Trade in Services and Exchange Rates: Evidence for Dominant Currency Pricing

Gita Gopinath, Nan Li and Sergii Meleshchuk *

This version: September 10, 2020

Abstract

This paper estimates, for the first time, the exchange rate elasticity of bilateral trade in services; in so doing, it provides indirect evidence of both producer currency pricing and dominant currency pricing in services trade. We draw on a new data set of bilateral trade flows in services that covers eleven service sectors in more than 200 countries for the period 1995–2017. We find that, different from manufacturing trade, the value of services trade has greater association with bilateral exchange rates than with US dollar exchange rates, although the results vary across different service categories. Zeroing in on tourism, a sector for which proxies for trade volume (viz., tourist arrivals and hotel nights spent) are available, we find that bilateral exchange rates play a larger role on the volume of tourism than do the dollar exchange rates. Since traded services are frequently used as inputs in the production of re-exported goods and services, our analysis also shows that downstream dollar exchange rate movements (i.e., through forward linkages), rather than downstream bilateral exchange rates affect the demand for service imports.

Keywords: trade in services; exchange rates; dominant currency pricing; producer currency pricing; global value chain

*Correspondence: Li, Research Department, International Monetary Fund, NLi@imf.org. *Acknowledgments:* We are grateful for helpful comments from Gustavo Adler, Emine Boz, Luis Cubbedu, Oleg Itskhoki, Chris Papageorgiou, Andres Rodriguez-Clare and for the excellent research assistance provided by Zijiao Wang. We also thank Joseph Francois and Olga Pindyuk for generously sharing their data set on bilateral trade flows in services, without which this study would not have been possible. The views expressed herein are those of the authors and should not be attributed to the IMF, its Executive Board, or its management.

1 Introduction

The effect of exchange rate movements on trade flows is a central question in international economics. A recent and growing literature shows that it is the US dollar (USD) exchange rate that drives global trade in the short run—a "dominant currency pricing" phenomenon (Gopinath et al., 2020)—since most traded goods are priced and sticky in dollars (Boz et al., 2020).[1] A dollar depreciation lowers import prices in the destination currency and increases trade via the expenditure-switching channel; however, a depreciation of the exporter's currency against the destination country's currency has little effect on import prices and so fails to stimulate exports much. Therefore, the existence of a dominant currency in trade pricing has profound implications on the role of exchange rates in external adjustment.

Prior work on the trade impact of exchange rates has focused exclusively on merchandise trade. Although goods still count for the majority of cross-border trade, services have become the faster-growing sector (Figure 1). Trade in services now constitutes a quarter of global gross exports, 40% in terms of value-added content, and it is expected to support the next wave of globalization (WTO, 2019). Even so, little is known about how services trade reacts to exchange rate fluctuations or about whether dominant currency pricing prevails also in services trade.[2] This paper marks the first attempt to address these questions, drawing on a new data set of *bilateral* trade in services for a broad sample of countries over the last two decades.

Figure 1: Global Trade in Goods and Services (1985 = 1)

Notes: This figure shows the (normalized) time series of global exports in services and in goods. The nominal 1985 values of services exports and of goods exports are each normalized to 1.
Source: The World Bank's World Development Indicator Database.

[1] Other important contributions in this vein include Goldberg and Tille (2008), Gopinath and Rigobon (2008), Goldberg and Tille (2016), Gopinath (2016), Amiti et al. (2018), and Mukhin (2018).

[2] While there is scant information on trade invoicing currencies for goods (a reflection of the US dollar's dominant role in the pricing of goods outside the euro area; see Gopinath, 2016). Such data are virtually nil for services trade.

Trade in services are distinguished from trade in goods in several ways, and these differences could affect the role played by exchange rate adjustments. First, unlike manufacturing exporters, which are often also importers of intermediate inputs, services exporters generally employ a much higher share of domestic labor and rely less on imported intermediate inputs. Second, services are intangible and not storable, so their exchange may require the proximity of a supplier and a consumer or even joint production with customers (Hill, 1977). Lastly, many service sectors are highly concentrated in a few large firms with great market share. The reasons are that both natural and policy-induced barriers to foreign entry are high (e.g., heavy regulation in the sectors of Telecommunications, Insurance, and Professional services) and that network externalities are large (as in Telecommunications, Finance, and Transport; Francois and Hoekman, 2010). These unique characteristics of services affect the sensitivity of marginal costs to exchange rate shocks as well as the strength of strategic complementarities in price setting across competitors—factors that, according to theories of endogenous invoicing currency choice (e.g., Gopinath et al., 2010; Amiti et al., 2018; Mukhin, 2018), determine the optimal currency choices of exporters and can lead to the services trade and the goods trade responding differently to exchange rate fluctuations.

The limited availability of services trade data has posed serious research challenges, precluding systematic exploration of how trade in services is affected by exchange rates. This paper uses a new data set of such trade that provides the most comprehensive information on *values of bilateral services flows* at the annual frequency. These data cover eleven 1-digit BPM6 services industries in more than 200 countries, and they yield more than 4,000 directed trading pairs for the last two decades. Unlike goods trade, however, measures of prices and quantities do not exist for most services sectors; this deficiency hampers any separate analysis of exchange rate pass-through into prices and its effect on trade volumes. Tourism is an exception—information on tourists arrival and hotel nights spent can be used to proxy the volume of tourism trade. We thus zero in on this specific type of services trade in one section to complement our baseline analysis.

The impact of exchange rates on values of trade depends on (a) the price pass-through of the exchange rate and (b) the price sensitivity of demand in the destination country. If prices adjust flexibly, then the choice of currency is irrelevant. Yet if only infrequent price adjustments can be made, then the currency of invoicing matters greatly for exchange rate pass-through during periods of price non-adjustment (Gopinath et al., 2010). Micro-level evidence on manufacturing trade documents that prices are often sticky in U.S. dollar at horizons of up to two years (Goldberg and Tille, 2008; Gopinath and Rigobon, 2008). Data are lacking for prices of traded services; however, studies that use consumer prices of detailed services categories to assess the frequency of price changes suggest that services exhibit considerable price rigidity—even more so than manufacturing

goods and foodstuffs (see e.g. Bils and Klenow, 2004; Nakamura and Steinsson, 2008; Klenow and Malin, 2010).

If prices are sticky in the currency of the producer, which is known as *producer currency pricing* (PCP), then import prices measured in a destination currency move in parallel with the bilateral exchange rate vis-à-vis the exporter (complete pass-through). As long as the price elasticity of demand differs significantly from 1, the volume effect does not completely offset the price effect and so import value in the destination currency changes with bilateral exchange rate movements (either negatively or positively, depending on whether the price elasticity of demand is less or greater than 1). In contrast, if prices are sticky in the destination currency—the case of *local currency pricing* (LCP)—then import prices are entirely unrelated to the bilateral exchange rate (zero pass-through), in which case there are no changes in the import volume or in its value (measured in the destination currency). If prices are set in a third country's currency—that is, regardless of the origin or destination of trade flows—then, in this *dominant currency pricing* (DCP) scenario, import prices in the destination currency respond to movements in the importer's currency exchange rate with respect to (w.r.t.) the dominant currency (usually, the US dollar) but *not* to movements in the exchange rate w.r.t. the trading partner's currency. Thus the value of imports responds to the importer's dollar exchange rate instead of to its bilateral exchange rate.

Therefore, our empirical strategy is to infer the *existence* of PCP and DCP by determining whether imports measured in the importer currency respond strongly to (respectively) bilateral exchange rates and dollar exchange rates. If neither exchange rate matters, then LCP is likely to prevail.[3] Focusing on bilateral trade flows mitigates the aggregation biases associated with weighted effective exchange rates (Spilimbergo and Vamvakidis, 2003; Mayer and Steingress, 2019). Using annual data from 1995 to 2017, we first estimate both bilateral and dollar exchange rate elasticities of bilateral services trade after controlling for shifts in demand conditions and in producer costs as well as for various lagged variables and for time fixed effects and directed country-pair fixed effects. Since it is almost impossible to identify exogenous exchange rate shocks, as well as exogenous demand and all relevant relative prices, our regression results should not be interpreted as estimates of structural parameters. Rather, we provide the first analysis, following the prevailing empirical strategy in the literature, on how services trade is related to exchange rate movements. Nevertheless, we refer to the reduced-form estimates of exchange rate coefficients as exchange rate elasticities of services trade.

Our cross-country evidence reveals that both bilateral and dollar exchange rates figure prominently in the aggregate trade in services, which indicates that substantial shares of services trade

[3]However, the existence of PCP and DCP does not preclude the existence of LCP; it could still be the case that some imports are priced in the local currency.

are invoiced in the exporter's currency or in US dollars. More specifically, if j's currency depreciates relative to country i by 10%, then the values of services imported from i by country j (measured in j's currency) increase by 4% in the short run, indicating that an increase in price dominates a decrease in traded quantities.[4] The effect of the USD exchange rate is comparable to that of the bilateral exchange rate and is statistically significant: a 10% depreciation of importer j's currency vis-à-vis the US dollar is associated with a 4.4% increase in import value in j's currency—even after we control for movements in bilateral exchange rates. Yet the effect of those bilateral exchange rates strengthens over the medium term, with cumulative elasticity rising to 0.57 over two years; this contrasts with the effect of USD exchange rate, with cumulative elasticity falling to 0.14 (and becoming statistically insignificant).[5] If the sensitivity of services demand to prices is the same irrespective of the currency in which transactions are priced, then the relative magnitude of bilateral and USD exchange rate elasticities can inform the relative extent to which PCP and DCP have been adopted. The results then suggest that the prevalence of DCP relative to PCP is less pronounced in services trade than in manufacturing trade (as documented in Gopinath et al., 2020).[6]

Traded services are extremely heterogeneous, spanning a diverse set of activities that include transportation services, tourism, financial services, communication services, royalty and license fees, health care and education services, and artistic exchange. We therefore estimate the exchange rate elasticities separately for individual 1-digit services trade categories. Our findings document meaningful differences across sectors in the effects of bilateral and dollar exchange rates. In the short term, the USD exchange rate seems to be more important than the bilateral exchange rate for three sectors: Transport, Travel, and Telecommunications, computer, and information (a.k.a. IT services). In contrast, neither Financial services nor Other business services are much affected by the USD exchange rate. There is no evidence of either PCP or DCP for Construction, which suggests that LCP dominates in this sector. These differences across sectors may reflect underlying differences in such industry-specific characteristics as the frequency of price adjustments, reliance on imported intermediate inputs, and markup elasticities to shocks.

Next we focus on one specific type of services trade, tourism, that features reliable data we can use to proxy for *trade volumes*. Using data on the number of tourists arrivals and hotel nights spent,

[4]This finding is consistent with Gopinath et al. (2020) which estimate higher absolute value for price pass-through than quantity elasticity for trade in manufactured goods.

[5]Our results are robust to alternative measures of exporters' marginal costs and to samples that differ in terms of their coverage's comprehensiveness.

[6]Evidence for manufacturing trade is based on Gopinath et al. (2020). According to their pass-through regression—which gives the relative share of trade in DCP versus PCP, since the exchange rate coefficients in the pass-through regression do not reflect price elasticity of demand—the value of the contemporaneous dollar coefficient is almost 5 times that of the bilateral coefficient.

which are obtained from the Eurostat database (33 reporting countries and 43 partner countries over the 1991–2017 period), we find evidence of both PCP and DCP—although tourism responds more to movements in bilateral exchange rates than to USD exchange rate fluctuations. When the currency of a tourist destination country (exporter) appreciates by 10% against the origin country, tourist arrivals at the destination are found to fall by 2.7% in the short term and by more than 4% in the medium term. The hotel nights spent also decline by a similar magnitude. Depreciation of the importer's (tourists') currency against the US dollar also discourages outbound tourism, but only by about half that magnitude in the short run. In the medium term, quantities become statistically insensitive to the USD exchange rate, while the effect of bilateral exchange rates becomes stronger. This implies that for countries specializing in tourism, the traditional Mundell-Fleming mechanism of boosting exports through currency depreication is still effective.

We then complement our cross-country results with evidence from US trade with the rest of the world. Under DCP, imports to the United States denominated in US dollars do not react to bilateral exchange rates whereas US exports do react. In contrast, both imports and exports should respond to exchange rate changes under PCP. We find evidence consistent with DCP both in the aggregate and across sectors; the only exceptions are Financial services and Telecommunications, computer, and information. The latter sector's imports by the United States also respond to exchange rate changes. This evidence points to dollar pricing for most services and to producer currency pricing for Financial services and IT services.

In assessing the role of exchange rates on services trade, it is useful to recognize that some modern services are frequently used as an input in the production of other sectors (see 2020 World Development Report). On the one hand, then, a depreciation of the importer currency shifts demand away from imports and toward domestically produced goods. On the other hand, a weaker currency also enhances the competitiveness of re-exported goods, which in turn increases demand for imported inputs. If a large enough share of service imports are used in the production of exports of goods and services, then changes in downstream exchange rates—that is, bilateral exchange rates between the initial importer and downstream producers in other countries as well as the dollar exchange rates of downstream producers—would also affect the demand for imported services that are used as inputs. We shall assess the effect of exchange rates on bilateral services flows not only through the *direct* expenditure-switching channel but also through the *indirect* global value chain (GVC) channel. Unfortunately, GVC data are only available for a subset of countries. Nevertheless, in one specification we augment the baseline regression of service trade values from country i to j with additional controls for downstream exchange rate fluctuations for the subsample of countries with the available data. These controls are constructed as the weighted averages of (i) bilateral

exchange rate changes between the initial importer country j and its respective downstream trading partners; and (ii) the USD exchange rate of downstream importers. The weights are measured using the World Input-Output Table, and effectively captures the shares of bilateral flows of services that are re-exported by importer j. We find that, if currencies of downstream buyer depreciate against the US dollar, then demand by j for services imported from i increases when those services are used as major inputs in the production of exported goods and services. Hence this dynamic dampens the negative import response associated with the traditional expenditure-switching channel. However, bilateral exchange rate movements between j and its downstream partners do not affect the demand for imported services in a statistically significant way. In addition, controlling for the downstream demand shock as a result of downstream exchange rate changes does not substantially alter the size of the coefficients of the original bilateral and dollar exchange rates.

Literature Review Our work contributes to the vast literature on the effects of exchange rates on trade flows and global imbalances, which until now has addressed only merchandise trade (Spilimbergo and Vamvakidis, 2003; Bussière et al., 2013; Bussière et al., 2016; Leigh et al., 2017; Mayer and Steingress, 2019). The primary focus has been on understanding the mechanisms that underlie the transmission of exchange rate shocks to prices and quantities (e.g., Atkeson and Burstein, 2008; Berman et al., 2012; Amiti et al., 2014; Devereux et al., 2015; Auer and Schoenle, 2016; Amiti et al., 2018). This paper is the first to exploit a globally representative data set on bilateral trade in services, and to quantify the elasticity of *services* trade flows to both bilateral and dollar exchange rates. Given the rapid rise of services in international trade and the increased specialization by countries, this study bears far-reaching implications for the spillover effects of monetary policy, for optimal exchange rate policies, and for the effort to contain large external imbalances.

The cross-sectional richness of our data set enables investigation of whether dominant currency pricing plays a leading role also in services. In this respect, our analysis adds to the recent literature on the dominant currency paradigm (Gopinath, 2016; Boz et al., 2017; Gopinath et al., 2020; Boz et al., 2020) and on vehicle currency pricing (Goldberg and Tille, 2008; Chung, 2016; Goldberg and Tille, 2016; Lyonnet et al., 2016; Chen et al., 2019). Our analysis is most closely related to that of Boz et al. (2017), who empirically evaluate the predictions of various currency paradigms using data on bilateral trade volumes and prices (unit values) of manufacturing goods. Following their strategy, we estimate the micro-founded dyadic bilateral trade equation with a parsimonious set of assumptions on pricing behavior. However, data limitations place serious constraints on the analysis because separate price and volume data do not exist for trade in services. Hence a direct test for the relative importance of DCP and PCP by evaluating exchange rate pass-through in

services is impossible.

Finally, this paper is related to the literature on how GVC participation affects the workings of exchange rates. Previous research on pass-through and exchange rate trade elasticities in the presence of value chains (see e.g. Amiti et al., 2014; Soyres et al. 2018; Adler et al., 2019) has dealt exclusively with trade in manufacturing goods. We augment this literature by focusing on trade in services and by using similar empirical approach of Adler et al. (2019) to construct the relevant weighted average exchange rate movements in the currencies of importers' immediate downstream partners.

The rest of our paper is organized as follows. Section 2 discusses how differences between trade in services and trade in goods can lead to different choices of invoicing currency and to varying responses to changes in exchange rates. In Section 3 we present the data and describe basic patterns of global services trade. Section 4 discusses our empirical strategy and results, and Section 5 explores the effects of forward GVC participation. We conclude in Section 6 with a brief summary of our approach and findings.

2 How Does Trade in Services Differ from Trade in Goods?

Before proceeding to the data and empirical analysis, we discuss conceptually the key factors that distinguish services from goods and that can lead to different choices of invoicing currencies.

Research on the endogenous choice of invoicing currency in a staggered price setting (e.g., Gopinath et al., 2010; Amiti et al., 2018; Mukhin, 2018) has established that a firm's currency choice is determined by its desirable exchange rate pass-through—that is, what the firm's pass-through would be if it could change prices in response to shocks. When prices are sticky, the firm optimally choose its invoicing currency to keep its prices closer to the desired level in periods when it cannot adjust prices. For example, if the desired pass-through to producer currency is low, then the firm would optimally choose *producer* currency pricing. Analogously, it would choose *local* currency pricing if the desired pass-through is high or *dominant* currency pricing for middle values of the preferred pass-through.

The desired pass-through depends, in turn, on the sensitivity both of the firm's marginal costs and of its desired markup to fluctuations in the exchange rate. The former is often related to the intensity of imported intermediate inputs. Exporters tend to invoice their sales in a currency that matches their production costs. A firm that uses a high percentage of imported inputs in production can achieve this match by pricing sales in the same currency as imports. The second factor, the sensitivity of markup to exchange rates, is closely related to the extent of strategic

complementarities in price setting with other firms in the same destination–industry. When an exporter faces competition from local producers and other exporters at the destination market, the elasticity of demand in that market varies with their market share. Therefore, the sensitivity of a firm's markup to an exchange rate shock depends on how sensitive demand elasticity is to the shock. Lowering the destination currency price increases the firm's market share—but at the cost of lower markups. If strategic complementarities in pricing are high, then a firm's profits are maximized when its prices remain stable relative to those of its competitors. In terms of the pricing decision, the implication is that firms are often better-off choosing a dominant currency rather than the producer's or the consumer's currency.

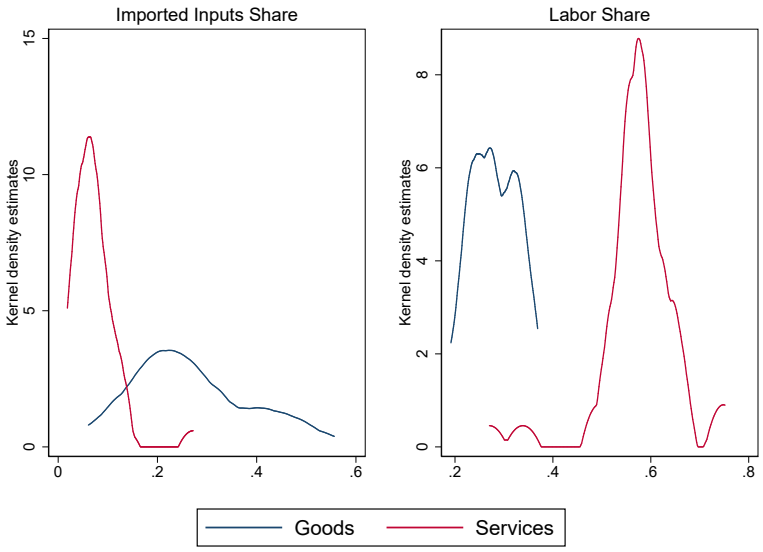
At the sectoral level, the prevalence of using different currencies depends on the sector's firms and general characteristics. In what follows, we discuss the differences between trade in services and trade in manufacturing goods, differences that could result in a variety of invoicing currency choices in response to exchange rate fluctuations.

First, in contrast to manufacturing trade—where exporters are often also importers (Bernard et al., 2009; Kugler and Verhoogen, 2009; Manova and Zhang, 2009)—services generally employ a much higher share of domestic labor and a lower share of imported intermediate inputs. According to the 2016 World Input-Output Database (WIOD), the average share of intermediate input in gross output for manufacturing production is 26.7% as compared with 8.7% for services (see Figure 2). The contrast in the share of domestic labor input is equally striking, with an average of 27.9% for manufacturing and 57.5% for services. A higher intensity of domestic inputs in the service sector translates into lower sensitivity of marginal costs (in producer currency) to exchange rate movements and hence into greater incentives to price in the producer's currency.

Second, services are intangible and nonstorable. Hence their exchange often requires the proximity of a supplier and a consumer, or of joint production with customers; this is known as the "proximity burden" (Hill, 1977). A firm's choice of currency, then, depends on its rivals' pricing at the location of service delivery—especially when strategic complementarities in pricing are high. When exporters compete mainly with other local providers in the customer's location, which tend to price in local currency (as in the case of Financial intermediation services), the proximity burden leads to local currency pricing. Yet if trade occurs at the exporter's location and if the exporter serves also the local consumers (as with Tourism), then the proximity burden leads to pricing in the producer currency.

Third, services are often characterized by considerable natural and behind-the-border policy barriers to entry (e.g., regulatory requirements) and large network externalities (Francois and Hoekman, 2010; Miroudot et al., 2013; Hoekman and Shepherd, 2019). All these factors give rise, in some

Figure 2: Distribution of Input Shares in the Production of Services and Manufactured Goods



Notes: This figure graphs, for year 2014 and across 56 countries, kernel density estimates of the share of imported inputs (left panel) and the share of labor inputs (right panel) in services industries (red plots) and in manufacturing industries (blue plots).
Source: World Input-Output Database (2016).

services sectors, to highly concentrated market shares of a small number of firms. This outcome implies that some service exporters may actively adjust their markups by choosing LCP or DCP (if other competitors adopt DCP) so as to ensure the stability of their market shares (Amiti et al., 2014, 2018).

Finally, some services trade relies less than others on external finance. For example, Borchert and Mattoo (2010) document low reliance on external sector financing across Indian firms in the IT sector. Duygan-Bump et al. (2015) establish that few service sectors depend on external finance. Several factors may explain the low reliance on external finance (Ariu, 2016), including the short or no lag between product delivery and the receipt of payment of some services sectors reduces their need for short-term working capital. In addition, some service exporters may simply be unable to obtain external finance—in other words, because services are so intangible and highly customized that they can hardly serve as collateral. The services trade's independence from external finance implies fewer liabilities that are denominated in foreign currency and therefore less incentive to price in a foreign currency (e.g., to match the currency of financing and revenues; see Gopinath and Stein, 2018).

3 Data Description

Generally speaking, services are not storable and their exchange often requires some sort of "jointness in production". Recognizing the different ways that services can be provided, the World Trade Organization's General Agreement on Trade in Services classifies services exports into four modes of supply: cross-border supply (mode 1), consumption abroad (mode 2), local commercial presence (mode 3), and movement of "natural persons" (mode 4).[7] However, international service trade identified in the Balance of Payment (BoP) Statistics includes only services provided by modes 1, 2, and 4 because BoP measures service transactions only between resident and nonresident entities. Hence services provided via a commercial presence in the importing country (mode 3), such as by the affiliates of a multinational enterprise, are excluded from our analysis.[8]

3.1 Data Sources

Bilateral Services Trade. We employ a new data set of bilateral services flows at the annual frequency: the Trade in Services Database (TSD).[9] This data base consolidates and reconciles official data from multiple sources, including the WTO-UNCTAD-ITC annual trade in commercial services database (primary source), Eurostat (for EU members, EU candidates, and "observer" countries), the OECD, and the International Monetary Fund (IMF).[10] The TSD contains information on exports and imports of services broken down by partner country and (when available) by subcategories. Its concepts, definitions, and classification conform with the 6th edition of the IMF Balance of Payments and International Investment Position Manual (BPM6). This panel covers the 1995–2018 period for more than 200 countries, although information in the earliest and latest

[7] Thus mode 1 service is provided by resources located in the exporting country and delivered to the importing country; one example is technical help provided by a customer service representative in India over phone to a US consumer whose computer has been infected by a virus. Mode 2, consumption abroad, applies when a person from the importing country travels to the exporting country to consume the service—as when a client from Singapore comes to his US lawyer's office. Under mode 3, the exporter has a commercial presence in the importing country; by this definition, a firm's foreign affiliate sales to host-country consumers are counted as the export of services. Mode 4, which involves the presence of natural persons, is in that sense the opposite of mode 2. So in mode 4, a natural person from the exporting country travels to the importing country to provide a service; examples include a financial consultant visiting her client in a foreign country and (say) Billy Joel giving a concert in the former Soviet Union.

[8] This is a minor issue given that we are primarily interested in how trade in services is affected by exchange rates. We presume that services supplied through foreign affiliates are usually priced in the local (destination) currency and so are less affected by changes in source–host country exchange rates or by dollar exchange rates.

[9] An earlier version of the data set for 1995–2011, which is based on BPM5, can be obtained from https://datacatalog. worldbank.org/dataset/trade-services-database. Our analysis uses an unpublished yet substantially updated version of the previous TSD that was provided by the original authors, Joseph Francois and Olga Pindyuk.

[10] It is critical that our analysis relies on official data rather than estimated data. Other data on bilateral services flows, such as those provided by WIOD, include figures estimated via gravity equations; they are unsuitable for our purposes because they would artificially imply the *absence* of any relationship between exchange rates and trade flows.

years of that span is sparse for some countries.[11] Such broad coverage is achieved by using "mirror" flows of the exports and imports of the reporting countries for partner countries (for methodological details of the data construction, see Francois and Pindyuk, 2013). For example, China and India are included in the database as partners owing to their transactions with other reporting countries—that is, despite the lack of data on trade *between* these two countries.

Services trades are most often categorized as either government or commercial services. Most *Government services* are provided by embassies, consulates, and military agencies. Table 1 displays the hierarchy of the various commercial services industries studied in this paper. According to BPM6, *Commercial services* comprise Goods-related services, Transport, Travel, and Other commercial services (OCS). Transportation services are the transactions associated with moving people and property (passengers and freight) internationally, and the Travel sector involves expenses for goods and services acquired by nonresidents abroad for business and personal purposes (related to health, education, or other personal reasons to travel). The OCS category is further disaggregated into: Construction; Insurance and pension services; Financial services; Charges for use of intellectual property (e.g., Royalties and license fees); Telecommunications, computer, and information (IT services); Other business services; and Personal, cultural, and recreational services. Our analysis is based on information for aggregated and 1-digit services. Although finer disaggregation (at the 2- or 3-digit level) is available in the data, the limited and lower-quality observations at those levels there hamper viable statistical analysis.

US Trade in Services. To complement our cross-country study, we obtain sectoral data on trade flows of the United States and its trading partners—for the period 1999–2018—from the US Bureau of Economic Analysis (BEA). There are two reasons for examining US evidence in particular. First, the data could be of higher quality because the BEA has made tremendous improvements in estimating the trade in commercial services. Second, trade flows to and from the United States provide an additional test for dominant currency pricing, since under DCP there is a noticeable asymmetry between the responses of imports and exports to exchange rate fluctuations.

Multilateral Services Trade. We use data on multilateral services trade for summarizing global trends and for making comparisons with our bilateral flow data. Sources are the World Bank's World Development Indicators (WDI) and the IMF's Trade in Services Database. Both data sets

[11] It is notoriously difficult to collect data on cross-border trade in services, and the quality of such data is decidedly lower than that of trade data for merchandise goods. The long tradition of tariff revenues has enabled highly accurate trade data for goods to be collected at customs. In contrast, the intangible and nonstorable nature of services makes at-the-border duties impossible to apply—resulting in much weaker (and ultimately less accurate) compilation procedures.

Table 1: Commercial Services Classifications, BPM6

1-digit	2-digit (description)
Goods-related services	
Manufacturing services on physical input owned by others	Goods for processing abroad
	Goods for processing in the reporting economy
Maintenance and repair services n.i.e.	—
Transport	Sea transport
	Air transport
	Other modes of transport
	Postal and courier services
Travel	Business
	Personal
Other commercial services (OCS)	
Construction	Construction abroad
	Construction in the reporting economy
Insurance and pension services	Direct insurance
	Re-insurance
	Auxiliary insurance services
	Pension and standardized guaranteed services
Financial services	Explicitly charged and other financial services
	Financial intermediation services indirectly measured
Charges for use of intellectual property n.i.e.	Franchise fees and trademark licensing fees
	Licences for the use of outcomes of research and development
	Licences to reproduce and/or distribute computer software
	Licences to reproduce and/or distribute audiovisual materials and related products
Telecom, computer, and information services	Telecommunications services
	Computer services
	Information services
Other business services	Research and development
	Professional and management consulting services
	Technical, trade-related, and other business services
Personal, cultural, and recreational services	Audiovisual and related services
	Other personal, cultural, and recreational services

Source: The International Monetary Fund's BPM6.

cover 192 countries, although the former encompasses a slightly longer period (1970–2017; the IMF data end at 2014). The disadvantage of WDI data is that they are available only for Total services, Other commercial services, Travel, and Transport. That is, they include no breakdown of Other commercial services—in contrast to IMF data, which covers up to 66 3-digit subcategories of services.

Tourism. Separate data on prices and quantities are seldom available for services trades. However, tourist arrivals and hotel nights spent are reasonable proxies for quantities in the case of one service trade: tourism (i.e., personal travel for reasons other than health or education). Statistics for Tourism, which are generally reliable, are based on counts of foreign visitors (for tourism purposes) to the exporting country and of domestic visitors to foreign countries. We obtain the data on arrivals of nonresidents and on nights spent by nonresidents at tourist accommodation establishments—by tourists' respective countries of origin—from Eurostat's tourism database. The Eurostat data, which covers the period 1991–2018, rely on reports from: (a) the 28 EU countries plus Iceland, Ireland, Norway, Turkey, and Switzerland; and (b) 43 partner countries, which include Australia, Brazil, Canada, China, Japan, Korea, Russia, South Africa, Ukraine, and the United States.

3.2 Basic Patterns of International Trade in Services

Before describing and analyzing the data, we examine the breadth of the Trade in Services Database's coverage. Table 2 gives the share of world exports (as recorded in WDI) that is covered by the TSD's three main categories. The first two columns report the 2005 dollar value of world service exports and its average annual growth rates over 1995–2017. Total services grew by 7% annually, with OCS the fastest-growing sector. The table's last column shows the share of world services exports that is covered by TSD in any specific category. The TSD includes more than 90% of total services, 82% of world transport, and 74% of travel as well as nearly all OCS trade.

Table 2: Worldwide Service Exports

	Global exports [1]	Growth [2]	TSD coverage [3]
Total services	2,696.3	7.0%	91%
Transport	592.5	5.7%	82%
Travel	716.0	5.4%	74%
Other commercial services	1,331.1	8.9%	98%

Notes: Column [1], global service export value in billions of US dollars (as recorded by the WDI in 2005); column [2], average annual growth rate of export value over the period 1994–2017; column [3], share of world trade covered by the TSD in 2005.

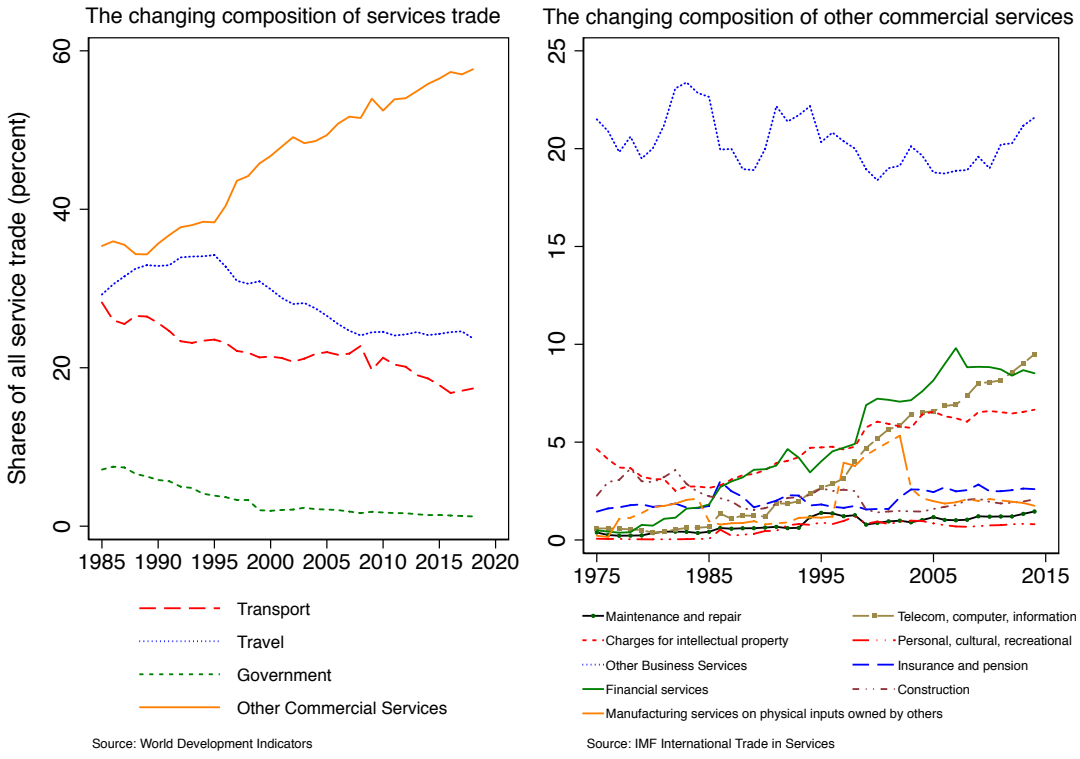
Cross-border trade in services has grown steadily over the past four decades. In comparison with the value of goods exports, which has increased at a modest 1% annually since 2011, the value of commercial services exports has expanded at 3 times that rate and now accounts for nearly a fourth of global exports in gross terms and for about two fifths in value-added terms. These services have also made a strong contribution to the export revenue of certain countries; they amount to 45% (resp. 33%) of UK (resp. US) gross exports. These percentages are even higher in terms of the value added that exports embody: the share exceeds 50% in France, Germany, Italy, the United Kingdom, and the United States. Even in China, which is traditionally viewed as a manufacturing exporter, more than a third of the value added in its exports is due to services.

Much of the rise in services exports stems from reduced trading costs—a result of advances in information and communication technologies that ease the proximity burden of services trade. The greater prevalence of global value chains is itself intricately linked to the rise of services trade. As in the case of goods, the emergence of GVCs has allowed for international specialization in service tasks; and services have been increasingly traded as components within GVCs (Heuser and Mattoo, 2017). Indeed, many services have become as tradable as manufactured goods (Gervais and Jensen, 2019). One consequence is that cross-border trade as a share of global services output has risen from about 3% in 1970 to 10% in 2014. This increase in the tradability of services is widespread across countries.

In terms of industries, the increase in services exports have been especially dramatic in "modern" services that can be delivered at a distance (e.g., IT services, financial intermediation, R&D and professional services, entertainment services). In the mid-1980s, the sectors of Transport, Travel, and OCS each accounted for about a third of world services exports (see Figure 3). The share of OCS increased to almost 60% in 2017, while the shares of such traditional services as Transport and Travel declined over time. The travel industry still accounts for a sizable fraction of the services exports of developing economies, although its relative importance has diminished. Within the OCS category, the fastest-growing segments are Financial services and IT services. Overall, trade in services have played an ever greater role in global trade—a trend that is driven mostly by growth in Financial services, IT services, and Charges for use of intellectual property. The top 5 services industries (Transport, Travel, Finance, IT, and Other business services) now account for 85% of global services exports.

As regards the composition change in terms of country income groups, Figure 4 shows that most services exports are sourced from high-income countries. Yet middle- and low-income countries play increasingly larger roles over time, a reflection of their growing economic significance in the world. A related outcome is that the global rise of services trade has been accompanied

Figure 3: Composition Changes of Services Trade by Industry



by specialization patterns that differ between advanced and emerging/developing economies: advanced economies have become increasingly specialized in services exports, whereas emerging and developing economies are more likely to specialize in the manufacture of exports (see Figure 5).

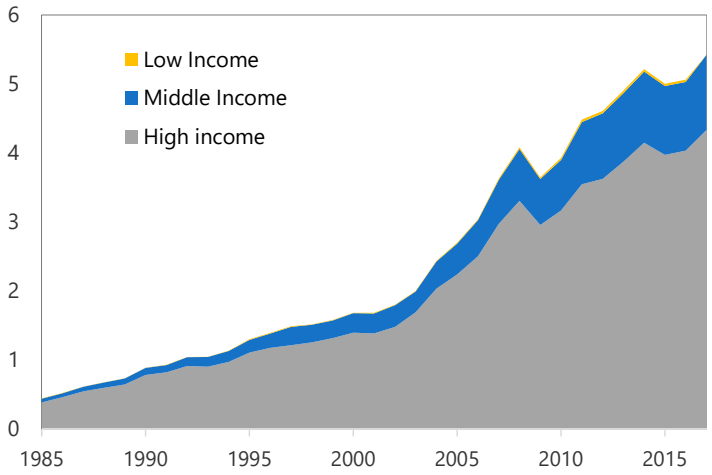
Services trade flows at the bilateral level have not been subject to much previous analysis. It turns out that the value of trade is highly concentrated in a relatively small share of trading partner pairs. Exporter–importer pairs in the top 1% of trade flows account for 52% of global trade in services, and the top 10% contribute more than 90%. In comparison with the trade in *goods*, however, it is much less common for there to be zero *services* trade flows between partners. Our data reveal that only some 15% of the dyads do not trade in services or contain no information on services trade, in contrast with about a third to a half of the world's country pairs trade no goods at all with each other (cf. Haveman and Hummels, 2004; Helpman et al., 2008).

4 Services Trade and Exchange Rates: Empirical Evidence

4.1 Conceptual Framework

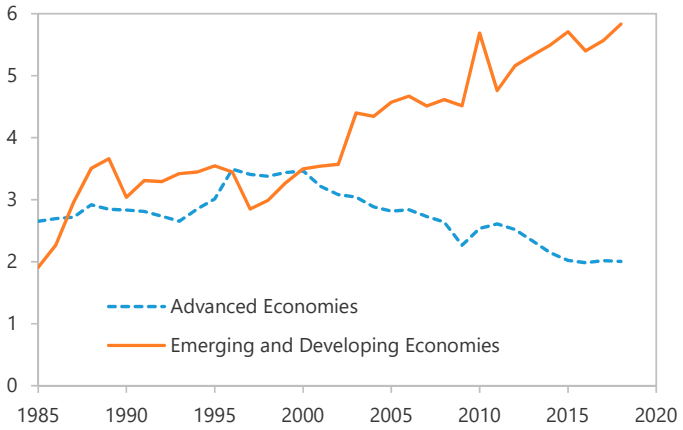
Services trade comprises a wide range of activities and is difficult to model within a single framework. To motivate the empirical analysis, we start by providing a simple conceptual framework.

Figure 4: Services Exporting by Income Group



Note: This figure plots the value, in trillions of USD, of services exports by high-income (gray), middle-income (blue), and low-income (orange) country groups from 1985 to 2018.
Source: The World Bank's World Development Indicators database.

Figure 5: Ratio of Manufacturing Exports to Service Exports, AEs vs. EMDEs



Note: This figure plots the time series of the GDP-weighted average of the manufacturing/services exports ratio for advanced economies (AEs, dashed blue line) and for emerging market and developing economies (EMDEs, solid orange line).
Source: The World Bank's World Development Indicators database.

Let q_{ij} denote the (log) quantity of imports by country j from country i, let $p_{ij} - p_j$ be the (log) price of imported services relative to the domestic price in destination country j, and let y_j indicate (log) real expenditures in the importing country j. Now consider a parsimonious representation of import demand in which the quantity of service imported depends on the product's price competitiveness in the destination market (i.e., relative prices) and on the demand conditions (real expenditures) in the destination country:

$$\Delta q_{ij,t} = -\sigma_{ij}(\Delta p_{ij,t} - \Delta p_{j,t}) + \Delta y_{jt}; \tag{1}$$

where σ_{ij} can be viewed as a reduced-form measurement of the elasticity of import quantities w.r.t. import prices, although it is more commonly given a structural interpretation. For example, this demand function can arise from a constant elasticity of substitution (CES) cost or demand function in which buyers regard different varieties as imperfect substitutes.[12] This is known as the Armington assumption, and σ is sometimes referred to as the Armington parameter or Armington elasticity; however, models of imperfect competition (e.g., Melitz-type trade models) would yield similar formulations.

As in Gopinath et al. (2020), firms face three currency choices when pricing their products: producer currency pricing (PCP), local currency pricing (LCP), and dominant currency pricing (DCP). Suppose a certain fraction θ_{ij}^{i} of imports are invoiced in producer i's currency (PCP), a fraction θ_{ij}^{j} in local importer j's currency (LCP), and a fraction $\theta_{ij}^{\$}$ in the dominant currency—whether it be dollar or euro (DCP). Assume that $\theta_{ij}^{i} + \theta_{ij}^{j} + \theta_{ij}^{\$} = 1$. Then the inflation in prices of services that country j imports from country i can be written as the weighted average of inflation of different invoicing currencies expressed in the importing country's currency:

$$\Delta p_{ij,t} = \sum_{k=i,j,\$} \theta_{ij}^{k}(\Delta p_{ij,t}^{k} + \Delta e_{kj,t}). \tag{2}$$

In this expression, k denotes the invoicing currency and $p_{ij,t}^{k}$ is the (log) price of services originating in i that are imported by j and invoiced in currency k.

In Calvo's (1983) "sticky prices" setup, $\Delta p_{ij,t}^{k} = (1-\delta)(\bar{p}_{ij,t}^{k} - p_{ij,t-1}^{k})$ for $\bar{p}_{ij,t}^{k}$ the (log) reset price in currency k. The inflation of services in country j that are imported from country i can

[12] This elasticity of demand can be either constant (in the case of CES demand; cf. Atkeson and Burstein, 2008) or time varying (as with the homothetic demand aggregator of Kimball, 1995).

then be written as

$$\Delta p_{ij,t} = \theta^{i}_{ij}\Delta e_{ij,t} + \theta^{\$}_{ij}\Delta e_{\$j,t} + (1-\delta)\sum_{k=i,j,\$}\theta^{k}_{ij}(\bar{p}^{k}_{ij,t} - p^{k}_{ij,t-1}). \tag{3}$$

Here $e_{ij,t}$ is the (log) bilateral nominal exchange rate between i and j (units of importer j's currency per unit of exporter i's currency); $e_{\$j,t}$ is the (log) dollar exchange rate of j (units of j's currency per USD); and δ represents the exogenous probability of price adjustment in the Calvo pricing environment.

To fix ideas, consider the very short run—that is, when prices are completely rigid and predetermined in the currency of invoicing, $\delta \to 1$.[13] Combining Equations (1) and (3) allows us to express the change in log *value* of services imported by country j from country i (expressed in j's currency) as follows:

$$\Delta v_{ij,t} = \Delta p_{ij,t} + \Delta q_{ij,t} = (1-\sigma_{ij})\theta^{i}_{ij}\Delta e_{ij,t} + (1-\sigma_{ij})\theta^{\$}_{ij}\Delta e_{\$j,t} - \sigma_{ij}\Delta p_{j,t} + \Delta y_{j,t}. \tag{4}$$

For countries other than the United States, if we control for destination prices $p_{j,t}$ and demand $y_{j,t}$ then the following statements hold.

- *Producer currency pricing* occurs if $\theta^{i}_{ij} = 1$ and $\theta^{\$}_{ij} = 0$, in which case the importers absorb all fluctuations in the bilateral exchange rate and so import values reflect changes in that rate up to $1-\sigma_{ij}$.
- In the case of *local currency pricing*, $\theta^{i}_{ij} = 0$ and $\theta^{\$}_{ij} = 0$, exporters fully absorb the fluctuations in exchange rates; also, the value of i's imports from j (in i's currency) is independent of exchange rate movements.
- With *dominant currency pricing*, $\theta^{i}_{ij} = 0$ and $\theta^{\$}_{ij} = 1$; here changes in import value reflect changes, scaled by $1-\sigma_{ij}$, in the importer currency–USD exchange rate.

As long as $\sigma_{ij} \neq 1$—that is, provided the valuation effect does not completely offset the volume effect of exchange rate movements—the value of imports will respond to changes in the bilateral (resp., dollar) exchange rate if a large share of imports are priced in the producer's (resp., a dominant) currency. We shall later use the estimated response of imports to the two exchange rates as a means of inferring the relative prevalence of producer and dominant currency pricing. Because the demand elasticity is unknown, we cannot test for the existence of LCP (e.g. when σ_{ij} is close to 1).

[13] Gopinath and Rigobon (2008) document that goods prices are rigid in the currency in which they are reportedly priced (with a median duration of eleven months).

4.2 Empirical Strategy

Motivated by Equation (4), we estimate the following log-linear regression specification, which is similar to the one used in the literature on DCP-augmented exchange rate pass-through (e.g., Gopinath et al., 2020):

$$\Delta v_{ij,t} = \sum_{\tau=0}^{L} \alpha_\tau \Delta e_{ij,t-\tau} + \sum_{\tau=0}^{L} \beta_\tau \Delta e_{\$j,t-\tau} + \Gamma' X_{ij,t} + \lambda_{ij} + \delta_t + \varepsilon_{ij,t}; \tag{5}$$

here $v_{ij,t}$ is the value of services imported by j from i at t in importer j's currency, and $\tau = 0, 1, 2$ denotes the time lag. The vector of other controls, $X_{ij,t}$, includes the log change of the importer's real gross domestic product (GDP) and consumer price index (CPI) (to capture the demand conditions) and the exporter's producer price index (PPI) (to capture marginal cost shifters), long with their two lags. We also control for directed dyadic fixed effects λ_{ij} and time fixed effects δ_t. The former control variable accommodates the effects of time-invariant factors (e.g., geographic distance, institutions) that have been shown to matter for services trade (e.g., Head et al., 2009; Eaton and Kortum, 2018) and possibly for its changes and of other persistent barriers to services trade. The latter variable controls for global trends in the services trade. Lagged independent variables are incorporated to allow for the possibility of a gradual adjustment of trade to exchange rates and other shocks. The short-term relationship between bilateral (dollar) exchange rates and the value imported by country j in j's currency is given by the estimated coefficient α_0 (resp. β_0). Medium-term elasticity is given by the sum of the coefficients for the contemporaneous and lagged exchange rates $\sum_{\tau=0}^{L} \alpha_\tau$ and $\sum_{\tau=0}^{L} \beta_\tau$. Standard errors are clustered at the directed dyadic level.

Identifying exogenous exchange rate shocks is difficult as exchange rate fluctuations (over the frequency of this analysis) are mostly a macro/financial economics phenomenon. In addition, we cannot control for all relevant relative prices, and import demand (proxied by importers' GDP) and marginal costs shifters (proxied by changes in PPI) are imperfectly measured. Therefore, our results should not be interpreted as providing estimates for structural parameters. Rather, they provide evidence on the relationship between (dollar and bilateral) exchange rate changes and services trade. Nevertheless, we adopt the general practice in this literature and refer to the reduced-form coefficients of exchange rates as exchange rate elasticities of the value of services trade.

4.3 Exchange Rate Elasticities of Aggregate Services Trade

First we apply the regression specification Equation (5) to total service trade; the estimates are presented in Table 3. We report results from unweighted regressions (columns [1] and [2]) and also

from weighted regressions (columns [3] and [4]), where the average (across years) share of world services trade value between a country-pair is used as the weight.

Table 3: Exchange Rate Elasticities of Overall Services Trade

	Unweighted		Weighted	
	[1]	[2]	[3]	[4]
		Contemporaneous		
$\Delta e_{ij,t}$	0.526***	0.399***	0.441***	0.361***
	(0.065)	(0.071)	(0.072)	(0.084)
$\Delta e_{\$j,t}$		0.442***		0.439***
		(0.152)		(0.128)
		Cumulative		
$\sum_{\tau=0}^{2} \Delta e_{ij,t-\tau}$	0.571***	0.531***	0.435***	0.337***
	(0.09)	(0.109)	(0.075)	(0.101)
$\sum_{\tau=0}^{2} \Delta e_{\$j,t-\tau}$		0.135		0.314*
		(0.182)		(0.14)
Observations	31,140	31,140	31,140	31,140
R^2	0.13	0.13	0.22	0.22
Dyadic FEs	Yes	Yes	Yes	Yes
Time FEs	Yes	Yes	Yes	Yes
Dyads	4,263	4,263	4,263	4,263

Notes: The dependent variable is the value of imports of country j from country i (in the destination currency). Columns [1] and [2] report results from unweighted regressions; columns [3] and [4] present the trade-weighted regressions. All regressions control for two lags of Δe_{ij} and $\Delta e_{\$j}$, for destination country GDP growth and CPI, and for exporter country PPI and their two lags. Robust standard errors (in parentheses) are clustered by dyad. $^{***}p < 0.001$.

The upper panel reports the estimated contemporaneous elasticities. Our results indicate that, if country j's currency depreciates by 10% w.r.t. country i's, then import value (in country j's currency) increases by 5.3% based on the unweighted regression and by 4.4% based on the weighted regression. However, including the dollar exchange rate reduces our estimated coefficients for the bilateral exchange rate, which declines from 0.53 to 0.40 in the unweighted regression and from 0.44 to 0.36 in the trade-weighted regression. The effect of the dollar exchange rate is slightly greater than that of the bilateral exchange rate, with an estimated elasticity of about 0.44 in both the unweighted and weighted regressions. Our estimates for α_0 and β_0 are positive and also statistically significant, which strongly suggests that both PCP and DCP are present in total services trade.[14] Without information on σ, the price elasticity of demand, we cannot test for the existence of local currency pricing in services. In addition, that the imports value responds positively to both bilateral and dollar depreciation of the importer's currency suggests that the rise of local currency price associated with exchange rate depreciation dominates the fall in the import volume. In other

[14] An insignificant coefficient need not imply that PCP or DCP is absent, because the price elasticity of demand (σ) could be close to 1.

words: $\sigma < 1$ on average, which accords with the common observation that consumer demand for services has low sensitivity to price changes (Bils and Klenow, 2004).

How are the estimated exchange rate elasticities compared with those for manufacturing trade? Using a similar reduced-form regression specification, Gopinath et al. (2020) estimate the exchange rate pass-through and trade elasticities separately. According to their estimates, import values of manufacturing goods increase by 1.3% in response to a same-period 10% depreciation of the importer's currency w.r.t. its trading partner's currency, and they increase by 5.9% in response to a 10% depreciation of its dollar exchange rate in the unweighted regression. That is, dollar exchange rate movements have a much larger effect on manufacturing trade (more than 4 times) than do bilateral exchange rate shocks, whereas the effects of both exchange rates are comparable for services trade. If the sensitivity of services demand to prices is the same irrespective of the currency in which the transaction is priced, then the relative magnitude of bilateral and USD exchange rate elasticities (α/β) can inform the relative prevalence of PCP versus DCP ($\theta^i/\theta^\$$). Our results suggest that DCP is adopted less often relative to PCP in services trade compared to manufacturing trade.

4.4 Exchange Rate Elasticities for Different Service Trade Categories

We now examine how the bilateral and dollar exchange rate elasticities differ across various categories of service trade. Examining individual service trade categories allows us to separate producer services (such as distribution services, IT services) from consumer services (such as tourism). Firms in different service categories may face different price elasticities of demand, have different price stickiness, and choose different invoicing currencies—from which it follows that exchange rate elasticities could likewise differ across categories. Here we focus on the five largest service sectors, which account for 85% of overall service trade and for which data are both more reliable and less subject to definitional changes when statistical practice changes to BPM6 (from BPM5): Transport, Travel, Financial services, Telecommunications, computer and information, and Other business services.[15]

[15]For example, additional statistics on goods-related services trade (Manufacturing services on physical input owned by others, Maintenance and repair services) were not included until BPM6 and are available starting only from 2005. In addition, major methodological changes in insurance transactions and in the treatment of intellectual property make the data for those sectors difficult to compare over time.

Table 4: Exchange Rate Elasticities of Individual Services Trade

	Transport		Travel		Financial services		IT		Other business	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8])	[9]	[10]
					Contemporaneous					
$\Delta e_{ij,t}$	0.524***	0.210**	0.580***	0.310***	0.669***	0.405***	0.544***	0.292**	0.596***	0.538***
	(0.066)	(0.084)	(0.061)	(0.066)	(0.110)	(0.156)	(0.095)	(0.115)	(0.089)	(0.097)
$\Delta e_{\$j,t}$		0.508***		0.639 ***		0.349		0.678***		–0.028
		(0.150)		(0.122)		(0.230)		(0.211)		(0.187)
					Cumulative					
$\sum_{\tau=0}^{2} \Delta e_{ij,t-\tau}$	0.71***	0.028	0.627***	0.265**	0.86***	0.274	0.691***	0.386*	0.811***	0.536***
	(0.089)	(0.121)	(0.087)	(0.092)	(0.142)	(0.213)	(0.14)	(0.171)	(0.088)	(0.128)
$\sum_{\tau=0}^{2} \Delta e_{\$j,t-\tau}$		1.167***		0.505***		0.931**		0.443		0.56**
		(0.176)		(0.147)		(0.285)		(0.262)		(0.198)
Observations	32,774	32,774	29,747	29,747	18,411	18,411	16,965	16,965	28,121	28,121
R^2	0.08	0.08	0.09	0.09	0.07	0.08	0.11	0.11	0.07	0.07
Dyadic FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dyads	2,807	2,807	2,613	2,613	2,071	2,071	2,212	2,212	2,693	2,693

Notes: The dependent variable is the value of country j's imports from country i (in the destination currency). All regressions control for two lags of Δe_{ij} and $\Delta e_{\$j}$, for destination country GDP growth and CPI, and for exporter country PPI and their two lags. Robust standard errors (in parentheses) are clustered by dyad. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Our results, reported in Table 4, exhibit considerable across-sector differences in the effects of bilateral and dollar exchange rates. In the short term, the USD exchange rate plays a larger role than does the bilateral exchange rate for trade in Transport, Travel, and Telecommunications. In contrast, the dollar exchange rate does not have a statistically significant effect on trade value in Financial services and Other business services. The effect of USD exchange rates strengthens over the two-year horizon in Transport, Financial services and Other business services; however, it weakens in Travel and IT services. Again, these differences across sectors may reflect underlying differences in industry-specific characteristics (e.g., how frequently prices are adjusted, the sector's reliance on imported intermediate inputs, and the extent of market concentration). [CAN WE SAY SOMETHING ABOUT OVER MEDIUM TERM WHEN PRICES ARE FLEXIBLE IT DOESN'T REALLY MATTER WHICH CURRENCY. HENCE THE RESULTS SHOULD BE TAKEN LESS SERIOUSLY? OF COURSE NOT IN SUCH LANUAGE]

4.5 Exchange Rates and Tourism: Volume Elasticities

Measuring prices (such as unit value) and quantities of services is difficult owing to the intangible nature of services. Countries and individual services sectors typically differ widely in the methodology used to construct real production and price indexes of services for their respective account statistics. In light of this scant information, we shall focus on a service sector (tourism) for which there exist relatively high-quality data that can be used to proxy for the quantity of trade. More specifically, for dependent variables we use log changes in (a) the arrivals of nonresidents from country j at hotels (and similar accommodations) in country i and (b) their hotel nights spent; we employ the same regression specifications as in Equation (5). Table 5 presents the results from panel regressions of trade volumes on changes in bilateral and dollar exchange rates.

The unweighted regressions yield consistent results that suggest significant PCP and DCP in the short term. Just as in the case of our value regressions, including the dollar exchange rate in these volume regressions reduces the coefficient for the bilateral exchange rate: from -0.369 to -0.270. However, the contemporaneous elasticity of the dollar exchange rate is smaller—about half the size of bilateral exchange rate elasticity when the dependent variable is outbound arrivals. The effects of dollar and bilateral exchange rates on hotel nights spent are similar. Moreover, the bilateral exchange rate effect strengthens over the two years following a shock whereas the USD exchange rate has little effect in the medium term. A 10% depreciation of a country's currency against the tourist hosting country's currency reduces, over our two-year horizon, tourist arrivals by 4.5% and hotel nights spent by 3.3%.

Yet when we use weighted regressions, the dollar exchange rate no longer plays a role—either

Table 5: Volume Elasticities of Tourism

	Arrivals				Hotel nights spent			
	Unweighted		Weighted		Unweighted		Weighted	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8])
				Contemporaneous				
$\Delta e_{ij,t}$	–0.369***	–0.270***	–0.309***	–0.383***	–0.369***	–0.232***	–0.312***	–0.322***
	(0.033)	(0.049)	(0.046)	(0.077)	(0.037)	(0.055)	(0.060)	(0.057)
$\Delta e_{\$j,t}$		–0.132**		0.096		–0.184***		0.008
		(0.057)		(0.111)		(0.064)		(0.053)
				Cumulative				
$\sum_{\tau=0}^{2} \Delta e_{ij,t-\tau}$	–0.493***	–0.45***	–0.575***	-0.598***	–0.459***	–0.325**	–0.705***	–0.717***
	(0.068)	(0.093)	(0.09)	(0.092)	(0.069)	(0.102)	(0.102)	(0.135)
$\sum_{\tau=0}^{2} \Delta e_{\$j,t-\tau}$		–0.054		0.031		–0.185		0.016
		(0.095)		(0.076)		(0.109)		(0.094)
Observations	17,881	17,881	17,881	17,881	18,607	18,607	18,607	18,607
R^2	0.19	0.19	0.19	0.20	0.13	0.13	0.15	0.15
Dyadic FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dyads	1,289	1,289	1,289	1,289	1,290	1,290	1,290	1,290

Notes: The dependent variable for columns [1]–[4] is arrivals of nonresidents from country j at hotel (and similar accommodations) in country i; for columns [5]–[8], it is hotel nights spent by nonresidents from country j. All regressions control for two lags of Δe_{ij} and $\Delta e_{\$j}$, for country j's GDP growth and CPI, and for exporter country i's PPI/CPI ratio and their two lags. Robust standard errors (in parentheses) are clustered by dyad. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.001$.

contemporaneously or over two years. Depreciation of the tourist's (importer's) currency against the US dollar essentially has no impact on outbound tourism. The implication is that DCP will be observed most frequently in smaller economies whereas PCP predominates in larger economies. Overall, it is evident that the dollar exchange rate has a much less negative effect on the volume of tourism than does the bilateral exchange rate. This result is interesting as it implies that the traditional Mundell-Fleming expenditure-switching effects of exchange rate on export volume still plays an important role for tourism export.

4.6 Evidence from US Imports and Exports

In this section we exploit bilateral services trade data involving the United States as a trading partner for an additional test of the DCP prevalence in services. Under dominant currency pricing, the bilateral exchange rate pass-through into US exports would be complete and immediate; hence it would affect the volume of trade unless demand is completely inelastic—in which case trade values should be strongly affected by bilateral exchange rates (provided, as mentioned previously, the volume effect does not completely offset the value effect). In contrast, the prices of US imports would be insensitive to bilateral exchange rate fluctuations in the short run and so exchange rates would not affect USD-denominated import values. Here we run, separately for US exports and

imports of services, a fixed-effects regression of (log changes of) trade value in the importer's currency on lagged (log changes of) bilateral exchange rates, importer GDP, CPI, and year fixed effects.

Gopinath et al. (2010, 2020) present strong evidence of DCP for trade in manufactures based on trade flows from and to the United States: neither the volumes or prices of US imports are influenced by bilateral exchange rate fluctuations, whereas export volumes and prices are clearly affected by such fluctuations. We similarly find that, although bilateral exchange rates matter quite a lot for exports from the United States, they have no significant effects on overall services imports to the United States (Table 6). These results amount to strong support for the pervasiveness of DCP in US services trade.

Table 6: Trade Flows to and from the United States

	Total	Transport	Travel	Finance	IT	Other	IP	Insurance
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
				A. Imports to the United States				
$\Delta e_{i\$,t}$	0.210	–0.046	0.157	0.559**	0.565**	0.289	0.600	–0.017
	(0.127)	(0.157)	(0.105)	(0.215)	(0.226)	(0.333)	(0.550)	(0.540)
$\sum_{\tau=0}^{2} \Delta e_{i\$,t-\tau}$	0.42**	0.25	0.079	0.99**	0.774	0.437	0.809	0.519
	(0.155)	(0.223)	(0.201)	(0.345)	(0.444)	(0.338)	(0.475)	(0.808)
Observations	730	687	736	557	534	551	542	509
R^2	0.17	0.19	0.31	0.20	0.15	0.13	0.12	0.15
Dyadic FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dyads	54	54	54	54	53	54	50	42
				B. Exports from the United States				
$\Delta e_{\$j,t}$	0.645***	0.582***	0.662***	0.431***	0.792***	0.941***	0.373***	1.083***
	(0.057)	(0.139)	(0.088)	(0.136)	(0.154)	(0.154)	(0.124)	(0.305)
$\sum_{\tau=0}^{2} \Delta e_{\$j,t-\tau}$	0.537***	0.583**	0.35**	0.576**	0.619*	1.387***	0.433*	0.768*
	(0.09)	(0.191)	(0.127)	(0.19)	(0.282)	(0.243)	(0.187)	(0.371)
Observations	981	932	981	822	804	779	966	918
R^2	0.37	0.11	0.42	0.21	0.14	0.14	0.19	0.10
Dyadic FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dyads	69	69	69	69	69	69	69	65

Notes: The dependent variable in Panel A (resp., in Panel B) is the value of exports from (resp., of imports to) the United States. All regressions control for two lags of $\Delta e_{i\$}$, for log changes of importer GDP and CPI, and for exporter country PPI and their two lags. Robust standard errors (in parentheses) are clustered by dyad. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.001$.

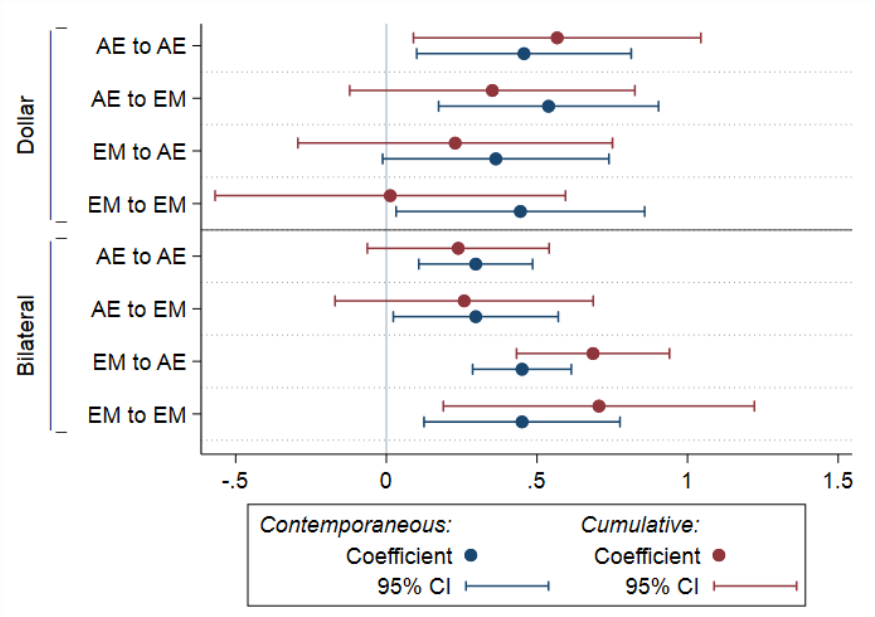
Qualitatively similar results are obtained for some (but not all) of the individual services categories in the short and medium run. On the one hand, Table 6 reveals that US imports in Financial services and IT services also respond strongly to bilateral exchange rate shocks in the short run, which means that—in these sectors—a sizable share of the providers' services are priced in producer currencies. On the other hand, US exports in all categories (denominated in foreign currency) respond to the depreciation of a foreign currency w.r.t. the US dollar in both the short term and the

medium term. The positive coefficient indicates that, despite prices in foreign currency increasing in response to that currency's depreciation, the subsequent trade volume decline is small; as a result, there is an increase in overall exports from the United States.

4.7 Trade Flows from and to Advanced and Emerging Market Economies

To determine whether firms in advanced economies (AEs) and those in emerging market economies (EMs) exhibit significant differences in their choice of currency invoicing, we augment Equation (5) by interacting contemporaneous and lagged exchange rates with a set of dummies that capture whether importers and exporters are of the AE or EM type. Thus we estimate exchange rate elasticities for four different country groupings and report the estimated coefficients in Figure 6. In the short run, there is little difference between advanced and emerging economies. Over our two-year horizon, the bilateral exchange rate seems to be relatively more important when the exporting country is an emerging market economy. Overall, there is some evidence that DCP might be used more often for flows between advanced economies—although the confidence bands are quite wide for these estimates. A possible explanation is that AEs and EMs trade different types of services.

Figure 6: Exchange Rate Elasticities for Emerging Markets and Advanced Economies

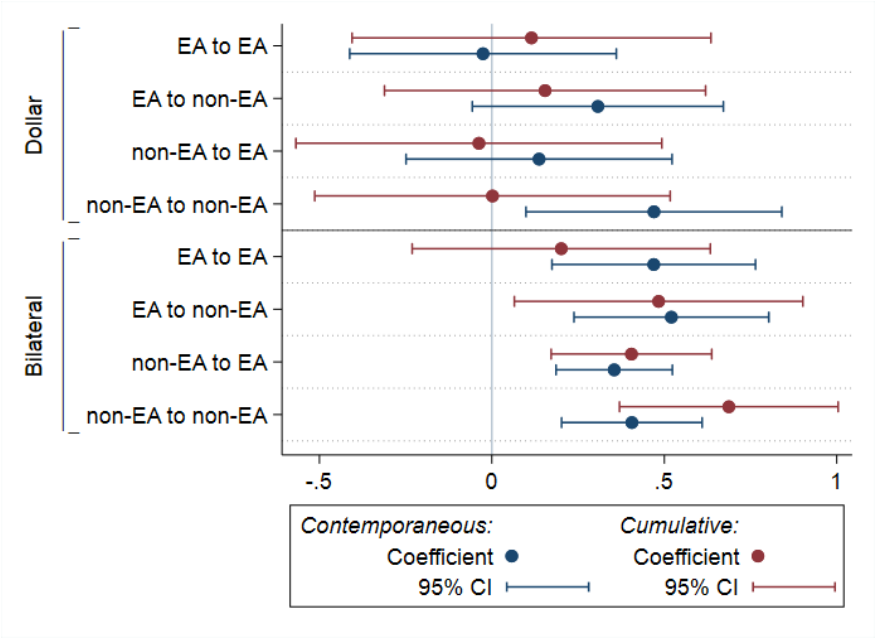


Notes: This figure plots the estimated *contemporaneous* coefficients (blue dots) and 95% confidence bands (blue lines) from Equation (5) when exchange rates are interacted with indicator variables for whether the importer or exporter is an advanced economy or an emerging market. The *cumulative* coefficients and confidence intervals are marked by red dots and lines, respectively. Standard errors are clustered at the directed dyadic level.

4.8 Euro Area versus Rest of the World

Many reporting countries in our bilateral services trade data are in the euro area (EA), and trade involving those countries is likely to be priced in a common currency—namely, the euro. Because time fixed effects are included in our regressions, we cannot discern whether services are priced in euros or dollars. We therefore investigate (i) whether the role played by USD exchange rates differs when trade involves an EA country and (ii) whether those rates affect trade between countries outside the euro area. Thus we interact bilateral and dollar exchange rates with four dummies indicating trade flows from and to an EA/non-EA country (as identified by their status in a given year).

Figure 7: Exchange Rate Elasticities for Euro Area and Rest of the World



Notes: This figure presents the estimated *contemporaneous* coefficients (blue dots) and 95% confidence bands (blue lines) from Equation (5) when exchange rates are interacted with the indicator variables for whether the importer or exporter is a country currently in the euro area. The *cumulative* coefficients and confidence intervals are marked by red dots and lines, respectively. Standard errors are clustered at the directed dyadic level.

Figure 7 plots the heterogeneous effects when exporters and importers are countries within or outside of the euro area. For bilateral trade between importers and exporters that are both in the EA, bilateral exchange rates should not matter since those exchange rates are fixed by definition. Yet because we use a time-invariant dummy for countries that are within the EA, identifying the impact of bilateral exchange rates on these country pairs is based on the sequential entry into the EA by the countries that had—before joining—a floating exchange rate vis-à-vis other EA countries. In the short run, we observe that dollar exchange rates play a prominent role only *outside* the euro

area whereas bilateral exchange rates have significant short-term effects on the value of trade flows between EA and non-EA countries. The effect of dollar exchange rates on trade value is neutral over our two-year horizon, which is consistent with the baseline results presented in Table 3.

4.9 Robustness

Our findings are robust to alternative measures of cost shifters. Because domestic labor is the main input for services trades, we also use unit labor costs (rather than PPI) as a proxy for shocks to marginal costs. The results (available from the authors upon request) are qualitatively similar.

Our baseline specification uses information on all trade flows in the data. Since the data set is built using mirror techniques, it follows that the services exports of some countries receive low coverage. Nonetheless, when we restrict the sample to countries with coverage of at least 10% (or 15% or 20%) of trade in services—as reported in the World Development Indicators—the results are nearly unchanged across all specifications.

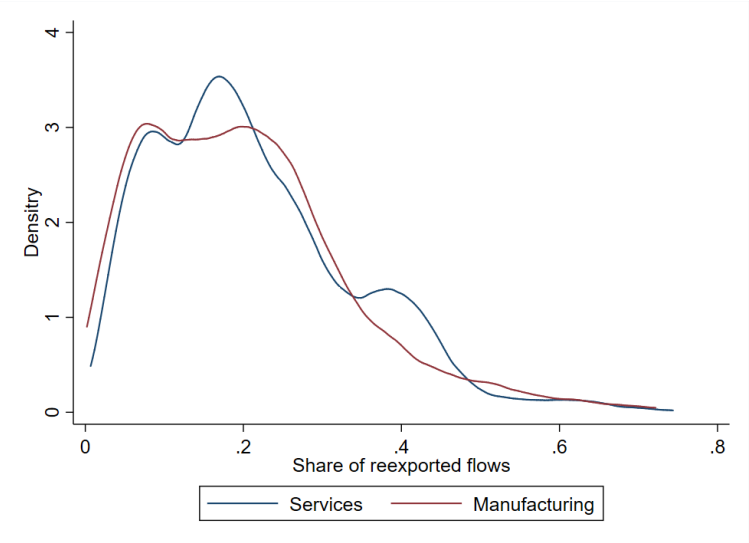
5 Role of Exchange Rates Through the Global Supply Chain

Services are an intangible but vital part of global value chains. The fragmentation of goods production has been associated with the outsourcing of not only manufacturing tasks but also service tasks (2020 World Development Report). Although services rely on far fewer imported intermediate inputs than do manufacturers (as shown in Section 2), part of the trade in services includes a component that is re-exported (see Figure 8). On average, 20% of bilateral services exports are used as inputs for further exports by the initial importing country. Especially such producer services as Transportation, Professional services, Financial services, and IT services facilitate and coordinate production across various geographic areas and in all sectors; hence they are crucial inputs for the exports of any sector. In fact, the goods trade increasingly involves services (both domestic and imported) in production, a process that has been dubbed the "servicification" of manufacturing (Baldwin et al., 2015).

In this section we further augment our baseline regression (5) to account for the role that exchange rates play—through their forward linkages—on services trade. In particular, importer j's currency depreciation or appreciation (w.r.t. its downstream trading partner's currency k or w.r.t. the US dollar) alters the import demand of downstream producers in country k, which in turn affects exports from i to j. Only a subset of countries in our sample are present in the data on global value chains, and hence our analysis below is based on a much smaller country sample.

An illustrative example is the exporting of services from Germany to China, exports that can

Figure 8: Re-exported Share of Services Trade Flows



Notes: This figure shows the density of the re-exported content of bilateral trade flows across different country pairs in 2015. The re-exported content of trade flows is defined in Equation (6) and reflects the share of flows from i to j that are re-exported by j to downstream partners.

be sensitive to the RMB–yen exchange rate or the RMB–USD exchange rate if a large share of services flows from Germany to China is used as inputs for exports to Japan and is priced and sticky in RMB, in yen, or in the dominant currency (here, USD). Suppose that a large percentage of re-exported products are priced in US dollars, as in the case of Chinese manufacturing exports. Then a depreciation of the yen against the dollar reduces demand for Chinese exports, which in turn reduces exports of services from Germany to China. To capture the effect that downstream exchange rates have on bilateral trade flows one step upstream, we construct a measure of demand shifters triggered by downstream exchange rate movements—in other words, weighted average downstream exchange rate changes for which our weights are the shares of bilateral flows that are further re-exported to those downstream destinations.

To understand the workings of exchange rate movements in the setting of forward GVC integration, consider a simplified version of the world. So for now we suppose that the world consists of three countries—i, j, and k—and just one sector. Assume further that j imports only from i and exports only to k. Some of the imports from i are used to produce goods and services that are then exported to k. Let $m_{ij,t}$ denote the share of imports from i to j that is used as intermediate inputs in country j. These inputs are combined with other factors of production (labor, capital, etc.) to produce the output in the single sector of j's economy, where a proportion $x_{jk,t}$ of that output is exported to country k. If we assume that all inputs enter into the production of exported goods in the same proportion as in the production of domestic goods, then $x_{jk,t}$ will also indicate

the share of imported inputs from i that are embedded in the production of exported goods to k. The share of imports from i to j that is re-exported to k, which we denote by $f_{ij,t}$, is then given by the following product: $f_{ij,t} = m_{ij,t}x_{jk,t}$. It is intuitive that, the higher is $f_{ij,t}$'s share, the more will a depreciation of country k's currency *increase* j's demand for inputs from i.

Next, we relax our assumptions on the number of sectors and countries in the world. In this case we must take into account that there are many countries to which country j may re-export intermediate inputs from country i, that imports of services involve more than one sector, and that country j has an input–output structure whereby imports purchased in one sector can easily be exported through another. We continue to assume that inputs are used in the same proportions irrespective of the output's destination—that is,whether the output is consumed domestically, in another domestic sector, or in a foreign country.

Suppose now that the world comprises N countries and S sectors, among which S_1 sectors are services sectors. Here we focus on the *immediate* downstream producers—in other words, on the change in demand induced by downstream exchange rates. Those rates include the bilateral exchange rate between the initial importer country j and its trading partners $k = \{1, 2, ..., N\}$ as well as the dollar exchange rate of the downstream importers k. Consider services trade flows from country i to country j across S_1 different sectors. The change in demand in j that is related to forward linkages (and not to final consumption directly by j) is proportional to

$$G_{ij,t} = M_{ij,t}(I - A_{j,t})^{-1}X_{j,t}, \tag{6}$$

where $M_{ij,t}$ is an $S_1 \times S$ matrix in which each element $m_{s,s'}$ is the share of exports from sector $s \in S_1$ of country i to sector $s' \in S$ of country j in the *total* exports of services from i to j;[16] $A_{j,t}$ is an $S \times S$ matrix in which each element $a_{s,s'}$ corresponds to the share of total output of sector s in j that goes into the production of sector s'; and $X_{j,t}$ is an $S \times N$ matrix of which each element $x_{s,k}$ reflects the share of total output in sector s of country j that is exported to country k for N the number of destinations. If there were no input–output linkages, then the product of M and X would be a multi-sector equivalent to the product of m and x in the single-sector world modeled previously. The presence of input–output linkages implies that imports by sector s can be used in the production of sector s' (and re-exported through that sector); this dynamic is captured by the $(I - A)^{-1}$ component.

Let $F_{ij,t}$ be a $1 \times N$ vector that sums across all rows of the matrix $G_{ij,t}$, in which each element $F^k_{ij,t}$ corresponds to the share of services exports from i to j that is re-exported by j to k. Multiplying

[16] Here we assume that all elements in the rows corresponding to non-service sectors in i are zeros.

this vector by a vector of exchange rate changes between downstream destinations and country j (or of changes in destinations' dollar exchange rates) gives us a measure of forward integration–related demand shock. The demand shock triggered by downstream bilateral exchange rates is thus given by

$$\mathrm{FW}_{ij,t}^{j} = \sum_{k} F_{ij}^{k} \Delta e_{jk,t}, \tag{7}$$

where "FW" signifies "forward". The demand shock triggered by downstream dollar exchange rates is similarly constructed as

$$\mathrm{FW}_{ij,t}^{\$} = \sum_{k} F_{ij}^{k} \Delta e_{\$k,t}. \tag{8}$$

Note that this demand shock associated with forward linkages is dyad specific. We can easily see that the sectoral composition of trade in services varies across exporters for a given importer. For example, China may import from Germany services that are used in the production of export-intensive sectors and also import from the United Kingdom services that are largely consumed domestically. As a result, the RMB movements against downstream partners affect Chinese demand for German and UK service exports differently.

We use the 2016 edition of the World Input-Output Database to construct this measure. Since the WIOD's sample period is shorter than that of the trade sample and since the input–output relationship is generally stable, it follows that we can reasonably fix the weights F_{ij}^{k} at the year 2000 level. We now augment the empirical specification from Equation (5) by including measures that capture exchange rate movements against forward partners:

$$\begin{aligned} \Delta v_{ij,t} \quad = \quad & \sum_{\tau=0}^{L} \alpha_{\tau} \Delta e_{ij,t-\tau} + \sum_{\tau=0}^{L} \beta_{\tau} \Delta e_{\$j,t-\tau} \\ & + \sum_{\tau=0}^{L} \phi_{\tau}^{j} \mathrm{FW}_{ij,t}^{j} + \sum_{l=0}^{L} \phi_{\tau}^{\$} \mathrm{FW}_{ij,t}^{\$} + \Gamma' Z_{ij,t} + \lambda_{ij} + \delta_{t} + \varepsilon_{ij,t}. \end{aligned} \tag{9}$$

Table 7 presents the result of this estimation. Columns [1] and [3] report the results of the regression with forward shocks, while columns [2] and [4] report estimation results of Equation (5) for the same sample used in columns [1] and [3].[17] The strong effects of forward exchange rate movements on trade in services are captured by the positive and significant short-run and medium-run coefficients. Thus depreciation (against the USD) in the currencies of an importer's downstream partners increases the value of bilateral trade flows from upstream exporters. In contrast, changes in downstream bilateral exchange rates seem not to play an important role. These findings highlight

[17] The sample of country-years is smaller than that used for our baseline analysis because the WIOD covers only a subset of countries.

the prevalence of dominant currency pricing in international trade, especially in manufacturing goods (which often use services as intermediate inputs). In addition, including additional GVC-related controls does not substantially alter the magnitude of regression coefficients for the original bilateral and dollar exchange rates.

Table 7: The Role of Exchange Rates through Forward Linkages

	Contemporaneous		*Cumulative*	
	[1]	[2]	[3[	[4]
$\Delta e_{ij,t}$	0.341***	0.357***	0.443***	0.473***
	(0.072)	(0.071)	(0.110)	(0.109)
$\Delta e_{i\$,t}$	0.518***	0.490***	0.385	0.284
	(0.193)	(0.163)	(0.232)	(0.174)
$\text{FW}^{j}_{ij,t}$	–0.250		0.723	
	(0.871)		(1.141)	
$\text{FW}^{\$}_{ij}, t$	–2.014***		–2.137**	
	(0.594)		(0.837)	
Observations	17,068	17,068	17,068	17,068
R^2	0.131	0.131	0.131	0.131
Dyadic FEs	Yes	Yes	Yes	Yes
Time FEs	Yes	Yes	Yes	Yes
Dyads	Yes	Yes	Yes	Yes

Notes: The dependent variable for all columns is the import value from i to j (in j's currency). Columns [1] and [2] report the contemporaneous effects; columns [3] and [4] present the cumulative results. All regressions control for two lags of Δe_{ij} and $\Delta e_{\$j}$, for $\text{FW}^{j}_{ij,t}$ and $\text{FW}^{\$}_{ij,t}$, for log changes in country j's GDP and CPI, and for exporter country i's PPI and their two lags. Robust standard errors (in parentheses) are clustered by dyad. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

6 Conclusion

This paper, which exploits a new and comprehensive data set, is the first to study the effects of bilateral and dollar exchange rates on bilateral trade flows in services. We find that, at least in the short run, trade in services is responsive to both bilateral and dollar exchange rates; hence we conclude that producer and dominant currency pricing are each widely used in the services trade, and the former is perhaps more prevalent than the latter. In addition, exchange rate elasticities are fairly heterogeneous across individual sectors, reflecting their peculiar features—for example, production function (nonstorability and intangibility), market structures and barriers to entry and trade, and the joint location of the production and consumption of services. We augment the global analysis by examining also the trade flows from and to the United States, and again we find evidence for dollar pricing in most sectors (except for Financial services and IT services). Using two measures of volumes of tourist flows, we obtain relatively stronger evidence in favor of producer currency pricing. Furthermore, we find that the absolute and relative sizes of dollar and bilateral

elasticities depend not only on the sector but also on characteristics of the exporting and importing countries. The cumulative effect of bilateral exchange rates is greater when trade flows originate in emerging markets (in comparison with advanced economies), and USD exchange rate elasticity is less for importers in the euro area than for other importers. Finally, we discover that downstream dollar exchange rate shocks, which operate as a demand shifter through forward linkages, have a pronounced effect on the competitiveness of imported services that are re-exported and hence on the overall value of services imports.

Our main result that compared to manufacturing trade services trade has a stronger association with bilateral exchange rate fluctuations than with dollar exchange rate has important implications on external adjustment. Countries that specialize more in services export may then expect to see stronger effects of their currency depreciation in boosting exports than countries specializing in manufacturing export, as demand for service imports are not as impervious to bilateral exchange rate shocks as manufacturing imports.

References

Adler, Gustavo, Sergii Meleshchuk, Carolina Osorio Buitron et al., "Global Value Chains and External Adjustment: Do Exchange Rates Still Matter?," Technical Report, International Monetary Fund 2019.

Amiti, Mary, Oleg Itskhoki, and Jozef Konings, "Importers, exporters, and exchange rate disconnect," *American Economic Review*, 2014, *104* (7), 1942–78.

_ , _ , and _ , "Dominant currencies: How firms choose currency invoicing and why it matters," Technical Report, National Bank of Belgium Working Paper No. 353, 2018.

Ariu, Andrea, "Crisis-proof services: Why trade in services did not suffer during the 2008–2009 collapse," *Journal of International Economics*, 2016, *98*, 138–149.

Atkeson, Andrew and Ariel Burstein, "Pricing-to-market, trade costs, and international relative prices," *American Economic Review*, 2008, *98* (5), 1998–2031.

Auer, Raphael A and Raphael S Schoenle, "Market structure and exchange rate pass-through," *Journal of International Economics*, 2016, *98*, 60–77.

Baldwin, Richard, Rikard Forslid, and Tadashi Ito, *Unveiling the evolving source of value added in exports*, Inst. of Developing Economies, 2015.

Berman, Nicolas, Philippe Martin, and Thierry Mayer, "How do different exporters react to exchange rate changes?," *The Quarterly Journal of Economics*, 2012, *127* (1), 437–492.

Bernard, Andrew B, J Bradford Jensen, Peter K Schott et al., "Importers, Exporters and Multinationals: A Portrait of Firms in the US that Trade Goods," *NBER Chapters*, 2009, pp. 513–552.

Bils, Mark and Peter J Klenow, "Some Evidence on the Importance of Sticky Prices," *Journal of Political Economy*, 2004, *112* (5), 947–985.

Borchert, Ingo and Aaditya Mattoo, "The crisis-resilience of services trade," *Service Industries Journal*, 2010, *30* (13), 2115–2136.

Boz, Emine, Camila Casas, Georgios Georgiadis, Gita Gopinath, Helena Le Mezo, Arnaud Mehl, and Tra Nguyen, "Patterns in Invoicing Currency in Global Trade," 2020.

_ , Gita Gopinath, and Mikkel Plagborg-Møller, "Global trade and the dollar," Technical Report, National Bureau of Economic Research 2017.

Bussière, Matthieu, Giovanni Callegari, Fabio Ghironi, Giulia Sestieri, and Norihiko Yamano, "Estimating trade elasticities: Demand composition and the trade collapse of 2008-2009," *American economic Journal: macroeconomics*, 2013, *5* (3), 118–51.

_ , Guillaume Gaulier, and Walter Steingress, "Global trade flows: Revisiting the exchange rate elasticities," *Banque de France Working Paper*, 2016.

Calvo, Guillermo A, "Staggered prices in a utility-maximizing framework," *Journal of monetary Economics*, 1983, *12* (3), 383–398.

Chen, Natalie, Wanyu Chung, and Dennis Novy, "Vehicle Currency Pricing and Exchange Rate Pass-Through," 2019.

Chung, Wanyu, "Imported inputs and invoicing currency choice: Theory and evidence from uk transaction data," *Journal of International Economics*, 2016, *99*, 237–250.

Devereux, Michael, Wei Dong, and Ben Tomlin, "Exchange rate pass-through, currency invoicing and trade partners," *Bank of Canada Working Paper*, 2015, (2015-31).

Duygan-Bump, Burcu, Alexey Levkov, and Judit Montoriol-Garriga, "Financing constraints and unemployment: Evidence from the Great Recession," *Journal of Monetary Economics*, 2015, *75*, 89–105.

Eaton, Jonathan and Samuel Kortum, "Trade in goods and trade in services," in "World Trade Evolution," Routledge, 2018, pp. 82–125.

Francois, Joseph and Bernard Hoekman, "Services trade and policy," *Journal of Economic Literature*, 2010, *48* (3), 642–92.

_ and Olga Pindyuk, "Consolidated Data on International Trade in Services v8. 9," *IIDE Discussion Paper 20130101*, 2013.

Gervais, Antoine and J Bradford Jensen, "The tradability of services: Geographic concentration and trade costs," *Journal of International Economics*, 2019, *118*, 331–350.

Goldberg, Linda S and Cédric Tille, "Vehicle currency use in international trade," *Journal of international Economics*, 2008, *76* (2), 177–192.

_ and Cedric Tille, "Micro, macro, and strategic forces in international trade invoicing: Synthesis and novel patterns," *Journal of International Economics*, 2016, *102*, 173–187.

Gopinath, Gita, "The international price system," *Jackson Hole Symposium Proceedings*, 2016.

_ and Jeremy C Stein, "Banking, Trade, and the making of a Dominant Currency," Technical Report, National Bureau of Economic Research 2018.

_ and Roberto Rigobon, "Sticky borders," *The Quarterly Journal of Economics*, 2008, *123* (2), 531–575.

_ , Emine Boz, Camila Casas, Federico J Díez, Pierre-Olivier Gourinchas, and Mikkel Plagborg-Møller, "Dominant currency paradigm," *American Economic Review*, 2020, *110* (3), 677–719.

_ , Oleg Itskhoki, and Roberto Rigobon, "Currency choice and exchange rate pass-through," *American Economic Review*, 2010, *100* (1), 304–36.

Haveman, Jon and David Hummels, "Alternative hypotheses and the volume of trade: the gravity equation and the extent of specialization," *Canadian Journal of Economics/Revue canadienne d'économique*, 2004, *37* (1), 199–218.

Head, Keith, Thierry Mayer, and John Ries, "How remote is the offshoring threat?," *European Economic Review*, 2009, *53* (4), 429–444.

Helpman, Elhanan, Marc Melitz, and Yona Rubinstein, "Estimating Trade Flows: Trading Partners and Trading Volumes," *The Quarterly Journal of Economics*, 2008, *123* (2), 441–487.

Heuser, Cecilia and Aaditya Mattoo, *Services trade and global value chains*, The World Bank, 2017.

Hill, T Peter, "On goods and services," *Review of income and wealth*, 1977, *23* (4), 315–338.

Hoekman, Bernard and Ben Shepherd, "Services Trade Policies and Economic Integration: New Evidence for Developing Countries," Technical Report, CEPR Discussion Papers No. DP14181 2019.

Kimball, Miles S, "The Quantitative Analytics of the Basic Neomonetarist Model," *Journal of Money, Credit, and Banking*, 1995, *27* (4).

Klenow, Peter J and Benjamin A Malin, "Microeconomic evidence on price-setting," *Handbook of monetary economics*, 2010, *3*, 231–284.

Kugler, Maurice and Eric Verhoogen, "Plants and imported inputs: New facts and an interpretation," *American Economic Review*, 2009, *99* (2), 501–07.

Leigh, Mr Daniel, Weicheng Lian, Marcos Poplawski-Ribeiro, Rachel Szymanski, Viktor Tsyrennikov, and Hong Yang, *Exchange rates and trade: A disconnect?*, International Monetary Fund, 2017.

Lyonnet, Victor, Julien Martin, and Isabelle Mejean, "Invoicing currency and financial hedging," *CEPR Discussion paper*, 2016, (DP11700).

Manova, Kalina and Zhiwei Zhang, "China's exporters and importers: Firms, products and trade partners," Technical Report, National Bureau of Economic Research 2009.

Mayer, Thierry and Walter Steingress, "Estimating the effect of exchange rate changes on total exports," *BIS Working Paper*, 2019, (786).

Miroudot, Sébastien, Jehan Sauvage, and Ben Shepherd, "Measuring the cost of international trade in services," *World Trade Review*, 2013, *12* (4), 719–735.

Mukhin, Dmitry, "An equilibrium model of the International Price System," in "2018 Meeting Papers" number 89 Society for Economic Dynamics 2018.

Nakamura, Emi and Jón Steinsson, "Five facts about prices: A reevaluation of menu cost models," *The Quarterly Journal of Economics*, 2008, *123* (4), 1415–1464.

Soyres, Francois De, Erik Frohm, Vanessa Gunnella, and Elena Pavlova, *Bought, sold, and bought again: the impact of complex value chains on export elasticities*, The World Bank, 2018.

Spilimbergo, Antonio and Athanasios Vamvakidis, "Real effective exchange rate and the constant elasticity of substitution assumption," *Journal of International Economics*, 2003, *60* (2), 337–354.

WTO, "The Future of Services Trade," 2019.