries. Concludes that exporters that depend more on foreign currency-denominated inputs are less likely to price in their home currency.

Döhring (2008) discusses exchange rate exposure in terms of transaction risk in the European Union. The paper argues that domestic-currency invoicing and hedging with exchange rate derivatives allow a fairly straightforward management of transaction and translation risk and discusses under which circumstances their use is optimal. It finds that euro-area

exporters have instruments a great menu of options to limit the adverse impact of euro appreciation and that they use financial derivatives intensely.

Martin and Mejaen (2012) use a European exporter firms survey describing that large firms are more likely to use another currency. They show that for large firms, pricing in another currency are also more likely to hedge against exchange rate risk.

Lyonnet, Martin and Mejaen (2016) in a revised version of the previous reference extending the analysis in a model of currency choice and hedging that rationalizes their findings. When the cost of hedging has a fixed component, large firms are more likely to hedge and to invoice in the importer's currency. This has implications for exchange rate pass-through.

Licandro and Mello (2015) using the Household Financial Survey 2013 presented and analyzed the phenomenon of cultural dollarization in the Uruguayan economy. This paper empirically analyzes the determinants of financial and cultural households, concluding that a level of household dollarization responds to one related to the pricing system and the holding of assets denominated in foreign currency. The savings of both financial and real assets makes Uruguayans think of dollars, once the fundamentals of factor value there is no need to relate to foreign currency.

Mello (2016) used the Annual Economic Activity Survey 2012 to analyze the dollarization of Uruguayan companies. The dollarization of the assets of Uruguayan companies responds to the dollarization of inputs and to the transability of their output, as well as to the level of indebtedness and the currency in which they are indebted.

Mello (2017) takes over the work of Licandro, Mello and Odriozola (2014) and formalizes the Uruguayan firms exchange rate risk hedging strategies. Basically, it endogenously models the use of financial derivatives versus alternative strategies such as foreign currency invoicing and the holding of high levels of liquidity for precautionary reasons. It concludes that strategies are substitutes but not exclusive and that large companies access sophisticated risk management tools and strategies.

The rest of the document is developed as follows: Section 2 presents a portfolio management model for the choice of the currency in which the firm invoices its sales; Section 3 presents the empirical approach, data description and empirical strategy; Section 4 concludes.

II Theoretical Framework

A A simple model of invoicing currency choice for domestic sales

Consider the profits of the firms that sell in the domestic market. The firms are divided in two groups exporting (X) and non-exporting (NX) firms. The expected profits of the exporting firm are:

$$E(\pi_i^X) = E(R_i^X - C_i^X + FM_i^X) \quad (1)$$

Similarly, the expected profits of the non-exporting firm are:

$$E(\pi_i^{NX}) = E(R_i^{NX} - C_i^{NX} + FM_i^{NX}) \quad (2)$$

Where R_i and C_i are the operating revenues and costs for exporting and non-exporting firms respectively, while FM_i is the financial margin generated by the assets and liabilities of the firm. We assume that both costs and financial margin have a similar representation for X and NX firms, while revenues in the exporting firm include sales abroad, which are priced and invoiced in foreign currency (FC). This assumption, very close to the small open economy paradigm, is also supported by available evidence on invoicing of exports for developing countries as in Burnstein and Gopinath (2016), and particularly for Uruguay as in Baron et al. (2017).

A.1 Firms Revenues

Let's consider that the X produces an output Q_i^X , that can be exported in foreign currency ($q_i^{X^*}$), sold in the domestic market and be invoiced in foreign currency ($q_i^{X^{FC}}$), or sold in the domestic market but be invoiced in local currency ($q_i^{X^{LC}}$), so that:

$$Q_i^X = q_i^{X^*} + q_i^{X^{FC}} + q_i^{X^{LC}} \quad (3)$$

Thus, we can consider $q_i^X = q_i^{X^{FC}} + q_i^{X^{LC}}$ as the total sales to the domestic market, and $\delta_i^X = \frac{q_i^{X^{FC}}}{q_i^X}$ as the portion of domestic sales invoiced in foreign currency.

We can write the *total revenues* of the X firms as:

$$R_i^X = S.P^*(q_i^{X*} + \delta_i^X q_i^X) + P^X(1 - \delta_i^X)q_i^X \quad (4)$$

Where P^* is the international price of the exported good, which we assume the firm takes as given as the country is a small open economy, P^X is the domestic price of the exportable good expressed in local currency, and S is the spot nominal exchange rate (a random variable for the firm). The choice variable of our (very simple) model is δ_i^X , which represents the share of domestic sales that the firm sells in foreign currency in the domestic market.

We assume that the price is set at the beginning of the period according to the law of one price, so that in expected terms the price of the tradable good is the same in both domestic and foreign markets. The domestic price is set at the beginning of the period but profits are computed at the end of the period.

Non exporting firms produce an output, Q_i^{NX} , that can be sold only in the domestic market and can be invoiced in foreign currency or in local currency, so that:

$$Q_i^{NX} = q_i^{NX^{FC}} + q_i^{NX^{LC}} \quad (5)$$

Where $\delta_i^{NX} = \frac{q_i^{NX^{FC}}}{Q_i^{NX}}$, is the fraction of sales invoiced in foreign currency by the non exporting firm. Thus, we can express the *total revenues* of the NX firm as:

$$R_i^{NX} = S.P^{NX^{FC}} \delta_i^{NX} Q_i^{NX} + P^{NX}(1 - \delta_i^{NX})Q_i^{NX} \quad (6)$$

We also assume that the firm sets its price to be equal at the beginning of the period and in expected terms, so that $P^{NX^{FC}} = \frac{P^{NX^{LC}}}{S}$ and $E(P^{NX^{FC}}) = E(\frac{P^{NX^{LC}}}{S})$.

A.2 Firms Costs

We assumed that exporting and non-exporting firms have a mix of domestic and imported inputs, as a mix of foreign currency and local currency nominated assets and liabilities. Both type of firms are price takers in real and in financial markets. For simplicity, we suppose the existence of only one domestic and imported input.

$$C_i = \omega d_i + S.\omega^* m_i \quad (7)$$

Where ω is the price of the domestic input and ω^* is the price of the imported input expressed in foreign currency, d_i is the quantity of domestic input and m_i the imported input.

A.3 Firms Financial Margin

The financial margin of the firm is the result of incomes and outcomes generated by assets and liabilities, and we consider they can be nominated in local or in foreign currency. So, the firms will have a financial margin in local currency and financial margin in foreign currency. We assume that all interest rates are arbitrated and the firms have no market power in determining the financial returns. We also assume that interest rates associated with the firms assets and liabilities are fix, and that the balance sheet structure during the period remains unchanged.¹

$$FM_i = A_i^{LC}(1 + i_A^{LC}) - L_i^{LC}(1 + i_L^{LC}) + S[A_i^{FC}(1 + i_A^{FC}) - L_i^{FC}(1 + i_L^{FC})] \quad (8)$$

We depart from the literature on invoicing currency choice and hedging by assuming that there are no hedging instruments like exchange rate forwards or futures. In several emerging countries foreign exchange derivatives markets are very shallow, and their use by non-financial firms is very limited, likewise if the size of the business sector is small, the development of hedging instruments will be restricted².

A.4 The Firms Problem

As in the previous literature, we will assume that the firm is risk averse, so that it optimizes a function of the profits. For simplicity we assume that the firm minimizes the variance of profits by choosing the share of domestic sales that is invoiced in foreign currency restricted by an expected return. The only source of uncertainty in the problem is the nominal exchange rate. Therefore the problem of the firm can be formulated as:

¹This assumption is strong since firms do adjust their balance sheets in order to hedge financial risks. In the case of Uruguay, the financial system is shallow, this constraints firms ability to manage their financial liabilities, and the change in leverage and liability dollarization has been very slow or non-existent in the firms data (see Licandro et al.(2014) and Mello(2017)). The data shows that despite strong changes in the composition of the asset side of the balance sheet of Uruguayan firms, a large level of the firms choose to hold open foreign currency positions.

²See Lyonnet et al. (2016).

Minimize

$$Var(\pi_i) = (R_i - C_i + FM_i)^2 \sigma_S^2 \quad (9)$$

Subject to:

$$E(\pi_i) = E(R_i - C_i + FM_i) \geq 0 \quad (10)$$

For the *exporting firms*, we can express the variance of benefits as:

$$Var(\pi_i^X) = [P^*(q_i^{X*} + \delta_i^X q_i^X) - \omega^* m_i + FM_i^{FC}]^2 \sigma_S^2 \quad (11)$$

The First Order Condition of the minimization gives us the optimal portion of the domestic sales invoiced in foreign currency by the exporting firm:

$$\delta_i^X = \frac{\lambda(SP^* - P^X)}{2(P^* q_i^X) P^* \sigma_S^2} - \frac{(P^* q_i^* - \omega^* m_i) + FM_i^{FC}}{P^* q_i^X} \quad (12)$$

Since we assume that the exporting firm charges the same price in the domestic market than abroad, $SP^* - P^X = 0$, the fraction of sales to the domestic market invoiced in foreign currency is:

$$\delta_i^X = - \frac{(P^* q_i^* - \omega^* m_i) + FM_i^{FC}}{P^* q_i^X} \quad (13)$$

In this framework, the incentives to invoice domestic sales in dollars increase with the quantity and price of foreign inputs, when the firm has a long position on foreign currency in its balance sheet, and when sales abroad (exports) fall. The formula suggests that there is a mismatch in stocks and other in flows. If the revenues from export cover the costs derived from imported inputs (mismatch in flows is zero) the only incentive to invoice domestic sales in foreign currency comes from the mismatch in stocks. In the case of non exporting firms, even when there is a zero FFM there is a need to hedge the flow mismatch derived from the existence of imported inputs.

Similarly, for the non-exporting firms the variance of benefits is:

$$Var(\pi_i^{NX}) = [P^{NXFC} \delta_i^{NX} q_i^{NX} - \omega^* m_i + FM_i^{FC}]^2 \sigma_S^2 \quad (14)$$

In this case, the *F.O.C.* for the non exporting firms is:

$$\delta_i^{NX} = \frac{\lambda(SP^{NX^{FC}} - P^{NX})q_i^{NX}}{2(P^{NX^{FC}} q_i^{NX})\sigma_S^2} + \frac{\omega^*m_i - FM_i^{FC}}{P^*q_i^X} \quad (15)$$

Similarly as the case of the exporting firm, we suppose that the non-exporting firm charges the same price in local currency as in foreign currency, thus, $SP^{NX^{FC}} - P^{NX} = 0$. Then the fraction of domestic sales invoiced y foreign currency by the non-exporting firm is represented as:

$$\delta_i^{NX} = \frac{\omega^*m_i - FM_i^{FC}}{P^*q_i^X} \quad (16)$$

Consequently, foreign currency invoicing depends positively on the foreign currency liabilities and inputs.

III Empirical Approach

A The Dataset and the Descriptive Statistics

The data used in this work combines several firm level surveys with a common statistical sampling frame, carried out by the National Institute of Statistics (INE) in coordination with the Central Bank of Uruguay (BCU).

The dataset represents all the firms installed in Uruguay with more than 50 employees, excluding the agricultural sector. It's a merge of an invoicing and financial stability survey done in June 2016 to 364 companies with data for 2015 (Invoicing Survey, IS); with the 2012 Annual Economic Activity Survey (AEAS). The AEAS was made to prepare the base year of the National Accounts, covers 5041 companies and is representative of the whole universe of companies installed in the country with more than 10 employees. The IS sample is a sub-sample of the AEAS, therefore, to make the descriptive statistics we used the IS expander.

Table 1 shows the sectorial distribution of the sample. The main sector is manufacturer industry that represents approximately a half of the sample.

Table 1: Firms Sectorial Distribution

Country	Percent
Uruguay	87.91
Argentina	1.37
Panama	1.10
Spain	1.10
United States	1.10
Brazil	0.82
France	0.82
Switzerland	0.82
Germany	0.55
Luxemburg	0.55
Netherlands	0.55
Other Various	3.31
Total	100

As shown in Table 2, most of these firms are owned by Uruguayan capitals, only 12% of the firms in the IS are owned by foreign shareholders.

Table 2: Firms Capital Origin Distribution

Economic Sector	Percent
Industry	46.98
Retail	18.68
Transport	11.54
Real Estate	10.99
Health and Social Services	4.4
Education	3.57
Hotels and restaurantes	2.47
Construction	0.82
Mining	0.27
Utilities	0.27
Total	100

Approximately 46% of the companies export some of their production. Table 3 shows the exports geographical distribution. As shown in Table 3 the principal destiny for the surveyed firms exports is Mercosur, followed by China, the Euro Area and USA. Tax Free Zones in Uruguayan territory are a relevant exports destiny for 10% of the firms in the survey. Dollar is the principal currency in which exports are nominated, even in the case of regional trading partners, representing 84% of total exports.

Table 3: Firms first destiny for exports

Country/Region	Percent
Mercosur	40.62
Latam	53.11
USA	8.59
China	10.16
Asia	4.68
Asia & China	14.84
Free Zones	9.36
Europe	9.36

Table 4 represents the geographical distribution of inputs. For 27.68% of the surveyed companies China is its principal inputs provider. As in exports, Mercosur and USA are relevant for Uruguayan firms.

Table 4: First provider of firms' imports

Country/Region	Percent
Mercosur	35.71
Latam	40.19
USA	10.27
China	27.68
Asia	5.37
Asia & China	33.05
Europe	14.31

To describe the whole population of the Uruguayan firms, we expand the data using the IS's expansion factor. Table 5 presents some descriptive statistics for the firms' universe.

In the sample 12% of the firms in the surveys are owned by foreign capitals, expanded to the whole population of firms with more than 50 employees, the portion of foreign owned companies reduces to 7.2%. Likewise, 4.9% of the all firms have subsidiaries.

Related to inputs structure, 59% of the firms buy some domestic inputs in USD and 66% use some imported inputs. However if we look how many have a relevant weight of inputs buy in USD (>10%) the proportion reduces to 55% of the Uruguayan companies.

Table 5: Firms Invoicing Survey Description

	Obs	Mean	Std. Dev.	Min	Max
Firm owns other firms	339	0.049	0.217	0	1
Foreign capital	339	0.072	0.259	0	1
Firm buys domestic inputs in USD	339	0.591	0.492	0	1
Firm uses imported inputs	339	0.666	0.472	0	1
Firm inputs in USD>10%	339	0.552	0.498	0	1
Firm can set currency of bank debts	339	0.570	0.496	0	1
Firm can set currency of commercial debts	339	0.532	0.499	0	1
Firm can set currency of all debts	339	0.407	0.492	0	1
Firm has some debt in USD	339	0.520	0.500	0	1
Exporting firm	339	0.319	0.467	0	1
Firm domestic invoice in USD	339	0.493	0.501	0	1
Firm invoice in USD >10%	339	0.334	0.472	0	1

If we analyze firms' preferences towards debt, 57% of the firms declare to have the possibility of choosing the currency of their banking debts, and 53% declare having power to set the currency for commercial debts. The portion of firms that can simultaneously choose the currency in which they will take commercial and banking debts is 40.7%. As a result, 52% of the Uruguayan companies have any debt nominated in USD.

Half of the companies make some sales in USD, but only 33.4% invoice more than 10% of the total sales in USD³.

Table 6 presents descriptive statistics for the relevant variables in the theoretical framework. Following Döhring (2008) we introduce a measure of market power. He used firm's size to approximate market power, we prefer using Lerner Index due it is available from our dataset⁴.

The share of USD invoiced in domestic markets is 24% of total sales, if we focus in those firms that invoice more than 10% of their sales in USD; the mean dollarized invoicing is 69%. We see that the weight of exports in total sales is higher for those firms that invoice in USD to domestic markets. Also, these firms have in average higher dollar nominated inputs.

³We opted to do this distinction and we will consider dollarized invoicing those firms that sell more than 10% of total sales in USD to the domestic markets, this ensures that selling in USD is a current practice and not corresponds to a particular business in USD.

⁴In the appendix A.1 we present the histograms of variables in Table 6.

Table 6: Firms characteristics

	Obs	All Firms		Invoice in USD>10%			DO NOT invoice in USD		
		Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
% Exports to Sales	339	11.214	26.286	137	19.441	31.524	202	7.111	22.186
% USD invoice in domestic market	339	23.999	36.671	138	69.350	30.397	201	1.295	2.825
% of foreign inputs	339	25.032	34.171	137	41.147	38.051	202	16.990	28.938
% of domestic inputs in USD	339	21.786	28.639	137	38.888	34.133	202	13.251	20.781
% of USD inputs	339	38.556	37.793	137	63.210	34.468	202	26.250	33.115
Market power	336	38.556	27.634	141	35.685	26.143	195	40.192	28.378
Liquidity Share	333	9.603	12.604	140	6.784	8.000	193	11.647	14.777
Debt Dollarization	330	13.116	22.914	139	22.705	27.433	191	7.539	17.620
Leverage=Liabilities/Assets	334	51.278	69.583	140	52.585	83.664	194	50.534	60.309
Efficiency	333	271.026	39.593	140	281.303	36.126	193	263.571	40.410
Bank Debt	333	78.679	41.019	140	85.000	35.835	193	74.093	43.926

Analyzing the financial structure of firms, we do not appreciate significant difference in leverage between USD sellers and Peso sellers, but the dollarization of the debt is much higher⁵.

Inputs and debt dollarization is significantly higher for those firms that invoice in USD, 63% of the inputs that USD sellers use are nominated in USD, while those firms that invoice less than 10% of their sales in USD have an input dollarization of 26%. Most of these USD nominated inputs are foreign, but there is a significant portion of USD nominated inputs bought domestically. Debt dollarization is also higher for those firms that have a significant USD invoicing, 22.7% versus 7.5% with no significant difference in leverage.

B Empirical strategy

B.1 Models for foreign currency invoicing

The objective of this section is to obtain a consistent estimate of equation (13), since it is a more generalized specification, and includes equation (16). Methodologically we face three challenges: in the first place, the endogeneity of the variables linked to the risk hedging decision of the company, in particular the proportion of debt in dollars. Second, the censored characteristic of the dependent variable; and in a third instance, the accumulation of density around the zero and the one values, as it is presented in the histogram in Figure A.1 of the Appendix.

⁵Mello (2016) reported an average leverage for the EAAE of 44.3%, and 49.2% for all the firms with more than 50 employees. In this work we have an expanded sub-sample of those big firms and the leverage of 51.3% that seems consistent with this previous work.

In order to contemplate these methodological difficulties we estimated two specifications of the model by five different econometric techniques. We estimate a model for equation (13), controlling for some firms characteristics. The dependent variable is the fraction of sales in domestic markets invoiced in USD. We estimate by OLS, 2SLS and Tobit and Two Steps Tobit, due it is a censored variable with endogenous explaining variables as it was presented in the theoretical framework . Finally we estimated a Zero Inflated Beta Model (*ZOIB*), this technique not only considers the character of the dependent variable censored in the interval $[0,1]$, through the use of a Beta distribution function, but also allows to model the non symmetrical distribution, particularly the accumulation of probability in the extreme values of the distribution (zeros and ones), considering them a decision with a different nature from the intermediate proportions of the distribution⁶.

We estimated the following equation, which represents a lineal formulation for equation (13):

$$\delta_i = \alpha_i + \beta_1 m_i + \beta_2 l_i + \rho_k F_{ik} + \varepsilon_i \quad (17)$$

Where, F_{ik} , is a vector of k characteristics of the firm i . As it was suggested in section 2, dollarized inputs, m_i , and debt dollarization, l_i , are predetermined in the firms decision, so we should instrument them. However, from data we can reject the hypothesis of exogeneity for dollarization debt but not for the proportion of USD nominated inputs⁷. We do not include nominal exchange rate volatility and the level of the real exchange rate because we have cross-section data, both variables should be captured by the constant term.

The endogenous variable is debt dollarization and we instrument it with two variables: *Exports Share* in total sales and a measure of *Efficiency* which is the interaction of sales per branch and sales per employee expressed in logarithms. From an intuitive perspective, the correlation of exports share and dollarization of debts is quite straightforward. Firms that receive their income in USD will prefer to contract USD nominated debt, but not necessarily will invoice their sales to the domestic market in USD. Invoicing in USD is an attempt to transfer exchange rate risk from the firm to consumers, so it is not optimal for exporters to invoice in USD due it could reduce the demand of consumers that hold their income in local currency. In addition, we can think the exporter profile of a firm as structural, while the portion of domestic sales invoiced in foreign currency is a short term decision.

Efficiency of the firms is linked to its efficient management of debt and currency mismatches. Thus, an efficient firm should carefully choose how much debt will contract in each currency. The error of the real unobserved model for

⁶For a detailed description of this methodology see Ospina and Ferrari (2010, 2012), and for a complete discussion about Fractional Responses Models see Williams (2016).

⁷Tests of exogeneity, over identification restrictions and the significance of the instruments are presented in Table A.2. in Appendix.

domestic USD invoicing could be related to economic not observed environment. This does not seem to be related to firms efficiency. Additionally, both instruments are surveyed for 2012 while the dependent variable is defined for 2016, this contributes to argument in favor of the exogeneity of the instruments used⁸.

Table 7 shows the results for the different estimations for a first specification which does not include control variables⁹. Debt dollarization and USD nominated inputs have positive sign, as the model suggested. Thus the firm will select a higher portion of sales in USD if it has more outflows in USD. Foreign currency nominated inputs and debt both imply actual and future liabilities in foreign currency, this result implies that Uruguayan firms are using invoicing as hedging instrument to transfer exchange rate risk due to their structural exposure. The real exchange rate level and the nominal exchange rate volatility should be recovered by the constant term in a cross sectional specification. Equations (12) and (15) suggests that the level of real exchange rate should have positive sign, while nominal volatility should have a negative sign, note that we can not be conclusive with this first specification in this point, thus the constant term has different sign depending the econometric technique used.

Table 7: Results for Specification 1

	OLS	2SLS	TOBIT	IV_TOBIT	ZOIB
<i>Debt Dollarization</i>	0.215*** (0.079)	0.206 (0.240)	0.438*** (0.141)	0.799* (0.451)	0.209** (0.091)
<i>% of USD inputs</i>	0.367*** (0.054)	0.369*** (0.068)	0.687*** (0.101)	0.630*** (0.127)	0.340*** (0.070)
<i>Constant</i>	0.075** (0.034)	0.076** (0.033)	-0.285*** (0.070)	-0.325*** (0.077)	
N	326	326	326	326	326
N_unc			169	169	
N_lc			126	126	
N_rc			31	31	
<i>Wald_exog (p_value)</i>				0.364	
R2	0.171	0.171			
R2_a	0.166	0.166			

* p<0.10, ** p<0.05, ***p<0.01

Table 8 shows a more precise specification, using control variables such as *Liquidity Share*, *Firm's Size*, a *Foreign Capital Dummy* and an *Industry Dummy*. Debt dollarization and USD nominated inputs are positively correlated with USD invoicing in domestic markets.

Additionally, liquidity share in assets and the firm's size are negatively correlated with the foreign currency invoicing. This results suggests that holding higher portions of liquid assets is a hedging strategy for non sophisticated firms. Big companies with market power and subsidiaries of foreign companies are less likely to invoice in USD. A possible

⁸Table A.1 in the Appendix shows the correlation matrix of these variables

⁹For the Zero Inflated Beta Model marginal effects are presented.

explanation to this result is that bigger companies are much more sophisticated, so they are more likely to manage their structural exposure and do hedging with financial instruments¹⁰. Real exchange rate level seems to prevail against the nominal exchange rate volatility as a determinant of USD invoicing since the constant term has positive sign and it is statistically significant for all models estimated for this specification.

Table 8: Results Specification 2

	OLS	2SLS	TOBIT	IV_TOBIT	ZOIB
<i>Debt Dollarization</i>	0.252*** (0.077)	0.795*** (0.272)	0.469*** (0.136)	1.701*** (0.545)	0.209** (0.090)
<i>% of USD inputs</i>	0.410*** (0.056)	0.333*** (0.071)	0.701*** (0.104)	0.529*** (0.142)	0.382*** (0.072)
<i>Liquidity Share</i>	-0.467*** (0.161)	-0.434*** (0.115)	-1.068*** (0.349)	-0.990*** (0.308)	-0.524* (0.286)
<i>Size</i>	-0.019*** (0.007)	-0.024*** (0.008)	-0.028** (0.013)	-0.040*** (0.015)	(0.014) (0.009)
<i>Foreign Capital</i>	-0.127** (0.057)	-0.161** (0.066)	-0.190* (0.102)	-0.273** (0.129)	(0.093) (0.060)
<i>D_Industry</i>	-0.147*** (0.042)	-0.159*** (0.047)	-0.181** (0.074)	-0.208** (0.085)	-0.127*** (0.047)
<i>Constant</i>	0.664*** (0.193)	0.735*** (0.201)	0.619* (0.347)	0.797** (0.394)	
N	326	326	326	326	326
N_unc			169	169	
N_lc			126	126	
N_rc			31	31	
<i>Wald_exog (p_value)</i>				0.012	
R2	0.238	0.120			
R2_a	0.223	0.104			

* p<0.10, ** p<0.05, ***p<0.01

¹⁰See Mello (2017)

IV Conclusions

This paper continues the dollarization research and gives a response to the fact that Uruguayan firms sell goods and services nominated in USD in domestic markets. Invoicing in foreign currency is a hedging strategy for domestic firms that do not access to sophisticate financial instruments. The portion of inflows in USD generated by firms is determined by actual and future USD outflows. The productive and financial structure of the firms defines foreign currency invoicing.

Firms with market power and foreign companies subsidiaries are less likely to use this strategy, this is related to the fact that they accede to financial hedging in banking system or with their parent companies. This fact could be related with the high cost of hedging with derivatives in a non developed financial market as the Uruguayan. The exposure to foreign trade in firms is relevant only for the imports, exporters have no difference in the domestic market invoicing with no tradable companies.

Hedging financial risk through invoicing in foreign currency to the domestic market does not seem to be an efficient strategy. Although it implies reducing the mismatch of currencies through the generation of a flow of income in foreign currency, in theory it is inefficient in at least two ways: on the one hand, implies maintaining high levels of liquidity with it associated costs; and on the other hand, it could reduce the demand that faces the firm in the domestic market. This possible reduction in demand is due to the fact that domestic consumers, whose incomes are mostly in national currency, are not necessarily willing to have a currency mismatch, mainly if they finance consume with debt, as in the case of durable goods.

Invoicing in dollars seems to be an attempt of the firms of transferring exchange rate risk to consumers. This attempt will be feasible depending on the elasticity of the demand for domestic goods to the level and volatility of the foreign currency.

A natural extension to this work is to determine on the demand side the elasticity and propensity to consume goods denominated in foreign currency by consumers, in order to quantify endogenously if invoicing in foreign currency is really optimal for firms. This seems relevant for determinate the impact of this invoicing practice over the consumption of durable goods, particularly if it's financed through household consumption credit.

Likewise, it should be pointed out that small firms that are mostly focused on the domestic market have difficulties in accessing more efficient instruments for the management of exchange rate risk. Actually, the explanation to not using hedging financial instruments points to the high costs and the little diffusion of these instruments. This implies that the authorities have a role to play in the generation and promotion of a market of derivatives that allows to manage the risk efficiently, benefiting domestic consumers in turn.

A Appendix

Figure A.1: Share of USD invoicing in domestic market

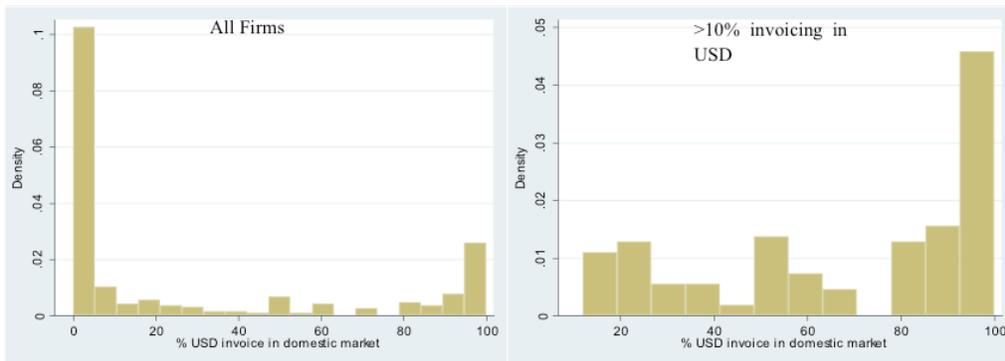


Figure A.2: Exports to total sells

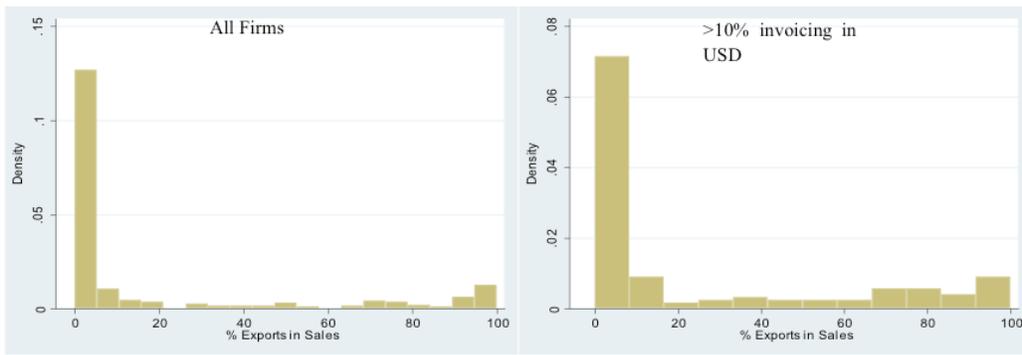


Figure A.3: Foreign inputs

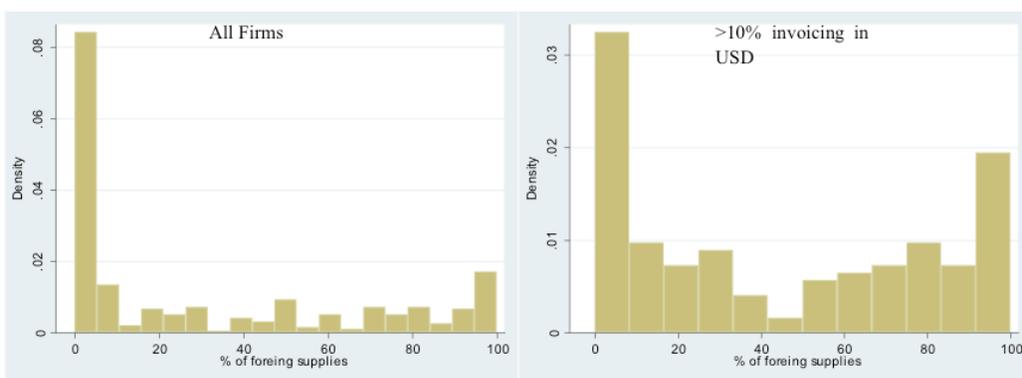


Figure A.4: Domestic inputs in USD

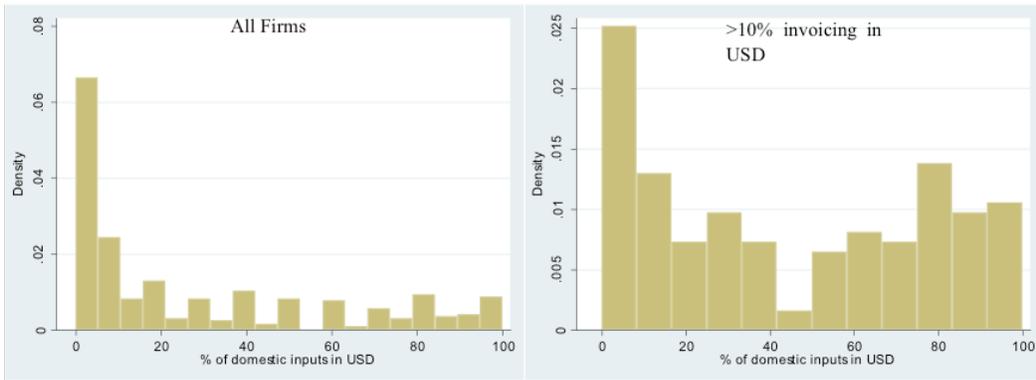


Figure A.5: Inputs bought in USD

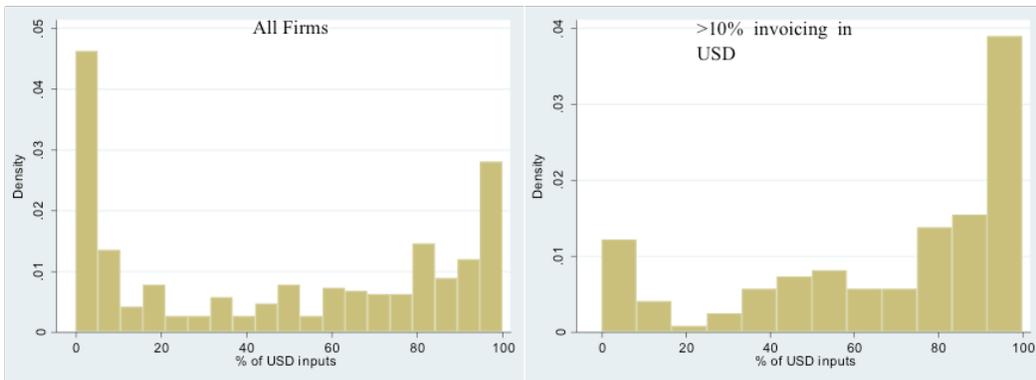


Figure A.6: Debt Dollarization

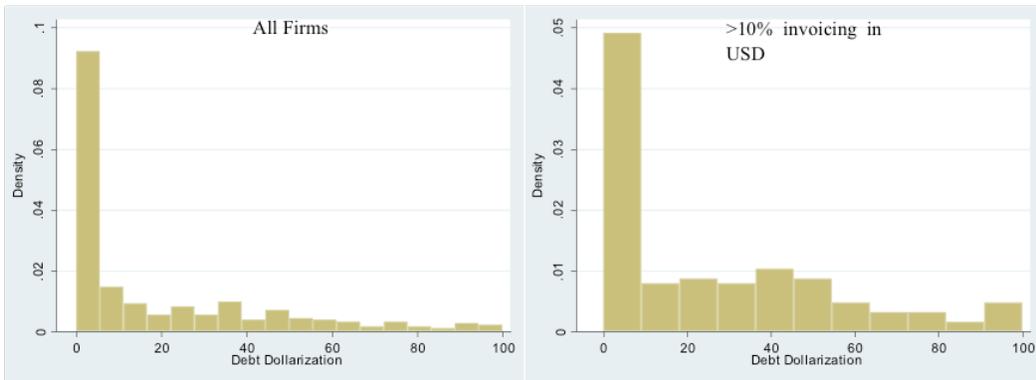


Table A.1: Correlation matrix between predetermined variables and instruments

	% USD Invoicing t=2016	% USD Invoicing t=2012	% USD Invoicing t=2012	Liquidity Share t=2012	Exports Share t=2012	Efficiency (t=-4)
<i>% USD Invoicing (t=2016)</i>	1.000					
<i>% USD Debt (t=2012)</i>	0.227	1.000				
<i>% USD Inputs (t=2012)</i>	0.391	0.240	1.000			
<i>Liquidity Share (t=2012)</i>	-0.195	-0.108	-0.231	1.000		
<i>Exports Share (t=2012)</i>	0.055	0.284	0.179	-0.135	1.000	
<i>Efficiency (t=2012)</i>	0.177	0.344	0.268	-0.168	0.300	1.000

Table: A.2 Postestimation 2SLS tests

Test of endogeneity:	
Ho: variables are exogenous	
Robust score	chi2(1) = 5.33324 (p=0.0209)
Robust regression	F(1,318)=5.2313 (p=0.0183)
Test of overidentifying restrictions:	
Score	chi2(1) = 1.91345 (p=0.1666)

References

- [1] Bacchetta Philippe and Eric van Wincoop (2005). “A Theory of the Currency Denomination of International Trade”. *Journal of International Economics* 67, 295-319.
- [2] Baron Andrea, G. Licandro, M.Mello and Pablo Piccardo (2017). “Moneda de facturación de las empresas uruguayas”, Mimeo BCU.
- [3] Baron, David (1976). “Fluctuating exchange rates and the pricing of exports”. *Economic Inquiry* 14, 425-438.
- [4] Cao, Shutao; Wei Dong and Ben Tomlin (2015). “Pricing-to-market, currency invoicing and exchange rate pass-through to produce prices”. *Journal of International Money and Finance* 58, 128-149.
- [5] Chung, Wanyu (2016). “Imported Inputs and Invoicing Currency Choice: Theory and Evidence from UK Transaction Data”. *Journal of International Economics* 99, 237-250.
- [6] Devereux, Michael; Charles Engel and Peter Storgaard (2004). “Endogenous exchange rate pass-through when nominal prices are set in advance”. *Journal of International Economics* 63, 263-291.
- [7] Devereux, Michael; Wei Dong and Ben Tomlin (2015). “Exchange rate pass-through, currency invoicing and market share”. *NBER Working papers* 21413, *National Bureau of Economic Research, Inc.*
- [8] Dohring, Bjorn (2008). “Hedging and invoicing strategies to reduce exchange rate exposure: a euro-area perspective”. *European Economy - Economic papers* 299, Directorate General Economic and Monetary Affairs, European Commission.
- [9] Donnenfeld, Shabtai and Alfred Haug (2003). “Currency Invoicing in International Trade: an Empirical Investigation”. *Review of International Economics* 11 (2), 332-345.
- [10] Donnenfeld, Shabtai and Itzhak Zilcha (1991). “Pricing of Exports and Exchange Rate Uncertainty”. *International Economic Review* 32, 1009-1022.
- [11] Drenik, Andres and Diego Perez (2017). “Pricing in multiple currencies in domestic markets”. *unpublished manuscript*.
- [12] Friberg, Richard (1998). “In which currency should exporters set their process?” *Journal of International Economics* 45, 59-76.
- [13] Friberg, Richard and Fredrik Wilander (2008). “The currency denomination of exports – A questionnaire study”. *Journal of International Economics* 75, 54-69.

- [14] Goldberg, Linda and Cédric Tille (2008). “Vehicle currency use in international trade”. *Journal of International Economics* 76 (2), 177-192.
- [15] Goldberg, Linda and Cédric Tille (2009). “Micro, macro, and strategic forces in international trade invoicing”. *Staff Reports* 405, Federal Reserve Bank of New York.
- [16] Ito, Takatoshi; Koibuchi Satoshi; Sato Kiyotaka and Shimizu Junko (2013). “Choice of invoicing currency: new evidence from a questionnaire survey of Japanese exports firms”. *The Research Institute of Economy, Trade and Industry, Discussion paper Series* 13-E-034.
- [17] Kang, Hyunju (2015). “Currency invoicing and state-dependent pricing”. *Journal of Macroeconomics* 44, 50-59.
- [18] Lyonnet, Victor; Julien Martin and Isabelle Mejean (2016). “Invoicing currency and financial hedging”. *CEPR Discussion paper* No. DP11700.
- [19] Licandro Gerardo and Miguel Mello (2015). “Dolarización cultural y financiera de los hogares uruguayos”, *CEMLA, Joint Research* 2016.
- [20] Markowitz, Harry (1952). “Portfolio selection”. *The Journal of Finance* 7 (1), 77-91.
- [21] Mello, Miguel (2016). “Determinantes de la dolarización financiera de las empresas uruguayas”. *XXXI Jornadas Anuales de Economía*, 2016. <http://www.bvrie.gub.uy/local/File/JAE/2016/mello.pdf>.
- [22] Mello, Miguel (2017). “Derivatives and Exchange Rate Hedging Strategies in Uruguayan Firms”, *mimeo BCU*.
- [23] Novy, Dennis (2006). “Hedge your costs: exchange rate risk and endogenous currency invoicing”. *Mimeo, University of Cambridge*.
- [24] Oi, Hiroyuki; Akira Otani and Toyochirou Shirota (2003). “The choice of invoice currency in international trade: implications for the internationalization of the yen”. *Discussion paper No. 2003-E-13: Institute for monetary and economic studies*, Bank of Japan.
- [25] Ospina, R. & Ferrari, S. (2010). “Inflated beta distributions”. *Statistical Papers*, 51(1):111- 126.
- [26] Ospina, R. & Ferrari, S. (2012). “A general class of zero-or-one inflated beta regression models”. *Computational Statistics & Data Analysis*, 56(6):1609-1623.
- [27] Riaño, Alejandro (2010). “The decision to export and the volatility of sales”. *Working paper 2010/12, Leverhulme Centre for Research in Globalisation and Economic Policy (GEP)*.
- [28] Tavlas, George (1998). “The international use of currencies: the U.S. Dollar and the Euro”. *IMF Finance and Development*, Vol. 35 no. 2.

- [29] Wang, Xiangning and Xing Zhao (2014). “The invoicing currency choice model of export enterprises assuming joint utility maximization and analysis of the factors influencing selection”. *Economic Modelling* 42, 38-42.