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Currency choices and the role of the U.S. dollar in international services trade

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Abstract

We analyze how firms choose the currency in which they price their transactions in services trade and explore to what extent the U.S. dollar has a dominant role in those transactions, as documented by earlier literature for goods trade. Using a new granular dataset detailing the currency used by Portuguese firms in extra and intra-EU trade, we show that currency choices in services trade are active firm-level decisions. Services exporters that are larger and that rely more on inputs priced in foreign currencies are less likely to use the domestic currency in their services exports. Moreover, we document that the U.S. dollar has a dominant role as a vehicle currency in services trade, but it is less prevalent than in goods trade. Our results are consistent with this difference arising from a lower openness of services markets and from a stronger reliance of services in domestic inputs.

JEL: F14, F31, F41

Keywords: Currency choices, international trade, services, dominant currency paradigm.

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1. Introduction

When selling a product to a foreign market, an exporting firm can use the currency of its home country, the currency of the destination country, or a third “vehicle” currency. This decision plays a central role in international economics, having important implications for the sensitivity of trade volumes to exchange rate fluctuations, for the pass-through to prices, and for optimal monetary and exchange rate policies (e.g. Corsetti and Pesenti 2005; Devereux and Engel 2007; Gopinath *et al.* 2010). From a microeconomic viewpoint, the choice of currency also determines whom among the importer or the exporter bears exchange rate risk, impacts the performance of firms in external markets, and may affect firms’ cash flows and profits (e.g. Bacchetta and Van Wincoop 2005; Barbiero 2021).

Given these far-reaching repercussions, a vast empirical literature analyses how firms participating in international trade choose in which currency they price their exports. In this article, we contribute to this growing literature by studying for the first time currency choices in services trade. We address the data unavailability obstacle that has prevented earlier studies from extending the analysis from goods to services trade by relying on a novel dataset with finely grained information about the currency choices of Portuguese firms in international transactions of services. This new dataset, from Banco de Portugal, comprises information on the currency of import and export services transactions, disaggregated by firm, type of service, country or origin or destination, and time period, and can be combined with a large set of firm-level characteristics. This rich information about currency choices in services trade contrasts with the current status quo where “data on invoicing currencies for services are (...) virtually nonexistent” (Adler *et al.* 2020).

Studying currency choices in services trade, and not restricting the analysis to goods trade, is increasingly relevant to have a complete picture of currency choices in international trade. Leaving aside services trade means disregarding a quarter of global trade in value terms.¹ Moreover, services trade is not only large but also growing fast, and there is the perception that the “future of trade is in services” (Baldwin 2022).

In addition, the relevance of studying currency choices in services trade arises from the fact that services have distinct characteristics from goods that may lead to different currency choices (Adler *et al.* 2020). For example, services often embody a lower share of imported inputs in their production and a higher share of wages, where the latter tend to be denominated in the producer’s currency. This implies a lower sensitivity of production costs to exchange rate movements and, possibly, lower incentives to use foreign currencies in exports of services. Additionally, services markets tend to be characterized by greater barriers to entry. To the extent that price complementarities with competitors shape the use of different currencies, as

1. In 2019, global services exports were valued at US\$6.1 trillion, representing 7 per cent of world GDP and one quarter of total world trade in both goods and services (UNCTAD 2020).

documented by earlier literature for goods trade, incentives to use the competitors' currency or to coordinate in a single vehicle currency may be different in services markets, and therefore result in different currency choices.

We start our empirical analysis by exploring which factors shape currency choices in services exports and by measuring their relative importance. In a variance decomposition exercise, we show that in the choice between using the domestic currency (the euro) or a foreign currency, the different behavior of different firms plays a central role in explaining the patterns of variation in the data. This result is consistent with the theoretical literature modeling the currency choice as an active-firm level decision (Engel 2006; Gopinath *et al.* 2010; Amiti *et al.* 2022; Mukhin 2022). We then explore the role of firm-level determinants identified by those models. We find that larger firms – which tend to exhibit greater strategic complementarities (Amiti *et al.* 2019) – are more likely to use foreign currencies in their exports of services. Moreover, while services tend to rely less on imported inputs than goods, the exposure of the firm to imports in foreign currencies also shapes currency choices in services exports. These results suggest that existing models where strategic complementarities and real hedging motives are key in shaping currency choices are also consistent with services trade data.

We then devote our attention to the choice of using either the currency of the destination currency or a vehicle currency. While firm heterogeneity is again key to explain the patterns of variation in the data, macroeconomic factors also play a large role. In particular, the likelihood of pricing services transactions in a vehicle currency is higher for transactions with countries with larger macroeconomic volatility and when transactions costs of exchanging the country's currency are higher.

Overall, these findings for the determinants of currency choices in services trade complement a large empirical literature studying which factors shape these choices in goods trade. While this literature has been boosted in recent years with the emergence of transaction-level datasets (e.g. Goldberg and Tille 2016; Chung 2016; Crowley *et al.* 2020) and with the possibility to combine them with firm-level characteristics (Amiti *et al.* 2022), to our knowledge we are the first to explore these determinants in services trade.

In a second part of our empirical analysis, we explore the role of the U.S. dollar (USD) in bilateral services trade flows. In particular, we assess to what extent the USD has a disproportionately large share in services trade, as documented in earlier literature for international trade in goods (e.g. Goldberg and Tille 2008; Gopinath 2015). The dominance of the USD in international trade is seen as resulting both from strategic complementarities across firms and from input-output linkages, which make exporters coordinate on the use of a vehicle currency. This currency is typically the USD, given the size of the US economy and history dependence (Mukhin 2022). As our empirical evidence is consistent with strategic complementarities and input-output linkages being also relevant in services trade, they should also lead to a disproportionately large prevalence of the USD in services transactions. This notwithstanding, its prevalence may be less disproportionate in services trade for two reasons. First, a lower reliance on imported inputs should

weaken the role of input-output linkages. Second, less open markets in services, so that a lower fraction of suppliers in the destination market are foreign, makes it less likely that those (fewer) exporters coordinate on a vehicle currency.

Our empirical evidence for the role of the USD in services trade and the quantitative comparisons we make with goods trade confirm those predictions. The USD is extensively used as a vehicle currency in services transactions, but its prevalence is systematically lower in services than in goods trade. Consistent with a key role of strategic complementarities and input-output linkages, the difference between the prevalence of the USD in services versus goods trade fades when services markets are particularly open, and in services where labor (instead of intermediates) constitute a smaller share of production costs.

A lower prevalence of the USD in services trade than in goods trade has important implications. It is well established in the literature that a widespread dollar pricing in goods trade meaningfully affects the relationship between nominal exchange rates and other nominal and real variables, and hence optimal policies. For example, the dominant role of the USD makes import prices of goods in non-US countries more sensitive to the dollar exchange rate than to bilateral exchange rates. It also makes the overall volume of global goods trade sensitive to fluctuations in the USD (Gopinath *et al.* 2020). As a result, if the USD is less dominant in services transactions, this should translate into a different impact of shocks in services versus goods trade. For example, our findings may rationalize different patterns of response of goods and services trade to exchange rate shocks (Smith *et al.* 2004; Adler *et al.* 2020). They also raise the question of to what extent optimal monetary and exchange rate policies change as economies diversify their exports from goods to services. While those implications go beyond the scope of this paper, the evidence we present informs that debate.

The remaining of the paper is organized as follows. Section 2 describes the datasets. Section 3 explores which factors shape firms' currency choices. Section 4 compares the role of the USD in services and in goods trade. Section 5 offers concluding remarks.

2. Data

The empirical analysis of currency choices in services trade is made possible by the availability of a novel dataset with finely grained information about the currencies used by Portuguese firms in their international transactions of services. This confidential dataset is maintained by the Statistics Department of Banco de Portugal, and covers services transactions between residents and non-residents entities, in accordance with the IMF Balance of Payments Manual (IMF 2016). For services exports and imports, the database reports the firm identifier, classification of service, country of origin or destination, time period (month and year), the amount of the transaction (in the original currency and in euros) and the currency used in the transaction. Information for travel and tourism flows is

not available. Types of services are defined according to the Extended Balance of Payments Services (EBOPS) 2010 classification, as detailed in the first two columns of Table A.1. A similar dataset is available for goods transactions (general merchandise according to the before-mentioned IMF Balance of Payments Manual). A breakdown by type of good is not available.

All observations have information on the currency used, and both intra-EU and extra-EU trade are covered. The statistical reporting is mandatory and regulated by law (Banco de Portugal 2018), and there is no reporting threshold applying specifically to international transactions of services or goods. There is instead a reporting threshold based on the yearly value of all economic and financial operations of a firm with non-residents, considering inflows and outflows, which has to be at least equal to 100 thousand euros. The dataset was made available for this paper for the period January 2014 - June 2021. We only include observations until December 2019 to remove the Covid pandemic period from the sample.

We combine the trade dataset with yearly firm characteristics drawn from the Central Balance Sheet database (Banco de Portugal Microdata Research Laboratory (BPLIM) 2020). That database is constructed based on information reported through *Informação Empresarial Simplificada* (IES, Simplified Corporate Information), which is a collaboration between the Portuguese Ministry of Finance, the Portuguese Ministry of Justice, Statistics Portugal and Banco de Portugal. Under IES, firms provide annual balance-sheet and income statement information, together with a set of firm characteristics such as number of employees. Merging the two datasets is straightforward since there is a common firm identifier. We keep transactions of firms that are present in both datasets.

Table 1 presents descriptive statistics about the incidence of different currencies in our services trade dataset. Both in extra-EU and intra-EU services trade, the euro is the most used currency, both on the export and on the import side. As expected, its share is markedly lower in extra-EU trade than in intra-EU trade. The currency with the second largest share is the USD. In total, in our services trade dataset there are transactions denominated in 116 different currencies.

	Exports	Imports		Exports	Imports
EUR	49.60	44.76	EUR	90.91	85.10
USD	31.19	40.93	USD	5.22	12.24
Other	19.22	14.30	Other	3.87	2.67

(a) Extra-EU

(b) Intra-EU

Table 1. Services trade: prevalence of EUR, USD and other currencies (percent, value terms)

3. The determinants of currency choices in services trade

3.1. Conceptual framework

To inform the empirical analysis of the determinants of currency choices, we provide a conceptual framework that draws on the theoretical literature studying how firms make those choices (Engel 2006; Gopinath *et al.* 2010; Amiti *et al.* 2022; Mukhin 2022). Based on that framework, we detail which factors should determine currency choices in international trade according to those models, and to what extent one should expect differences in those determinants in services trade.

We focus on the problem of a firm exporting a given product from Portugal (country i , with currency €) to destination country k with currency k . The profits from exports to that destination are denoted by $\Pi_{ik}(p_{ik}|\Omega)$, where p_{ik} is the log export price expressed in the currency of destination, and Ω is the state of the world. Lower-case letters indicate logarithms of the variables.

The environment for currency choices is characterized by price rigidities. Were the firm setting prices flexibly, in every state of the world it would choose the desired price \tilde{p}_{ik} which is given by $\tilde{p}_{ik} = \arg \max_{p_{ik}} \Pi_{ik}(p_{ik}|\Omega)$. That desired price can be written in terms of any currency l as $\tilde{p}_{ik}^l \equiv \tilde{p}_{ik} + e_{lk}$, where e_{lk} is the bilateral exchange rate between currency l and the currency of the destination country.

The firm pre-sets the price \tilde{p}_{ik}^l in currency l before the state Ω is observed. Three modes of pricing can be used. First, the firm can price the transaction in euros (producer currency pricing, PCP). Second, it can use the importer's currency (local currency pricing, LCP).² Third, it can use a third currency, say currency v (vehicle currency pricing, VCP). In each case, the realized price in destination currency (p_{ik}) conditional on price non-adjustment will be equal to:

$$p_{ik} = \begin{cases} \tilde{p}_{ik}^{\text{€}} + e_{k\text{€}} & \text{under PCP} \\ \tilde{p}_{ik} & \text{under LCP} \\ \tilde{p}_{ik}^v + e_{kv} & \text{under VCP} \end{cases} \quad (1)$$

where $e_{k\text{€}}$ is the bilateral exchange rate between currency k and the euro, while e_{kv} is the bilateral exchange rate between currency k and currency v .

A well-know theoretical result in this literature is that the currency choice problem $\arg \max_l \mathbb{E} \Pi_k(\tilde{p}_{ik}^l + e_{kl}|\Omega)$ is equivalent to $\arg \min_l \text{var}(\tilde{p}_{ik}^l)$. That, is the currency choice problem is equivalent to determining the currency in which the desired price is less volatile. Therefore, PCP will be favored if the desired price tracks closely $e_{k\text{€}}$, or in other words the desired price is stable in euros. LCP will be chosen if the desired price is stable and does not track any exchange rate. Currency v will be chosen if the desired price tracks closely e_{kv} , that is, if the desired price is stable in currency v .

2. In transactions with countries whose currency is the euro, PCP and LCP coincide. This is taken into account in the empirical analysis.

In a broad class of monopolistic and oligopolistic models (Amiti *et al.* 2019), the desired price in destination currency can be written as a linear combination of the firm's marginal cost and its competitors' prices in the destination currency:

$$\tilde{p}_{ik} = (1 - \alpha)(mc_i + e_{k\text{€}}) + \alpha p_k \quad (2)$$

where α captures strategic complementarities in price setting across firms, so that the desired price of an exporter depends not only on its marginal costs but also on the prices of competitors in the destination market. It follows that the stronger are strategic complementarities (i.e. the higher is α), the more likely it is that the firm favors using the competitors' currency. To the extent that competitors price in foreign currencies, this favors the use of those currencies. This strategy keeps the firm's relative price and thereby market shares stable in the presence of exchange shocks.

Larger firms tend to exhibit greater strategic complementarities (Amiti *et al.* 2019). They tend to charge higher markups and actively adjust them to ensure stable market shares. Contrarily, small firms tend to charge low markups and hence have a limited margin for those adjustments. Therefore, larger firms should be more likely to use foreign currencies in their exports, regardless of the product that they export. That is, everything else constant, larger services exporters should be more likely to use foreign currencies in their exports (prediction 1).

As for the firm's marginal cost, it can be written as a weighted sum of local wages (w_i) and prices of intermediates (p_i):

$$mc_i = (1 - \varphi)w_i + \varphi p_i \quad (3)$$

Moreover, the aggregate price index (p_i) can be written as a weighted sum of the prices of locally produced goods (p_{ii}) and imported goods (p_i^I):

$$p_i = (1 - \gamma)p_{ii} + \gamma p_i^I \quad (4)$$

It then follows that the more the firm relies on local inputs (labor and locally produced intermediates), the more the firm's desired price tracks the cost of those inputs. As that cost is typically stable in producer currency, then the firm is more likely to price in euros. Alternatively, the more the firm relies on internationally sourced inputs, the more the desired price tracks the cost of those inputs. If that cost is stable in a foreign currency, then the firm is less likely to price its exports in euros. This mechanism should also not depend on what is the specific product that the firm is exporting, and therefore should not depend on whether the firm is exporting a service or a good. As a result, the more an exporter of services relies on inputs imported in foreign currencies, the more likely should be the use of foreign currencies in its exports (prediction 2). This strategy coordinates the pass-through into export prices with the co-movements in marginal costs, thus providing real hedging.

According to this conceptual framework, the two key determinants shaping currency choices in goods trade, and for which for example Amiti *et al.* (2022)

provide systematic empirical evidence – firms' size and exposure to foreign currencies in imported inputs – should also shape currency choices in services trade. This does not mean that we should expect a similar prevalence of different pricing strategies in aggregate services and goods trade data. For example, a less important role of input-output linkages in services may result in a lower prevalence of foreign currencies in services exports.

In the next subsections, we focus only on the determinants of firm's currency choices. The implications of those choices for the share of use of foreign currencies (namely the USD) in aggregate services and goods trade are explored in section 4.

3.2. Decomposition of variation

We conduct a variance decomposition exercise that quantifies the relative role of different forces in shaping the variation in currency choices in services exports. Namely, the first goal of our analysis is understanding to what extent what matters more to explain the patterns of variation in the data is “who is the exporting firm”, “what is the destination country”, “what is the service that is being exported” or “what is the time period”.

Initially, we focus on the decision between using the euro or a foreign currency (PCP or not), which is the one for which the conceptual framework presented in the previous subsection provides clear predictions. Moreover, initially we focus on extra-EU exports, where the role of the EUR is less prevalent (Table 1). The analysis is extended to the choice of using VCP (namely the USD) or LCP, and to intra-EU exports in subsections 3.4 and 3.5, respectively.

To decompose the patterns of variation in the data, we start with the following model:

$$NonEuro_{fcpt} = \gamma_f + \varphi_c + \omega_p + \rho_t + \varepsilon_{fcpt} \quad (5)$$

$NonEuro_{fcpt}$ is a dummy variable equal to 0 if firm f exports service p to country c on month-year t in euros, and 1 if it uses another currency. γ_f , φ_c , ω_p and ρ_t are firm, country, service, and month-year fixed effects, respectively. Equation 5 considers five distinct sources of variability in our dependent variable: firm permanent heterogeneity (γ_f), country permanent heterogeneity (φ_c), service permanent heterogeneity (ω_p), time heterogeneity (ρ_t) and unexplained random variation (ε_{fcpt}). Our aim is assessing the contribution of each of those components to the currency dummy ($NonEuro_{fcpt}$) variation.

We use the following decomposition:³

$$NonEuro_{fcpt} = \gamma_f + \varphi_c + \omega_p + \rho_t + \varepsilon_{fcpt} = \sum_{i=1}^5 C_{fcpt}^i \quad (6)$$

3. We adapt to our binary dependent variable setting the procedure followed by Torres *et al.* (2018) to measure the contribution of worker, firm, and job title characteristics to wage variation.

where C_{fcpt}^i represents the individual summands (firm heterogeneity, country heterogeneity, service heterogeneity, time heterogeneity and unexplained variation).

By definition:

$$\frac{\sum_{i=1}^5 \text{cov}(NonEuro_{fcpt}, C_{fcpt}^i)}{V(NonEuro_{fcpt})} \equiv 1 \quad (7)$$

Therefore, the contribution of each component can be computed as:

$$\frac{\text{Cov}(NonEuro_{fcpt}, C_{fcpt}^i)}{V(NonEuro_{fcpt})} = \frac{\text{Cov}(NonEuro_{fcpt}, C_{fcpt}^i)}{p(1-p)} \quad (8)$$

We know that :

$$NonEuro_{fcpt} = p + \hat{\gamma}_f + \hat{\varphi}_c + \hat{\omega}_p + \hat{\rho}_t + \hat{\varepsilon}_{fcpt} \quad (9)$$

where all fixed effects and the residuals add up to zero and $p = N_1/N$ is the proportion of 1s in $NonEuro_{fcpt}$. Thus (omitting subscripts to simplify notation), we obtain for example that:

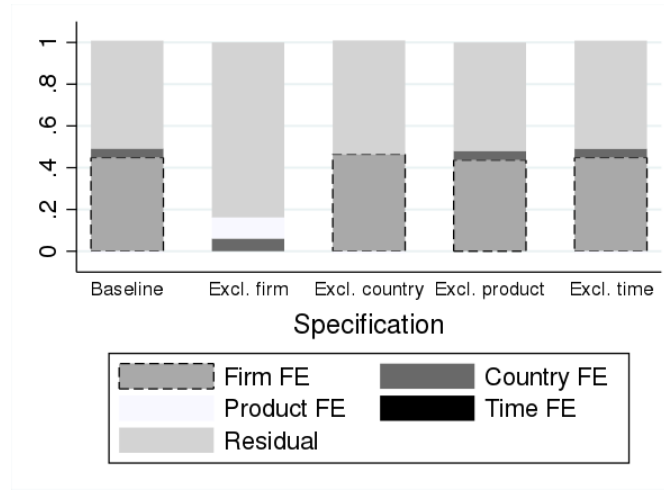
$$\widehat{\text{cov}}(NonEuro, \hat{\gamma}) = \frac{\sum NonEuro \hat{\gamma}}{N} = \frac{N_1}{N} \frac{\sum NonEuro \hat{\gamma}}{N_1} = p \hat{\gamma}|_{NonEuro=1} \quad (10)$$

That is, $\widehat{\text{cov}}(NonEuro, \hat{\gamma})$ is simply the average of the firm fixed effects for the $NonEuro = 1$ case, multiplied by p . The contribution of each component to the variation of $NonEuro$ can thus be computed as follows:

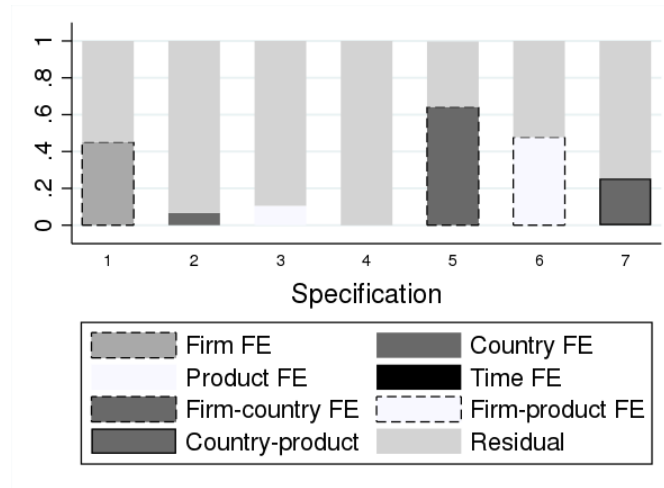
$$\begin{aligned} \frac{\sum_{i=1}^5 \widehat{\text{cov}}(NonEuro, C^i)}{\widehat{V}(NonEuro)} &= \frac{\hat{\gamma}|_{NonEuro=1}}{1-p} + \frac{\hat{\varphi}|_{NonEuro=1}}{1-p} + \frac{\hat{\omega}|_{NonEuro=1}}{1-p} + \\ &\quad \frac{\hat{\rho}|_{NonEuro=1}}{1-p} + \frac{\hat{\varepsilon}|_{NonEuro=1}}{1-p} \end{aligned} \quad (11)$$

This decomposition has an intuitive interpretation. For example, if the average of the firm fixed effects for the subsample where $NonEuro = 1$ is the same as for the overall sample (and thus is, zero), then the contribution of that component is zero. The contribution will be higher, the higher the average of the estimated fixed effects for the $NonEuro = 1$ subsample.

The estimated values for each component of equation 11 are presented in the first bar of Figure 1a. In Figure 1a, we also present the results obtained when we make an analogous exercise omitting each set of fixed effects at a time. Figure 1b provides a similar quantification exercise where we project $NonEuro_{fcpt}$ on only one set of fixed effects at a time. In this latter exercise, we consider not only firm, country, product and time fixed effects, but also firm-country, firm-product and country-product fixed effects.



(a) Baseline model and alternative specifications which exclude one set of fixed effect at a time



(b) Models with one set of fixed effects at a time

Figure 1: Contributions to the variation of $NonEuro_{fcpt}$ in extra-EU services exports

This set of results highlights the key role that firm heterogeneity plays in explaining the variation in currency choices in the data. It accounts for almost half of $NonEuro_{fcpt}$ variance in the baseline specification and in the specification where we only consider firm fixed effects. Moreover, comparing the baseline specification with the one excluding firm fixed effects, we see that introducing firm fixed effects narrows substantially the residual component of the regression. Accordingly, our results are consistent with a central role played by the differential behavior across firms in explaining the patterns of variation in currency choices. These results are

consistent with the conceptual framework presented in section 3.1, where currency choices are active firm-level decisions.

3.3. Firm-level determinants

We now explore the role of firm's size and exposure to inputs in foreign currencies (predictions 1 and 2) in shaping firm's currency choices. To proxy firm size, we use the log of turnover of the firm, averaged over the sample period. Figure 2a illustrates how the choice between using the EUR or a foreign currency correlates with this measure. In line with the mechanisms described in the conceptual framework, the share of use of currencies other than the EUR is larger among larger firms.⁴

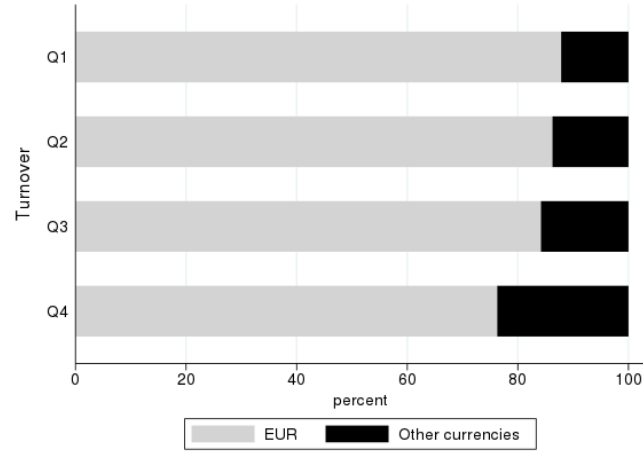
As for the role of the import intensity of the firm in foreign currencies, Figure 2b illustrates how it is correlated with the use of the EUR versus other currencies. The import intensity in foreign currencies is computed as the ratio of the import value of the firm (of goods and services) in currencies other than the euro, divided by the firm's total variable costs. The latter are obtained from income statements and comprise expenditures with employees, costs of goods sold and materials consumed and supplies by external services. We classify firms into five categories. The first category comprises firms whose intensity in foreign currencies is equal to zero. The remaining four categories divide firms into four quartiles depending on the magnitude of their (strictly positive) import intensity in foreign currencies, averaged over the sample period. We then plot the share of the euro and of other currencies in extra-EU services exports for each category of firms. The use of foreign currencies in services exports increases with the intensity of foreign currencies in imports and is particularly large for the firms in the last quartile. In line with prediction 2, this evidence suggests that real hedging may have an important role in shaping currency choices also in services exports, even if services are less intensive in foreign inputs than goods.

Following this illustrative evidence, we investigate formally the role of firm size and import intensity in foreign currencies in shaping currency choices in services exports. We estimate the regression:

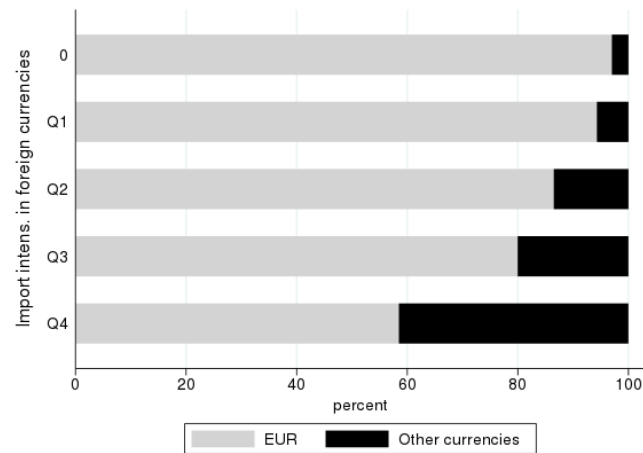
$$NonEuro_{fcpt} = \beta_1 S_f + \beta_2 I_f^X + FE_{pc} + FE_t + \varepsilon_{fcpt} \quad (12)$$

As before, $NonEuro_{fcpt}$ is a dummy variable equal to 0 if firm f exports service p to country c on month-year t in euros, and 1 if the firm uses another currency. S_f is firm's size, proxied with the log of firm's employment, turnover or export value (of goods and services). I_f^X is the above-mentioned measure of

4. This systematic relationship between firm size and currency pricing is less clear in import transactions than in the corresponding export transactions (Figure A.1). Since the size of the firm is strongly correlated with several firm characteristics, this illustrative evidence suggests that the currency decision in services trade is less of an active firm-level decision on the import side, corroborating qualitatively similar results for goods trade documented in Amiti *et al.* (2022).



(a) Currency choices and firms' size



(b) Currency choices and firms' import intensity in foreign currencies

Figure 2: Currency choices in extra-EU services exports and firm-level determinants

Notes: Shares in count terms. Q – quartile. In the second panel, “0” comprises firms whose import intensity ratio in foreign currencies is equal to zero. The remaining four categories divide the remaining firms into four quartiles depending on their ratios.

import intensity in foreign currencies. FE_{pc} are product-country fixed effects, and FE_t are time (month-year) fixed effects.

Table 2a presents the estimation results of equation 12. The coefficients on the different measures of firm size are positive and significant. That is, larger firms are more likely to price their services exports in foreign currencies and less likely to price them in euros, in line with prediction 1. As to the import intensity

in foreign currencies, it is also positively and strongly associated to the use of foreign currencies in services exports, in line with prediction 2. When we consider instead the import intensity of the firm in euros, we no longer obtain a statistically significant coefficient. Overall, these results suggest that firm size and the import intensity of the firm in foreign currencies shape the decision of using the euro or a foreign currency. These results are in line with patterns documented by earlier literature (e.g. Chung 2016; Amiti *et al.* 2022) for goods trade.

	(1)	(2)	(3)	(4)
S_f (ln turnover)	0.015** (0.006)			
S_f (ln employees)		0.017** (0.007)		
S_f (ln exports)			0.018*** (0.006)	0.042** (0.016)
I_f^X	1.294*** (0.186)	1.301*** (0.179)	1.236*** (0.172)	
I_f^E				-0.040 (0.062)
Product-country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
No. of observations	306910	306910	306910	306910
Adjusted R2	0.340	0.341	0.342	0.281
Standard errors in parentheses				
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$				

Table 2. Currency choices in extra-EU exports (euro vs foreign currencies): firm-level determinants

Note: Standard errors are clustered at the firm level.

3.4. Use of vehicle currencies versus local currency pricing

In the previous subsection, we studied the forces shaping the use of a foreign currency versus the exporter's currency (the euro). Now we explore the decision between using the local currency (LCP) or a vehicle currency (VCP). To make this distinction, we focus on the sample of extra-EU services export transactions not conducted in euros. Moreover, we focus on export destinations that do not have the euro or the USD as local currencies.⁵

5. Information about the currency(ies) of each country was obtained in the ISO currency codes: <https://www.iso.org/iso-4217-currency-codes.html>.

Our dependent variable – USD_{fcpt} – is a dummy variable equal to 1 if firm f exports service p to country c on month-year t in USD, and 0 if it uses another currency. In this sample, 80% of the services transactions are conducted in USD, 19% in the destination currency and only 1% in other currencies.

The decomposition of the variation in USD_{fcpt} into its firm, country, product and time components is given in Figure 3. While in the choice of using the euro or a foreign currency the contribution of country fixed effects was relatively small when compared to that of firm fixed effects (Figure 1), in the choice between the local or a vehicle currency country fixed effects account for a larger share of the variation. In our baseline specification, permanent country heterogeneity accounts for 24% of the total variation in USD_{fcpt} .

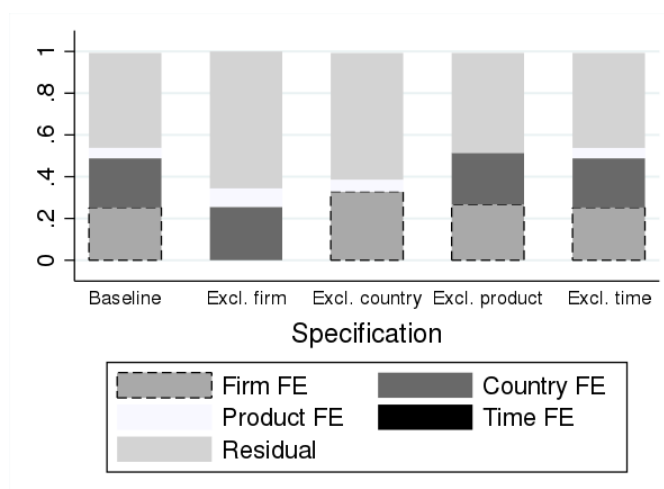
We then estimate an equation analogous to equation 12, except that now our dependent variable is USD_{fcpt} . For the import intensity of the firm, we now include in the numerator the value of imports in USD rather than the value of imports in foreign currencies.

The results are presented in the first column of Table 3. The coefficient of firm size is negative, in contrast to the results for the euro/foreign currency decision. That is, larger services exporters adopt more the local currency instead of the USD. This pattern is consistent with the conceptual framework of section 3.1. Due to stronger strategic complementarities, we expect larger firms to use more local currencies to synchronize their prices with those of local competitors. As to the import intensity in USD, as expected we find a positive and significant coefficient. That is, importing in USD favors the use of the USD in services exports.

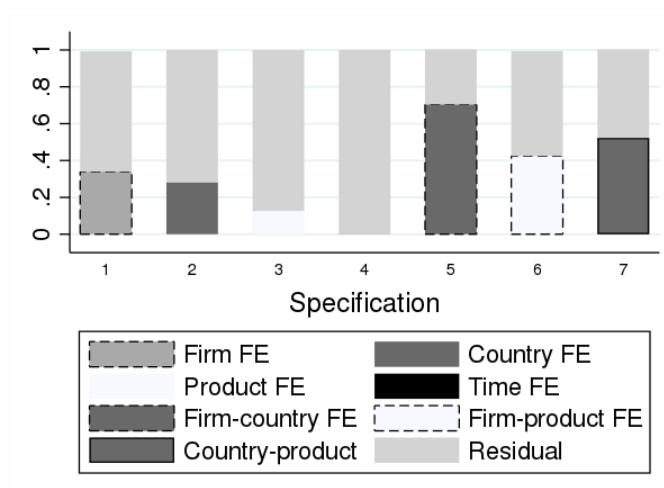
In addition to firm-level determinants, and given the larger role of country fixed effects in the VCP/LCP decision than in the euro/non-euro decision, we also consider explicitly macroeconomic determinants in our regression. In the conceptual framework presented in section 3.1, macroeconomic factors can be incorporated as an additional fixed cost associated to the use of any currency (Amiti *et al.* 2022), which should not depend on the specific product that is being traded.

To incorporate macroeconomic factors in the regression, we replace the product-country fixed effects by product fixed effects and a number of country-level observables. The results are presented in columns 2-4. In column 2, we add as regressors country income and inflation, measured by average GDP per capita and average CPI inflation over the sample period (from the World Bank's World Development Indicators). In column 3, we include the transactions costs of exchanging the country's currency, proxied (inversely) by the share of a country's currency in global foreign exchange market's turnover, and a measure of exchange rate volatility. The shares in foreign exchange markets are obtained from the BIS Triennial Survey of Foreign Exchange and Derivatives, and we use the average of the 2013, 2016 and 2019 shares.⁶ Exchange rate volatility is measured by the volatility of the country's exchange rate against the euro, where the exchanged rates were

6. Currencies not listed in the survey are assigned a zero share.



(a) Baseline model and alternative specifications which exclude one fixed effect at a time



(b) Models with one set of fixed effects at a time

Figure 3: Contributions to the variation of USD_{cpt} in extra-EU services exports

Note: Export transactions not conducted in euros and with destination countries that do not have the euro or the USD as local currencies.

obtained in the Bundesbank's exchange rate statistics. Finally, in column 4 we include a dummy variable for countries that have an exchange rate arrangement whose anchor is the USD. The list of exchange rate arrangements is obtained from the IMF database of the Annual Report on Exchange Arrangements and Exchange Restrictions.

	(1)	(2)	(3)	(4)
S_f (ln exports)	-0.017** (0.007)	-0.020*** (0.006)	-0.021*** (0.006)	-0.019*** (0.007)
I_{USD_f}	0.396*** (0.123)	0.279** (0.110)	0.277*** (0.107)	0.293*** (0.110)
ln GDP per capita _c		-0.007 (0.029)		
CPI inflation _c		0.005*** (0.002)		
Exch. rate volatility _c			0.208** (0.098)	
Currency turnover _c			-0.369* (0.221)	
USD arrangement _c				0.142*** (0.053)
Product-country FE	Yes	No	No	No
Product FE	No	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
No. of observations	42917	43219	43219	43219
Adjusted R2	0.504	0.133	0.143	0.142

Standard errors in parentheses

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

Table 3. Currency choices in extra-EU exports (USD vs local currency): firm-level and macroeconomic determinants

Note: Standard errors are clustered at the firm level.

The likelihood of pricing services transactions in USD is higher (and statistically significant) for countries with higher CPI inflation, higher exchange rate volatility, lower turnover of the currency in foreign exchange markets, and in countries that have an arrangement linking their currency to the USD. These results about the role of macroeconomic determinants in services exports complement similar patterns documented for goods trade in earlier literature (e.g. Chung 2016; Goldberg and Tille 2016).

3.5. Intra-EU exports

We now benefit from the fact that our dataset also provides information for intra-EU services trade to document the incidence of different currencies in those transactions and explore the determinants of currency choices. To our knowledge,

evidence on the determinants of currency choices within the EU is largely inexistent, even for goods trade, due to data unavailability. We also aim at filling that gap.

As documented in Table 1, the overall prevalence of currencies other than the EUR in intra-EU trade is relatively small. There is nonetheless heterogeneity across countries. In Table 4, we document the shares of use of the euro, US dollar and of other currencies for three groups of EU countries: (i) euro area countries; (ii) countries whose currency is linked to the euro through an exchange rate arrangement (Bulgaria, Croatia and Denmark); and (iii) other countries.

	EUR	USD	GBP	Other	Total
Euro area	93.37	5.01	0.15	1.47	100.00
EUR arrangements	84.77	3.61	0.01	11.61	100.00
Other countries	82.61	6.05	8.68	2.66	100.00
Total	90.91	5.22	1.99	1.88	100.00

Table 4. Intra-EU services exports: destination exchange rate regime and currency of transactions (percent)

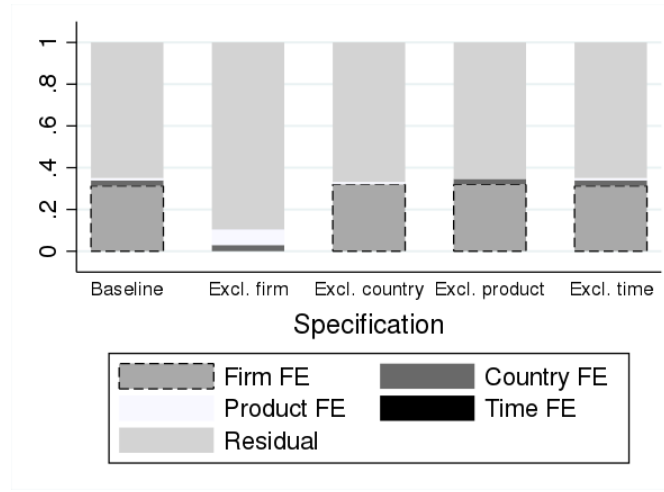
Note: Shares in value terms.

As expected, in the euro area the share of currencies other than the EUR is small. Nevertheless, it is not negligible: in value terms 7% of services exports to euro area countries are denominated in currencies other than the euro, mostly the USD. There is heterogeneity across euro area countries (Table A.2). For example, while 8% of the services export value to Germany is denominated in USD, only 1% of the services export value to Spain is denominated in that currency. As to firm heterogeneity, the share of use of currencies other than the euro is larger among the largest firms and among the firms that are more import intense in foreign currencies (Figure A.2).

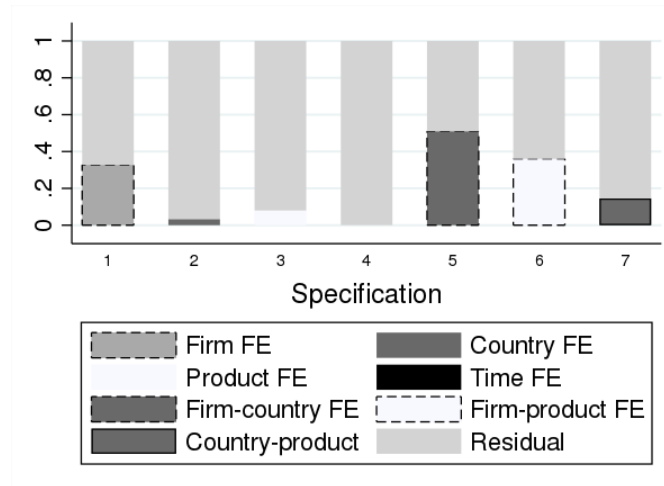
Following this illustrative evidence, we now explore formally the sources of variation in currency choices in the data. As before, we start by partitioning the variation in the variable $NonEuro_{cpt}$ into the components associated to different sets of fixed effects. The results are presented in Figure 4.

The share of the variance explained by the fixed effects included in the baseline model is smaller than in the analogous exercise for extra-EU exports. As in extra-EU services exports, firm fixed effects account for the largest share of explained variation. Larger firms and those whose import intensity in foreign currencies is larger are more likely to use foreign currencies (Table 5).

Overall, the empirical evidence for both intra-EU and extra-EU trade highlights a key role of firm heterogeneity in firms' currency choices of using either the euro or a foreign currency in services exports. Moreover, the systematic evidence on the firm-level determinants of these choices that we provide both for extra and for intra-EU exports is consistent with a role of firm size and input-output linkages in shaping currency choices in services exports, as the conceptual framework presented in section 3.1 would predict. While services have unique characteristics (e.g. in terms



(a) Baseline model and alternative specifications which exclude one set of fixed effect at a time



(b) Models with one set of fixed effects at a time

Figure 4: Contributions to the variation of $NonEuro_{fcpt}$ in intra-EU exports

of cost structures, possibility to store or barriers to entry), these findings indicate that existing models of currency choices (Engel 2006; Gopinath *et al.* 2010; Amiti *et al.* 2022) are also consistent with observed currency choices in services trade.

4. The dominant role of the USD: services vs goods trade

It is well established in the literature that the USD has a dominant role in international transactions of goods (e.g. Goldberg and Tille 2016; Gopinath 2015),

	(1)	(2)	(3)	(4)
S_f (ln turnover)	0.005*** (0.002)			
S_f (ln employees)		0.006*** (0.002)		
S_f (ln exports)			0.007*** (0.002)	0.014*** (0.005)
l_f^X	0.742*** (0.108)	0.749*** (0.107)	0.715*** (0.102)	
l_{ef}				-0.007 (0.019)
Product-country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
No. of observations	703475	703475	703474	703474
Adjusted R2	0.222	0.222	0.224	0.167

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5. Currency choices in intra-EU exports (euro vs foreign currencies): firm-level determinants

Notes: Standard errors are clustered at the firm level.

being widely used as a vehicle currency in trade between countries that do not have the USD as local currency. In this section, we investigate to what extent this dominance of the USD extends to services trade. We draw on the insights from Mukhin (2022)'s model of equilibrium currency choice and make predictions about the relative use of dollar currency pricing in services versus goods trade. We then confront those predictions with our dataset for Portuguese international trade.

4.1. Theoretical background

Extending the conceptual framework of Section 3.1, it can be shown that strategic complementarities in currency choices and input-output linkages may give rise to an equilibrium with exporters coordinating on the use of a dominant currency (Mukhin 2022). If price linkages are strong enough, firms want to synchronize their currency choices with those of suppliers and competitors, coordinating on a vehicle currency.

As coordination arises due to input-output linkages and price complementarities with foreign firms, it can be shown that vehicle currency pricing is more likely (i) the higher the share of intermediates in production, and (ii) the higher the share of foreign competitors (vs local competitors) in a given market (Mukhin 2022). Intuitively, a higher share of intermediates strengthens input-output linkages. When

markets are more open, so that a significant fraction of suppliers in the destination market are coming from abroad, the optimal price of exporters is no longer stable in either producer or local currency, and coordination on the use of a vehicle currency is more likely. In particular, the USD is likely to play a role of dominant vehicle currency because of the size of the US economy, widespread exchange arrangements linking different currencies to the USD, and history dependence.

Those results indicate that while at the firm-level the determinants of currency choices in services and goods trade may be largely similar (predictions 1 and 2), in equilibrium we may observe a different prevalence of the USD in services and in goods trade. Namely, to the extent that the degree of openness of markets in services is lower than in goods (e.g. Imbs and Pauwels 2020) for example due to a stronger home bias or regulatory barriers, and to the extent that local wage costs represent a higher share of production costs in services than in goods (e.g. Bobeica *et al.* 2019), one should observe a lower prevalence of dollar currency pricing in services than in goods trade (prediction 3). Moreover, if these two mechanisms are relevant in explaining a possible differential prevalence of the USD in services and in goods trade, that difference should be smaller in services for which wages represent a smaller share of production costs and in more open markets (prediction 4).

In the subsequent empirical analysis, we test predictions 3 and 4. We start by presenting descriptive statistics about the use of different pricing strategies in services versus goods trade, and we compare the share of dollar currency pricing. We then evaluate to what extent there is a systematically lower prevalence of the USD in services versus goods trade across country-year pairs. Finally, we test whether such a differential prevalence of the USD also holds in services for which wages typically represent a particularly low share of production costs and in markets where the import penetration is particularly high.

4.2. Share of the USD in services vs goods trade

We start by providing descriptive statistics that document how prevalent is the use of the USD as a vehicle currency in services vs goods trade. We group the export and import transactions in our database into the three pricing strategies schemes described in Section 3.1: producer currency pricing (PCP) if the transaction is in euros; local currency pricing (LCP) if the transaction is in the currency of the destination country; and vehicle currency pricing (VCP) if the transaction is conducted in a third-country currency. In transactions in euros with countries whose currency is the euro, PCP and LCP coincide (PCP/LCP). In transactions where VCP is adopted, we distinguish between the use of the USD as a vehicle currency versus the use of other currencies. As for imports, the interpretation is reverted and import transactions are grouped in a symmetric way: imports in euros are classified as LCP, imports in the currency of the foreign exporter are classified as PCP and imports in other currencies are classified as VCP.

Table 6 presents the prevalence of different pricing strategies in Portuguese trade. The share of VCP-USD is large both in services and goods trade. While prediction 3 cannot be tested directly from this descriptive evidence, for example because of a different structure of trade partners in services and goods trade, in general the share of VCP-USD is lower in services than in goods trade, and therefore consistent with that prediction.

	Exports	Imports		Exports	Imports
PCP	49.32	33.87	PCP	59.24	8.12
LCP	30.36	44.64	LCP	10.63	39.74
PCP/LCP	0.28	0.12	PCP/LCP	0.24	0.07
VCP - USD	19.95	21.13	VCP - USD	29.74	52.00
VCP - Other	0.09	0.24	VCP - Other	0.15	0.06

(a) Services (extra-EU) (b) Goods (extra-EU)

	Exports	Imports		Exports	Imports
PCP	19.12	2.53	PCP	10.55	0.42
LCP	2.41	15.39	LCP	1.63	9.07
PCP/LCP	71.79	69.71	PCP/LCP	80.19	82.75
VCP - USD	5.22	12.24	VCP - USD	7.56	7.39
VCP - Other	1.46	0.13	VCP - Other	0.07	0.38

(c) Services (intra-EU) (d) Goods (intra-EU)

Table 6. Services and goods trade: prevalence of different pricing strategies (percent, value terms)

We then investigate formally whether there is a systematically lower prevalence of VCP-USD in services versus goods trade, accounting for country-time heterogeneity. We start by aggregating firm-level exports at the product-country-year level. We then compute the share of the USD in each product-country-year triplet, and we estimate the following regression:

$$ShareUSD_{pct} = \beta Service_p + \gamma_{ct} + \varepsilon_{pct} \quad (13)$$

$ShareUSD_{pct}$ is the share of export value of product p to country c at year t which is denominated in USD. $Service_p$ is a dummy variable equal to 1 if product p is a service (i.e. belongs to one of the service categories detailed in the first two columns of Table A.1) and 0 if it is a good (i.e. is classified as general merchandise in our database). γ_{ct} are country-year fixed effects. Thus, we focus on the variation in the share of the USD across products within country-year pairs, and we explore whether that share is systematically lower for services exports than for goods exports. Standard errors are clustered at the country level. We consider exports to all countries, except those whose currency is the USD.

Additionally, to test prediction 4, we construct empirical proxies for the share of wages in production costs of different services and for the degree of openness of different services markets. As to the wage share, we first compute for every

Portuguese firm that exports service s the share of labor costs in total variable costs. We then compute a (weighted) average value of that share across firms. As for the openness of the different export markets, we compute the share of imports in each country-sector pair using the OECD inter-country input-output tables (ICIO tables) for 2014. In the ISCIO tables, sectors are defined by two-digit ISIC Rev. 4 industries. We make a conversion to EBOPS services categories, as detailed in Table A.1. We did not find a close match for some service categories. Moreover, the set of countries covered by the ICIO tables is smaller than that of our trade database. As a result, we could only compute these proxies for a subset of the observations. We only keep the triplets for which we could compute these proxies, which account for 94% of total exports.

In our analysis, we evaluate to what extent there is a meaningful difference in the share of USD in goods exports versus services exports when the wage share of those services is below the 25th percentile and/or when the service-destination openness is above the 75th percentile. We focus on extreme values of these two proxies given the likely large measurement error.

The results are presented in Table 7. The first column presents the estimation of equation 13. We obtain a negative and highly significant coefficient on the $Service_p$ dummy, consistent with a lower prevalence of the USD in services than in goods exports (prediction 3). The second to fourth columns build on that specification by interacting $Service_p$ with the above-described proxies for the wage share and for the degree of openness of markets. The p-values of tests in the bottom of the table show that in services with a relatively low wage share and/or in markets where openness is high, we cannot reject the null that there is no statistically significant difference in the prevalence of the USD in services versus goods exports. These results are consistent with prediction 4, suggesting that the cost structure of services versus goods and a different degree of openness in services markets shapes the differential prevalence of the USD in services versus goods exports.

Overall, the analyses presented in this section document a systematic use of the USD in services trade, but a less prevalent one than in goods trade. Our results are consistent with this difference arising from a lower openness of services markets and from a stronger reliance of services in domestic inputs.

5. Conclusions

In this paper, we explored the determinants of currency choices in services trade. We showed that in the choice between using the euro or a foreign currency, firm heterogeneity is the most important source of variation of currency choices in the data. Larger firms – which tend to exhibit greater strategic complementarities – are more likely to use foreign currencies in their exports of both goods and services. Moreover, while services tend to rely less on imported inputs than goods, firms that have a large share of import transactions denominated in foreign currencies are also more likely to use foreign currencies in their services exports. These results

	(1)	(2)	(3)	(4)
Service _p (S)	-0.079*** (0.021)	-0.096*** (0.021)	-0.093*** (0.021)	-0.108*** (0.021)
Service _p * Low Wage Share _p (S*W)		0.063*** (0.012)		0.060*** (0.012)
Service _p * High Openness _{pc} (S*O)			0.055*** (0.016)	0.047*** (0.015)
Country-year FE	Yes	Yes	Yes	Yes
No. of observations	8352	8352	8352	8352
Adjusted R2	0.153	0.168	0.159	0.173
Test S+S*W=0 (p-value)		0.1777		
Test S+S*O=0 (p-value)			0.1480	
Test S+S*W+S*O=0 (p-value)				0.9734

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7. Share of exports in USD: services vs goods

Notes: Countries whose currency is the USD are excluded from the analysis. Standard errors are clustered at the country level.

indicate that models of currency choices where strategic complementarities and input-output linkages are key elements (Engel 2006; Gopinath *et al.* 2010; Amiti *et al.* 2022) also explain relatively well currency choices in services trade data.

We also documented novel stylized facts on the prevalence of the USD in services trade. We showed that while the USD is also extensively used as a vehicle currency in services trade, its prevalence is systematically lower than in goods trade. Consistent with a key role of strategic complementarities and input-output linkages, this difference disappears when services markets are particularly open, so that a significant fraction of suppliers in the destination market are coming from abroad, and in services where intermediates (instead of labor) constitute a large share of labor costs.

Our novel evidence for services trade is an important contribution to the literature studying currency choices in international trade given the large and increasing share of services in global trade. This notwithstanding, our results rely on data for a country that belongs to a monetary union and whose international trade is strongly shaped by a small set of large firms. Although this a well-known feature in the trade literature, having a data set with more countries and a larger number of more complex traders would bring additional robustness to the results.

There are several natural next questions that arise from our analysis and that are interesting avenues of future research. It is established in the literature that a widespread dollar pricing in goods trade affects meaningfully the relationship between nominal exchange rates and other nominal and real variables, and hence optimal policies. If the dollar is less dominant in services trade because of different

characteristics of services and of services markets, this should translate into a different impact of shocks in services versus goods trade. As economies diversify their exports to services, their sensitivity to shocks and optimal policies may change. We leave those questions for future research.

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Appendix

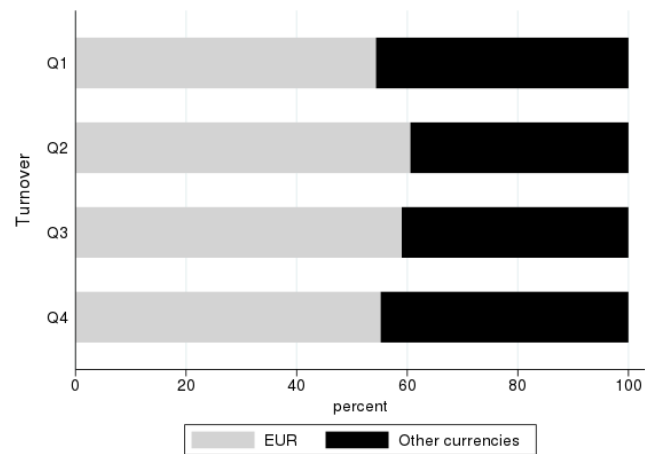


Figure A.1: Currency choices in extra-EU services imports and firm's size

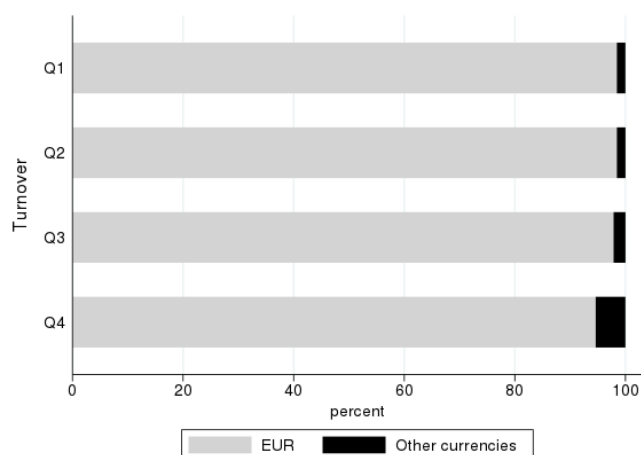
Notes: Shares in count terms. Q – quartile of firm's turnover.

EBOPS	Description	ISIC Rev.4
SB	Maintenance and repair services	33
SC11	Sea transport - passenger	50
SC12	Sea transport - freight	50
SC13	Sea transport - other	50
SC21	Air transport - passenger	51
SC22	Air transport - freight	51
SC23	Air transport - other	51
SC3A	Space transport	51
SC3B1	Rail transport - passenger	49
SC3B2	Rail transport - freight	49
SC3B3	Rail transport - other	49
SC3C1	Road transport - passenger	49
SC3C2	Road transport - freight	49
SC3C3	Road transport - other	49
SC3D1	Inland waterway transport - passenger	50
SC3D2	Inland waterway transport - freight	50
SC3D3	Inland waterway transport - other	50
SC3E	Pipeline transport	49
SC3F	Electricity transmission	
SC4	Postal and courier services	53
SE1	Construction abroad	41
SE2	Construction in the reporting economy	41
SF1	Direct insurance	65
SF2	Reinsurance	65
SF3	Auxiliary insurance services	65
SF4	Pension and standardized guarantee services	65
SG1	Financial services	64
SH1	Franchises and trademarks licensing fees	
SH3	Licenses for the use of outcomes of research and development	
SH41	Licenses to reproduce and/or distribute audio-visual products	
SH42	Licenses to reproduce and/or distribute other products	
SI1	Telecommunications services	61
SI2	Computer services	62
SI3	Information services	63
SJ111	Provision of research and development services	72
SJ112	Sale of proprietary rights arising from research and development	72
SJ12	Other research and development services	72
SJ211	Legal services	69
SJ212	Accounting, auditing, bookkeeping, and tax consulting services	69
SJ213	Business, management consulting and public relations services	70
SJ22	Advertising, market research, and public opinion polling services	73
SJ311	Architectural services	71
SJ312	Engineering services	71
SJ313	Scientific and other technical services	71
SJ321	Waste treatment and de-pollution	38
SJ322	Services incidental to agriculture, forestry and fishing	
SJ323	Services incidental to mining, and oil and gas extraction	
SJ33	Operating leasing services	77
SJ34	Trade-related services	
SJ35	Other business services n.i.e.	
SK1	Audio-visual and related services	59
SK21	Health services	86
SK22	Education services	85
SK23	Heritage and recreational services	90-94
SK24	Other personal services	

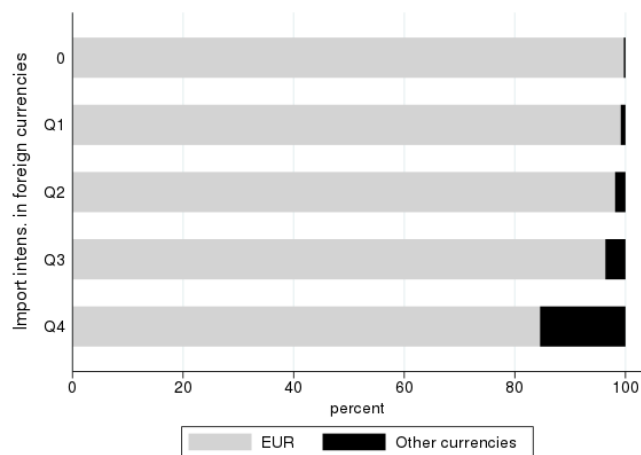
Table A.1. EBOPS service categories and conversion to ISIC Rev. 4 divisions

Germany	
EUR	91.82
USD	8.12
GBP	0.03
Other	0.02
Spain	
EUR	98.96
USD	1.02
GBP	0.01
Other	0.01
France	
EUR	86.15
USD	8.03
GBP	0.54
Other	5.27
United Kingdom	
EUR	83.09
USD	5.94
GBP	9.86
Other	1.11
Other countries	
EUR	93.25
USD	4.51
GBP	0.03
Other	2.22

Table A.2. Intra-EU services and goods trade: shares of different currencies (percent), by partner country



(a) Currency choices and firms' size



(b) Currency choices and firms' import intensity in foreign currencies

Figure A.2: Currency choices in intra-EU services exports and firm-level determinants

Notes: Shares in count terms. Q – quartile. In the second panel, “0” comprises firms whose import intensity ratio in foreign currencies is equal to zero. The remaining four categories divide the remaining firms into four quartiles depending on their ratios.

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