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Bilateral Trade in Services and Exchange Rates: Evidence of Dominant Currency Pricing

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ABSTRACT: This paper estimates, for the first time, the exchange rate elasticity of bilateral trade in services, providing indirect evidence of both producer currency pricing and dominant currency pricing in services trade. We developed a novel dataset of bilateral trade flows in services, covering twelve broad service sectors across 245 countries from 1985 to 2022. We find that, similar to manufacturing trade, the value of services trade is more closely associated with US dollar exchange rates than with bilateral exchange rates, although this relationship varies by service category. Zeroing in on tourism, where proxies for trade volume (such as tourist arrivals and hotel stays) are available, we find that bilateral exchange rates play a larger role on tourism volume compared to the dollar exchange rates. In addition, in the context of global supply chain, we find that downstream dollar exchange rate movements, rather than downstream bilateral exchange rates, affect the demand for service imports via forward linkages.

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

Bilateral Trade in Services and Exchange Rates: Evidence of Dominant Currency Pricing

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1 Introduction

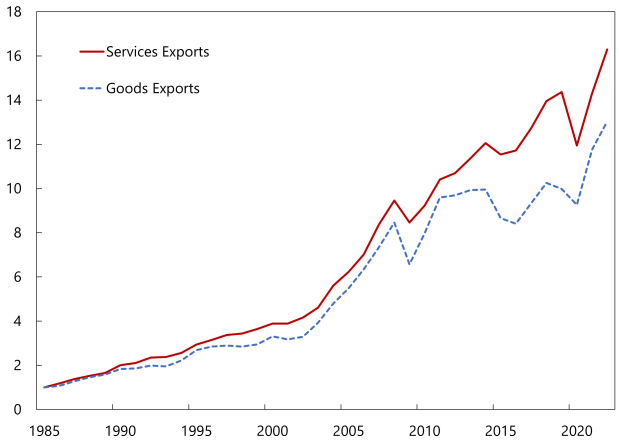
In recent years, services trade has outpaced goods trade (Figure 1), emerging as a potential driving force behind the next wave of globalization (WTO, 2019; Baldwin, 2022a,b). Accounting for approximately a quarter of global gross exports and over 40% of in value-added terms, services have become an important component of international trade. Sectors such as financial services, telecommunications, and other business services are not only growing rapidly but are also playing increasingly crucial roles in global value chains (GVCs). Yet, despite the burgeoning importance of services trade, the relationship between exchange rates and services trade remains largely unexplored. Existing literature has primarily focused on exchange rate pass-through and pricing behavior in goods trade, leaving a significant gap in our understanding of how currency fluctuations affect services trade.

Recent advances in international economics have underscored the growing importance of "dominant currency pricing" (DCP), offering new insights into the role of exchange rates in global trade dynamics. Research shows that the dominant currency (e.g., the U.S. dollar) exchange rate drives global goods trade in the short run (Gopinath, 2015; Gopinath et al., 2020), as most traded goods' prices are sticky in the dominant currency regardless of the countries involved in the transaction (Gopinath and Rigobon, 2008; Goldberg and Tille, 2008, 2016; Amiti et al., 2022; Boz et al., 2022). Under DCP, a dollar depreciation lowers import prices in the destination currency and boosts trade via the expenditure-switching effect, while bilateral exchange rate movements between trading partners have only a limited effect on trade volumes and prices (Boz et al., 2019).

While dominant currency pricing in goods trade has been well-documented, services trade presents distinct characteristics that could lead to different outcomes in currency choice and exchange rate pass-through. Compared to goods, services often depend more on domestic labor inputs, rely less on imported intermediate inputs, face higher barriers to entry and market concentration, and exhibit greater price stickiness (Francois and Hoekman, 2010; Klenow and Malin, 2010). The "proximity burden" faced by certain services (e.g. tourism), where direct interaction between the provider and consumer is essential, further complicates the relationship between exchange rates and trade (Hill, 1977). These differences may affect the sensitivity of exporters' marginal costs to exchange rate shocks and the extent of strategic complementarities in price setting across competitors—factors that affect currency choices and the resulting responses of trade to exchange rate fluctuations (Gopinath et al., 2010; Amiti et al., 2022; Mukhin, 2022).

This paper addresses this gap by (1) developing a new database which offers the most comprehensive information on the values of *bilateral* services flows covering 245 countries, more than 6,000 directed trading pairs (dyads) and 12 service sectors from 1985 to 2022; (2) estimating, for the

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.

first time, the exchange rate elasticities of bilateral services trade and its subcategories, and hence providing indirect evidence on the prevalence of DCP in services trade; and (3) shedding light on the role of services in global value chains and how downstream exchange rates may affect services trade.

Specifically, we consolidate, impute and reconcile the latest official data from multiple sources including WTO-UNCTAD-ITC Trade in Commercial Services Database, UN Comtrade and Eurostat. By focusing on bilateral trade flows, we avoid the aggregation biases often associated with weighted effective exchange rates (Spilimbergo and Vamvakidis, 2003; Mayer and Steingress, 2020). Using this panel data, we estimate the elasticities of services trade values with respect to both bilateral and dollar exchange rates. Following the empirical strategy of Gopinath et al. (2020), we estimate the dyadic bilateral trade equation under the simplifying assumption that prices are sticky in their invoicing currency for up to two years. While price data for traded services are not available, this assumption is supported by studies on consumer prices in detailed services categories, which typically find that services prices change less frequently than goods prices, suggesting significant price stickiness in services (Bils and Klenow, 2004; Nakamura and Steinsson, 2008; Klenow and Malin, 2010).[1] The estimation controls for shifts in demand conditions and producer costs, and includes various lagged variables along with time and directed country-pair fixed effects.[2]

[1]For example, Klenow and Malin (2010) finds that services producers take twice as long to change prices compared to nondurable goods producers and three times as long compared to durables goods producers. Bils and Klenow (2004) attribute this lower frequency of price changes in services reflects to the lower volatility of consumer demand. In the case of goods trade, Goldberg and Tille (2008) and Gopinath and Rigobon (2008) present micro-level evidence that prices often remain sticky in USD for up to two years.

[2]Identifying exogenous exchange rate shocks, as well as exogenous demand shocks and relevant relative prices, is almost impossible. Therefore, our results should not be interpreted as structural estimates but as the first analysis

If prices are sticky in the producer's currency (PCP), import prices in the destination currency move in parallel with the bilateral exchange rate (complete pass-through). As long as the elasticity of import quantities with respect to import prices differs significantly from 1, import values in the destination currency will change with bilateral exchange rate movements, holding overall demand constant. In contrast, under *local currency pricing* (LCP), import prices are unaffected by bilateral exchange rates (zero pass-through), resulting in no change in import value. With DCP, import values in the destination currency respond to movements in the importer's exchange rate vis-a-vis the dominant currency but *not* to movements in the bilateral exchange rate.

Our cross-country evidence shows that both bilateral and dollar exchange rates play prominent roles in services trade, suggesting a substantial share of services trade is invoiced in either the exporter's currency or US dollars. Specifically, if country j's currency depreciates by 10% against country i's currency, the value of services imported from i by j (measured in j's currency) increases by about 2% in the short run.[3] The effect of the USD exchange rate is twice that of the bilateral exchange rate and is statistically significant. However, the effect of bilateral exchange rates weakens over the medium term, with cumulative elasticity dropping to 0.02 over two years and becoming statistically insignificant, while the cumulative elasticity of the USD exchange rate increases to 0.6. This finding aligns with and generalizes the recent single-country study by Amador et al. (2024), which used actual currency composition data from Portuguese firm exports to show that the use of the US Dollar as a vehicle currency for services exports is extensive, though to a lesser extent than for goods exports.

If the sensitivity of services demand to prices is the same irrespective of the transaction currency, the relative magnitudes of bilateral and US dollar exchange rate elasticities can inform the relative extent to which PCP and DCP are adopted. Comparing these results with those from manufacturing trade, we find that the dominance of DCP relative to PCP is less pronounced in services trade than in manufacturing trade. While the ratio of dollar exchange rate elasticity to bilateral elasticity is about five based on manufacturing trade, it is only two for services trade.

Traded services are extremely heterogeneous, spanning a diverse set of activities. We therefore estimate the exchange rate elasticities separately for individual 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 four sectors: Transport, Financial, Telecommunications, and Intellectual Property

following the prevailing empirical strategy in the literature to assess 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.

[3]This suggests that price increases outweigh reductions in traded quantities, similar to the findings of Gopinath et al. (2020), which estimate that price pass-through has a larger effect than quantity elasticity in manufacturing trade.

Services. In contrast, 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 tourism which features reliable data we can use to proxy for *trade volumes*. Using data on the number of tourists arrivals and hotel nights spent, 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 depreciation is still effective.

We then complement our cross-country results with evidence from US services trade with the rest of the world. Under DCP, value of 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 much stronger (and significant) responses of overall services exports from the U.S. than overall services imports to the U.S., consistent with DCP. Across sectors, however imports of Financial, IT and Other business services to the U.S. also respond to bilateral exchange rate changes in the short run, suggesting the importance of producer currency pricing for these sectors in the U.S.

Lastly, when assessing the role of exchange rates on services trade, it is important to recognize that traded services are frequently used as inputs in the production of other goods and services, particularly within global value chains (GVCs) (see WB, 2020). In these cases, exchange rate fluctuations can have indirect effects through the global production network. Specifically, under DCP, a depreciation in the currencies of downstream markets against US dollar makes exported goods more expensive, reducing demand for the imported services used as inputs in the production of those goods. Therefore, changes in downstream exchange rates–both bilateral exchange rates between the initial importer and downstream producers, as well as the U.S. dollar exchange rates

of downstream producers–can have significant effects on the demand for imported services.

To capture this indirect impact, we extend the analysis of exchange rate effects on services trade by incorporating not just the direct expenditure-switching channel but also the *indirect* GVC channel. This novel approach provides new insights into how currency fluctuations affect services in ways that have not been previously explored in the literature. We augment the baseline regression of service trade values from country i to j by including additional controls for downstream exchange rate fluctuations. These controls are constructed as the weighted averages of (i) bilateral exchange rate changes between the initial importer country j and its downstream trading partners; and (ii) the USD exchange rate of downstream importers. The weights, derived from the Eora multi-region input-output table, effectively capture the shares of bilateral flows of services that are re-exported by importer j.

Our results show that when the currencies of downstream buyers depreciate against the *US dollar*, the value of services imported by j from i increases, particularly when those services are major inputs in the production of exported goods and services. In contrast, bilateral exchange rate movements between j and its downstream partners do not have a statistically significant impact on the value for imported services. This analysis contributes to the existing literature on how GVC participation affects the workings of exchange rates, which has so far focused exclusively on trade in manufacturing goods (e.g. Amiti et al., 2014; De Soyres et al., 2021; Adler et al., 2023).

In addition to contributing to the growing literature on DCP and vehicle currency pricing (Goldberg and Tille, 2008, 2016; Chung, 2016; Lyonnet et al., 2022; Chen et al., 2022), our work also extends the vast literature on the effects of exchange rates on trade flows and global imbalances, which until now has primarily focused on merchandise trade (Spilimbergo and Vamvakidis, 2003; Bussière et al., 2013; Leigh et al., 2017; Mayer and Steingress, 2020; IMF, 2019; Bussière et al., 2020). This literature has centered 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., 2022). This paper is the first to develop and study a globally representative dataset on bilateral trade in services, and to quantify the elasticity of *services* trade flows with respect 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 significant implications for the spillover effects of monetary policy, optimal exchange rate policies, and effort to contain large external imbalances.

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., 2022; Mukhin, 2022) 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.

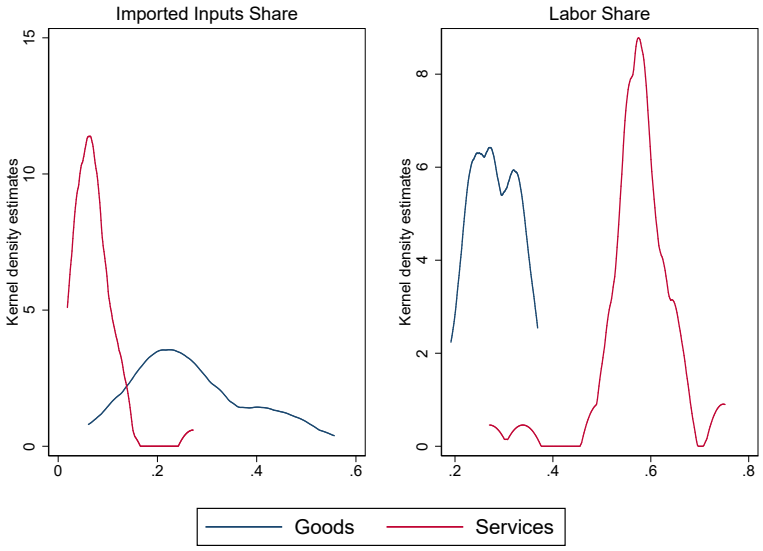
The desired pass-through depends, in turn, on the sensitivity both of the firm's marginal costs and of its desired markup to fluctuations in the exchange rate. The former is often related to the intensity of imported intermediate inputs. Exporters tend to invoice their sales in a currency that matches 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.

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).

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, 2021). All these factors give rise, in some 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, 2022).

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, 2021).

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).[4] However, international service trade identified in the Balance of Payment (BoP) Statistics includes only services provided by modes 1,

[4]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.

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.

3.1 Data Construction and Sources

Bilateral Services Trade Database. We developed a Bilateral Services Trade Database (BiTS), which provides detailed information on international bilateral trade flows in services. This database consolidates, imputes and reconciles the latest official data from multiple sources, with the WTO-UNCTAD-ITC Annual Trade in Commercial Services Database serving as the primary source, supplemented by data from UN COMTRADE and historical records from Eurostat.[5] Descriptions of the data construction are available in the Appendix (for more details see Li et al., forthcoming).

The BiTS contains data on exports and imports across 12 broad commercial service sectors, broken down by partner country and by subcategories. Its concepts, definitions, and classification is based on the Extended Balance of Payments Services Classification (EBOPS 2010), which aligns with the 6th edition of the IMF Balance of Payments and International Investment Position Manual (BPM6). The database spans from 1985 to 2022 and covers 245 countries, although data from the earliest years are limited.

Unlike goods, services trade does not involve tariffs, which means importing countries often lack financial incentives to closely monitor services imports. Consequently, services exports data, typically collected through compulsory surveys conducted by national statistical agencies or central banks, tends to be more reliable than import data. For this reason, the BiTS primarily uses exporter reported services trade flows as the base value. To address discrepancies and maximize data coverage, it employs reported imports from trading partners to create "mirror" flows that help fill in missing export values. Systematic hierarchical consistency checks are also performed across all levels of categories.

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

[5]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 and WTO-OECD BaTIS, include values estimated using gravity-based models; they are unsuitable for our purposes because they would artificially imply the *absence* of any relationship between exchange rates and trade flows.

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 uses information for aggregated and 1-digit services. Although finer disaggregation (at the 2- or 3-digit level) is available in the database, the more limited number of observations at those levels hamper viable statistical analysis.

Table 1: Commercial Services Classifications, BPM6

1-digit	2-digit (description)
Goods-related services	
SA: Manufacturing services on physical input owned by others	SAy: Goods for processing abroad
	SAz: Goods for processing in the reporting economy
SB: Maintenance and repair services n.i.e.	—
SC: Transport	SC1: Sea transport
	SC2: Air transport
	SC3: Other modes of transport
	SC4: Postal and courier services
SD: Travel	SDA: Business
	SDB: Personal
Other commercial services (OCS)	
SE: Construction	SE1: Construction abroad
	SE2: Construction in the reporting economy
SF: Insurance and pension services	SF1: Direct insurance
	SF2: Re-insurance
	SF3: Auxiliary insurance services
	SF4: Pension and standardized guaranteed services
SG: Financial services	SG1: Explicitly charged and other financial services
	SG2: Financial intermediation services indirectly measured (FISIM)
SH: Charges for use of intellectual property n.i.e.	SH1: Franchise fees and trademark licensing fees
	SH2: Licenses for the use of outcomes of research and development
	SH3: Licenses to reproduce and/or distribute computer software
	SH4: Licenses to reproduce and/or distribute audio-visual materials and related products
SI: Telecom, computer, and information services	SI1: Telecommunications services
	SI2: Computer services
	SI3: Information services
SJ: Other business services	SJ1: Research and development services
	SJ2: Professional and management consulting services
	SJ3: Technical, trade-related, and other business services
SK: Personal, cultural, and recreational services	SK1: Audio-visual and related services
	SK2: Other personal, cultural, and recreational services
SL: Government goods and services n.i.e	

Source: The International Monetary Fund's BPM6.

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 1999–2022—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 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. Although WDI encompasses more recent data (up to 2022; the IMF data covers 1970–2014) and slightly more countries, 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 not available for bilateral 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 BiTS. Table 2 gives the share of world exports (as recorded in WDI) that is covered by the BiTS's three main categories. The first two columns report the dollar value of world service exports in 2022 and its average annual growth rates over 1995–2022. 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 BiTS in any specific category, averaged across 2005-2022. The BiTS includes about 90% of OCS trade, 97% of world transport, and 97% of travel as well as nearly all total services trade.

Cross-border trade in services has grown steadily over the past four decades. In comparison

Table 2: Worldwide Service Exports

	Global exports [1]	Growth [2]	BiTS coverage [3]
Total services	7,209.0	7.2%	91%
Transport	1,471.9	7.0%	82%
Travel	1,095.5	6.0%	74%
Other commercial services	4,554.4	9.0%	98%

Notes: Column [1], global service export value in billions of US dollars (as recorded in the WDI for 2022); column [2], average annual growth rate of export value over the period 1995–2022; column [3], average share of world trade covered by the BiTS during 2005-2022.

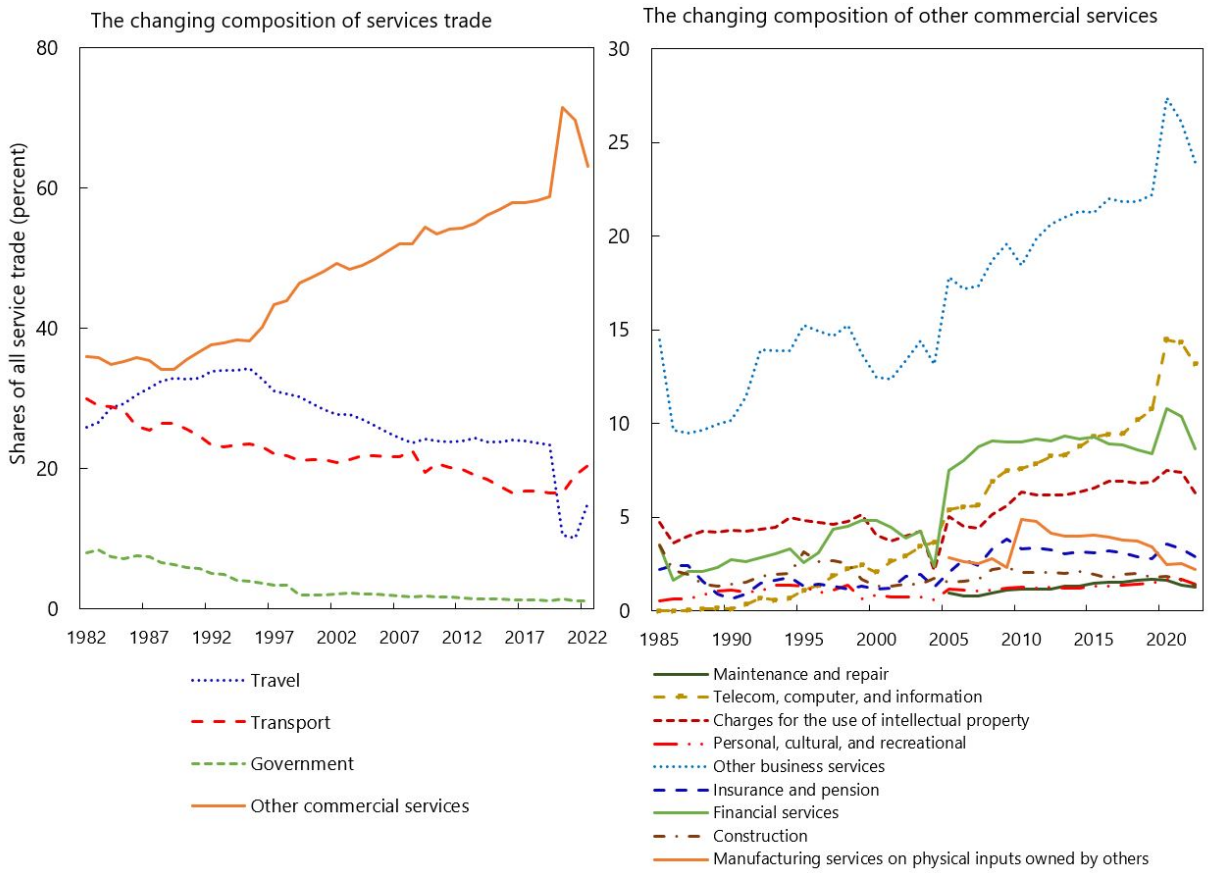
with the value of goods exports, which has increased at a modest 1% annually since 2011, the value of commercial services exports has expanded at 3 times that rate and now accounts for nearly a quarter of global exports in gross terms and for about 40 percent in value-added terms. These services have also made a strong contribution to the export revenue of certain countries; they amount to 45% of UK and 33% of 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 growth in services exports stems from reduced trading costs, largely driven by advances in information and communication technologies that mitigate the proximity burden traditionally associated with services trade (Baldwin, 2022a). The increased prevalence of global value chains is closely linked to this rise in services trade. Similar to goods, the emergence of GVCs has enabled international specialization in service-related tasks, leading to services being traded increasingly as components within GVCs (Heuser and Mattoo, 2017). As a result, many services have become as tradable as manufactured goods (Gervais and Jensen, 2019). 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 70% in 2019, 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, especially during the pandemic. Within the OCS category, the fastest-growing segments are Other business services, Financial services, IT services and Charges for use of intellectual property. Overall, the top 5 services industries (Transport, Travel, Finance, IT, and Other business services) now account for

80% of global services exports.

Figure 3: Composition Changes of Services Trade by Industry

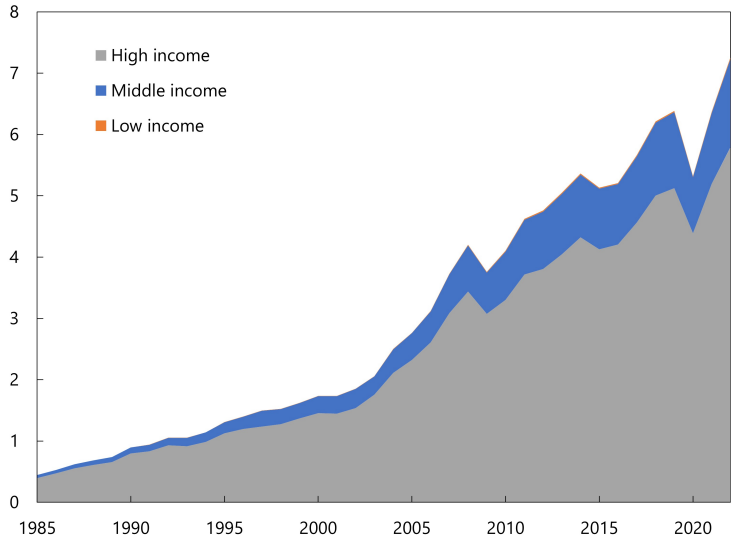


Notes: Data sources are the World Bank's WDI database for the chart on the left hand side, and IMF International Trade in Services database for the right.

With regards to the compositional change in terms of country groups by income, Figure 4 shows that most services exports are sourced from high-income countries. Yet middle-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 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).

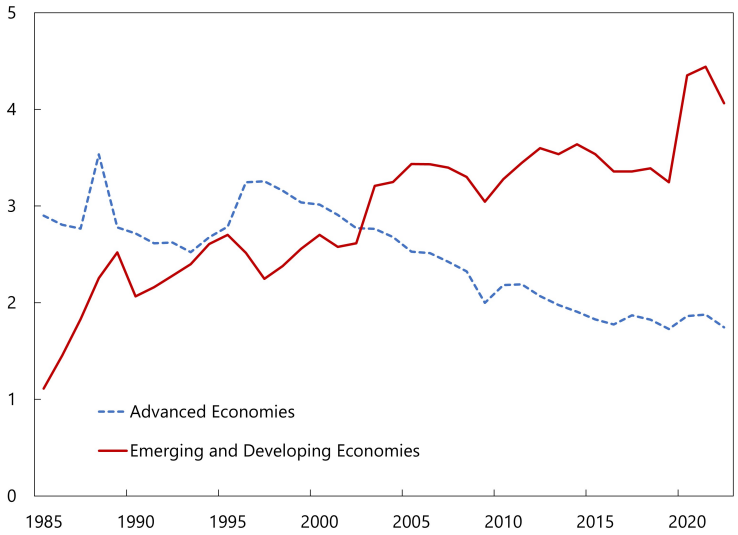
Services trade flows at the bilateral level have not been subject to much previous analysis. It turns out that the value of trade is highly concentrated in a relatively small share of trading partner pairs. Exporter–importer pairs in the top 1% of trade flows account for 56% of global trade in services, and the top 10% contribute about 95% in 2021. In comparison with the trade in *goods*, there seem to be a comparable share of zero *services* trade flows between partners. Our data reveal

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 2022.
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.

that some 45% of the dyads do not trade in services or contain no information on services trade, similar to about a third to a half of the world's country pairs trade no goods at all with each other (see for example, 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. 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.[6] 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

[6] 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).

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 then be written as

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

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, $\delta \to 1$.[7] 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:

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

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 $\theta_{ij}^{i} = 1$ 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*, $\theta_{ij}^{i} = 0$ 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*, $\theta_{ij}^{i} = 0$ and $\theta_{ij}^{\$} = 1$; here changes in import value reflect

[7] 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).

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).

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), along 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, travel time, institutions) that have been shown to matter for services trade (e.g., Head, Mayer and Ries, 2009; Eaton and Kortum, 2018) and possibly for its changes and of other persistent barriers to services trade (e.g. geopolitical disagreement). 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:			
$\Delta e_{ij,t}$	0.436***	0.223***	0.391***	0.176***
	(0.028)	(0.039)	(0.078)	(0.056)
$\Delta e_{\$j,t}$		0.453***		0.539***
		(0.057)		(0.097)
	Cumulative:			
$\sum_{l=0}^{2} \Delta e_{ij,t-l}$	0.264***	0.019	0.222*	0.016
	(0.046)	(0.057)	(0.133)	(0.102)
$\sum_{l=0}^{2} \Delta e_{\$j,t-l}$		0.601***		0.593***
		(0.087)		(0.141)
Observations	79,552	79,552	79,552	79,552
R^2	0.17	0.17	0.32	0.33
Dyadic FEs	Yes	Yes	Yes	Yes
Time FEs	Yes	Yes	Yes	Yes
Dyads	6,708	6,708	6,708	6,708

Notes: The country sample excludes U.S. both as an exporter and an importer. 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. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

The upper panel reports the estimated contemporaneous elasticities. Our results indicate that, if country j's currency depreciates by 10% relative to country i's, then import value (in country j's currency) increases by 4.4% based on the unweighted regression and by 3.9% based on the weighted regression. However, including the dollar exchange rate reduces our estimated coefficients for the bilateral exchange rate, which declines from 0.44 to 0.22 in the unweighted regression and from 0.39

to 0.18 in the trade-weighted regression. The effect of the dollar exchange rate is greater than that of the bilateral exchange rate, with an estimated elasticity of about 0.45 in the unweighted and 0.54 in the 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.[8] Without information on σ, the price elasticity of demand, we cannot test for the existence of local currency pricing in services. In addition, the positive response of imports value 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. This is consistent with $\sigma < 1$ on average, which accords with the common observation that consumer demand for services has low sensitivity to price changes (Bils and Klenow, 2004).

How do the estimated exchange rate elasticities for services trade compare to those for manufacturing trade? To answer this, we perform a similar reduced-form regression analysis for bilateral trade in *goods* using the IMF Direction of Trade Statistics database. Table 4 presents the results, using the sample periods and country-pairs for both goods and services. We find that the import values of manufacturing goods increase by 0.8% in response to a 10% depreciation of the importer's currency relative to its trading partner's currency, and by 4.9% in response to a 10% depreciation of its dollar exchange rate in the unweighted regression. The results suggest that dollar exchange rate elasticities are quite comparable between manufacturing and services trade in both the short and medium run. However, dollar exchange rate movements have a much larger effect—about six times greater—than bilateral exchange rate shocks on manufacturing trade, while for services trade, the coefficient on the dollar exchange rate is only twice as large as that for the bilateral exchange rate. If the sensitivity of demand for services (and goods) to prices is the same irrespective of the transaction's currency, then the relative magnitude of bilateral and USD exchange rate elasticities (α/β) can provide insight into the relative prevalence of PCP versus DCP ($\theta^i/\theta^\$$). Based on the contemporaneous coefficients, our results suggest that DCP (relative to PCP) is more commonly adopted in manufacturing trade than in services 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

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

Table 4: Exchange Rate Elasticities of Manufacturing vs. Services Trade

	Unweighted		Weighted	
	(1)	(2)	(3)	(4)
		Manufacturing		
		Contemporaneous:		
$\Delta e_{ij,t}$	0.312***	0.082*	0.327***	0.161***
	(0.031)	(0.043)	(0.044)	(0.038)
$\Delta e_{\$j,t}$		0.488***		0.438***
		(0.061)		(0.054)
		Cumulative:		
$\sum_{l=0}^{2} \Delta e_{ij,t-l}$	0.308***	0.086*	0.169***	-0.021
	(0.039)	(0.049)	(0.055)	(0.044)
$\sum_{l=0}^{2} \Delta e_{\$j,t-l}$		0.525***		0.538***
		(0.078)		(0.058)
R^2	0.15	0.16	0.44	0.45
		Services		
		Contemporaneous:		
$\Delta e_{ij,t}$	0.450***	0.227***	0.390***	0.173***
	(0.027)	(0.037)	(0.078)	(0.056)
$\Delta e_{\$j,t}$		0.468***		0.543***
		(0.055)		(0.097)
		Cumulative:		
$\sum_{l=0}^{2} \Delta e_{ij,t-l}$	0.305***	0.08	0.222*	0.015
	(0.043)	(0.052)	(0.134)	(0.103)
$\sum_{l=0}^{2} \Delta e_{\$j,t-l}$		0.543***		0.596***
		(0.081)		(0.141)
R^2	0.18	0.18	0.32	0.33
Dyadic FEs	Yes	Yes	Yes	Yes
Time FEs	Yes	Yes	Yes	Yes
Observations	76,860	76,860	76,860	76,860
Dyads	6,446	6,446	6,446	6,446

Notes: The country sample excludes U.S. both as an exporter and an importer. The dependent variable is the value of manufacturing 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. Robust standard errors (in parentheses) are clustered by dyad. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

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.[9]

[9]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 5: Exchange Rate Elasticities of Individual Services Trade

	Transport		Travel		Financial Services		IT		Other Business		Intellectual Property	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
						Contemporaneous:						
$\Delta e_{ij,t}$	0.443***	0.186***	0.304***	0.225***	0.387***	0.238**	0.455***	0.256***	0.514***	0.456***	0.299***	0.032
	(0.048)	(0.055)	(0.039)	(0.048)	(0.077)	(0.098)	(0.073)	(0.098)	(0.056)	(0.081)	(0.111)	(0.161)
$\Delta e_{\$j,t}$		0.587***		0.217***		0.356**		0.430***		0.142		0.538**
		(0.090)		(0.076)		(0.148)		(0.143)		(0.110)		(0.212)
						Cumulative:						
$\sum_{l=0}^{2} \Delta e_{ij,t-l}$	0.346***	0.208***	0.114*	0.017	0.388***	0.065	0.241**	0.263**	0.455***	0.379***	0.342**	0.154
	(0.059)	(0.07)	(0.063)	(0.078)	(0.119)	(0.155)	(0.104)	(0.128)	(0.064)	(0.082)	(0.161)	(0.211)
$\sum_{l=0}^{2} \Delta e_{\$j,t-l}$		0.345***		0.282**		0.76***		-0.033		0.199		0.373
		(0.116)		(0.123)		(0.237)		(0.216)		(0.135)		(0.299)
Observations	43,662	43,662	41,311	41,311	23,971	23,971	30,764	30,764	39,059	39,059	20,507	20,507
R^2	0.15	0.15	0.27	0.27	0.12	0.12	0.11	0.11	0.12	0.12	0.08	0.08
Dyadic FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dyads	3,267	3,267	3,158	3,158	2,229	2,229	2,690	2,690	3,112	3,112	1,924	1,924

Notes: The country sample excludes U.S. both as an exporter and an importer. 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. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Our results, reported in Table 5, 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, financial services, IT, and IP sectors. The effect of the bilateral and dollar exchange rates is similar for Travel tradce values. In contrast, the dollar exchange rate does not have a statistically significant effect on trade value in Other business services. The effect of USD exchange rates strengthens over the two-year horizon in Travel, Financial services and Other business services; however, it weakens in Transport, IT, and IP 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).

4.5 Exchange Rates and Tourism: Volume Elasticities

Measuring prices (for instance, using unit values) and quantities of services is difficult owing to their intangible nature. 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 6 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 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

Table 6: 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. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.001$.

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 manufacturing exports from the United States, they have no significant effects on the value of manufacturing imports to the United States (Table 7 Column (9)). The results for total services trade are similar (Column (1)), providing support for the pervasiveness of DCP in US total services trade. However, trade in individual services sectors seem to tell a different story.

Table 7: Trade Flows to and from the United States: Services and Manufacturing Trade

	Total Services	Transport	Travel	Finance	IT	Other Business	IP	Insurance	Manufacturing
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
					A. Imports to the US:				
$\Delta e_{i\$,t}$	0.094*	-0.237**	0.087*	0.271**	0.504***	0.457**	-0.423	-0.007	0.222
	(0.056)	(0.092)	(0.052)	(0.129)	(0.180)	(0.173)	(0.264)	(0.385)	(0.191)
$\sum_{l=0}^{2} \Delta e_{i\$,t-l}$	0.167*	-0.446***	0.252***	0.45***	0.297	0.518**	0.057	-0.015	0.081
	(0.089)	(0.112)	(0.089)	(0.148)	(0.237)	(0.219)	(0.465)	(0.653)	(0.206)
Observations	916	905	916	723	723	716	724	667	1062
R^2	0.08	0.19	0.08	0.11	0.06	0.06	0.02	0.06	0.17
Dyadic FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dyads	62	62	62	62	62	61	59	54	71
					B. Exports from the US:				
$\Delta e_{\$j,t}$	0.652***	0.683***	0.797***	0.361***	0.692***	0.734***	0.090	0.336**	0.737***
	(0.034)	(0.049)	(0.090)	(0.083)	(0.084)	(0.127)	(0.132)	(0.129)	(0.207)
$\sum_{l=0}^{2} \Delta e_{\$j,t-l}$	0.686***	0.74***	0.526***	0.642***	0.674***	0.906***	0.566***	0.678***	0.657***
	(0.053)	(0.072)	(0.073)	(0.116)	(0.169)	(0.159)	(0.139)	(0.228)	(0.141)
Observations	1068	1068	1068	891	895	859	1048	1002	1796
R^2	0.21	0.15	0.28	0.06	0.04	0.05	0.04	0.03	0.06
Dyadic FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dyads	70	70	70	70	70	70	70	66	101

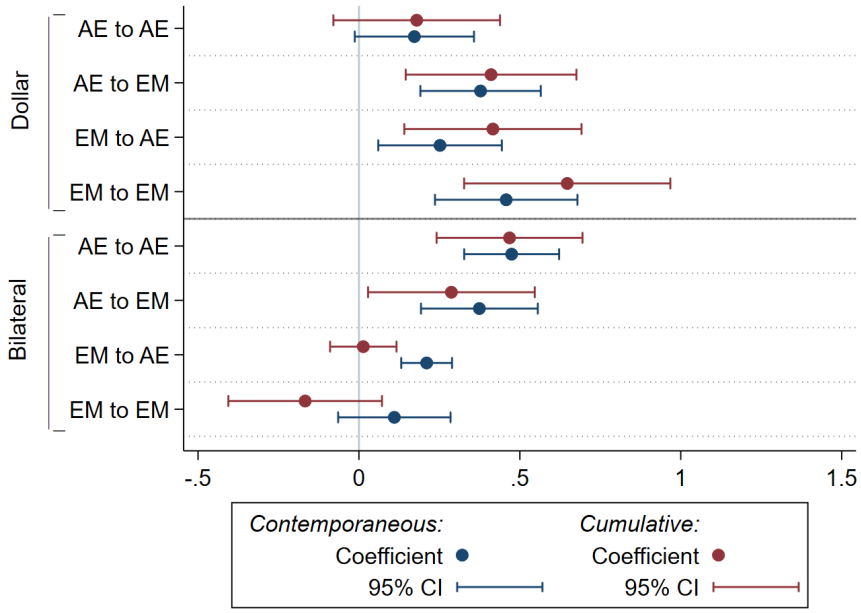
Notes: The dependent variable in Panel A (resp., in Panel B) is the value of exports from (resp., of imports to) the United States denominated in the destination country currency. All regressions control for two lags of $\Delta e_{i\$}$, for log changes of importer GDP and CPI, and for exporter country PPI and their two lags. Robust standard errors (in parentheses) are clustered by dyad. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

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 7 reveals that US imports in Transport, Financial services, IT, and other business 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 relative to 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 exports value 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. The dollar exchange rates seem to be relatively more important than the bilateral exchange rates when emerging markets are involved as a trading partner. This observation is stronger over the two-year horizon than in the short run. Overall, there is evidence that DCP might be used more often for flows between emerging market economies. A possible explanation is that AEs and EMs trade different types of services.

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



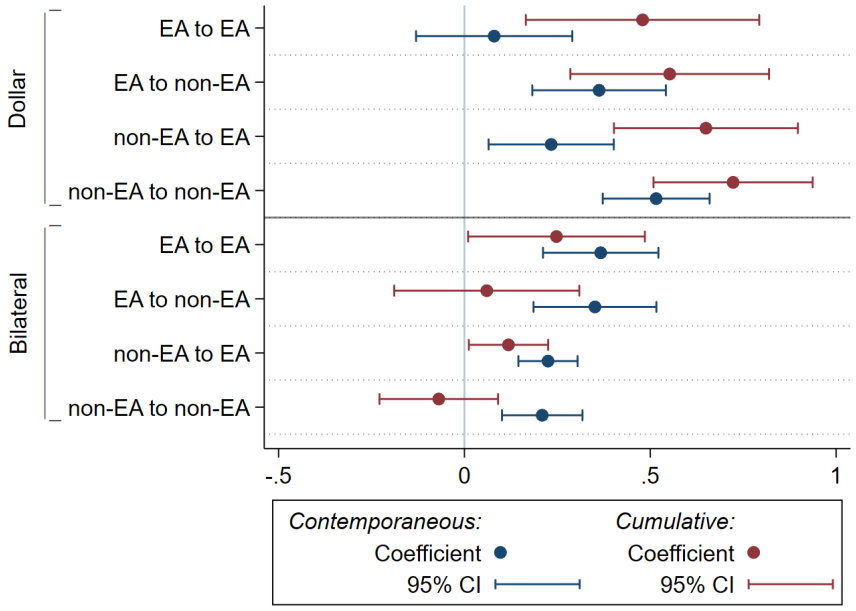
Notes: This figure plots the estimated *contemporaneous* coefficients (blue dots) and 95% confidence bands (blue lines) from Equation (5) when exchange rates are interacted with indicator variables for whether the importer or exporter is an advanced economy or an emerging market. The *cumulative* coefficients 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 stronger over our two-year horizon than in the short run, 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.

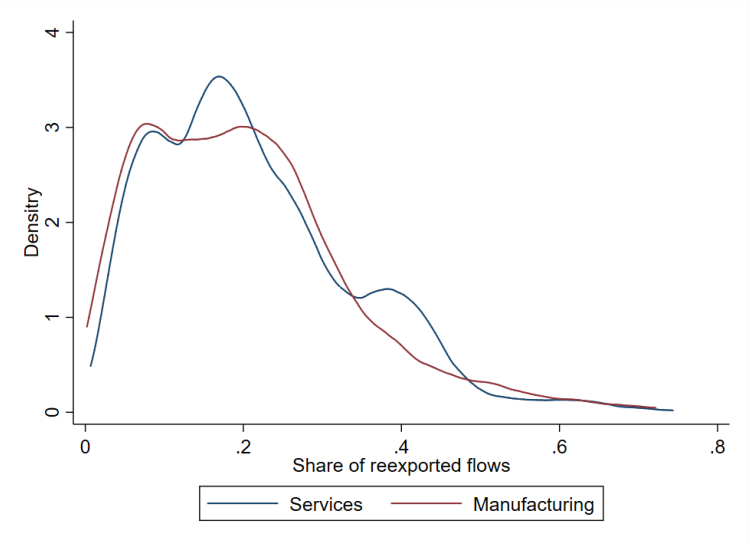
5 The Role of Exchange Rates Through the Global Supply Chain

Services are a vital part of global value chains and are about three times more important as intermediates than manufactured goods (Baldwin, 2022a). The fragmentation of goods production led to 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 discussed in Section 2), a non-negligible share of the trade in services includes components that are re-exported (see Figure 8). On average, 20% of bilateral services exports are used as inputs for further exports by the initial importing country. This is particularly true for producer services such as Transportation, Professional services, Financial services, and IT services, which facilitate and coordinate production across various geographic areas and sectors. These services are therefore crucial inputs for exports in any sector. Indeed, goods trade increasingly involves services—both domestic and imported—in production, a phenomenon known as the "servicification" of manufacturing (Baldwin et al., 2015).

In this section, we further augment our baseline regression (5) to account for the impact of exchange rates on services trade through their forward linkages. Specifically, when importer j's currency depreciates or appreciates (relative to its downstream trading partner's currency k or the US dollar) it alters the import demand of downstream producers in country k, which in turn affects exports from i to j.

To illustrate, consider the export of services from Germany to China. These exports can be sensitive to the RMB–yen exchange rate or the RMB–USD exchange rate, particularly if a large share of services flowing from Germany to China is used as inputs for exports to Japan and is priced and sticky in RMB, yen, or the dominant currency (USD in this case). Suppose a significant percentage of re-exported products are priced in US dollars, as is common with Chinese

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.

manufacturing exports. In this scenario, a depreciation of the yen against the dollar would reduce demand for Chinese exports, which in turn would decrease the export of services from Germany to China. To capture the effect of downstream exchange rate movements on bilateral trade flows one step upstream, we construct a measure of demand shifters triggered by downstream exchange rate changes—essentially, a weighted average of downstream exchange rate changes, where the weights are the shares of bilateral flows that are subsequently re-exported to those downstream destinations.

To understand how exchange rate movements work within the context of forward global value chain integration, consider a simplified world consisting of three countries—i, j, and k—and just one sector. Further, assume 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 j's single sector, with a proportion $x_{jk,t}$ of that output exported to country k. If all inputs are assumed to enter the production of exported goods in the same proportion as domestic goods, then $x_{jk,t}$ will also indicate the share of imported inputs from i embedded in the production of goods exported to k. The share of imports from i to j that is re-exported to k, denote by $f_{ij,t}$, is then given by the following product: $f_{ij,t} = m_{ij,t}x_{jk,t}$. Intuitively, the higher the share of $f_{ij,t}$, the more a depreciation of country k's currency will *increase* j's demand for inputs from i.

Next, we relax our assumptions about the number of sectors and countries in the world. In this

more complex scenario, we must account for the fact that country j may re-export intermediate inputs from country i to multiple countries, that imports of services involve more than one sector, and that country j has an input–output structure allowing imports purchased in one sector to be easily exported through another. We continue to assume that inputs are used in the same proportions regardless of 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, with S_1 of these sectors being 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 both the bilateral exchange rate between the initial importer country j and its downstream buyers $k = \{1, 2, ..., N\}$, 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 $m_{s,s'}$ represents 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. The matrix $A_{j,t}$ is an $S \times S$ matrix where 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'. The matrix $X_{j,t}$ is an $S \times N$ matrix where each element $x_{s,k}$ reflects the share of total output in sector s of country j that is exported to one of the N countries k. Without input–output linkages, the product of M and X would be a multi-sector equivalent to the product of m and x in the previously modeled single-sector world. 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 this vector by a vector of exchange rate changes between downstream destinations and country j (or by a vector of changes in destinations' dollar exchange rates) gives us a measure of the demand shock related to foward integration. The demand shock triggered by downstream bilateral exchange rates is thus given by

$$\text{FW}^j_{ij,t} = \sum_k F^k_{ij}\Delta e_{jk,t}, \tag{7}$$

where "FW" signifies "forward". The demand shock triggered by downstream dollar exchange rates

is similarly constructed as

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

If all countries k depreciated relative to the dollar or country j's currency, we would observe a positive FW variable. Note that this demand shock associated with forward linkages is dyad-specific. It is evident that the sectoral composition of trade in services varies across exporters for a given importer. For example, China may import services from Germany that are used in the production of export-intensive sectors, while importing services from the United Kingdom that are largely consumed domestically. As a result, RMB movements against downstream partners affect Chinese demand for German and UK service exports differently.

We use the the Eora global supply chain Database to construct this measure.[10] Since the input–output relationship is generally stable, it follows that we can reasonably fix the weights F^{k}_{ij} at the year 2010 level . We now augment the empirical specification from Equation (5) by including measures that capture exchange rate movements against forward partners:

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

Table 8 presents the result of this estimation. Columns [1] and [3] report the regression results with forward shocks, while columns [2] and [4] provide the estimation results of Equation (5) for the same sample used in columns [1] and [3]. An increase in FW implies a depreciation of downstream currencies across countries k relative to country j, leading to reduced demand for goods from j and, hence, less inputs from i that are re-exported by j. Therefore, we expect the coefficients ϕ to be negative if this is the case. The strong effects of forward exchange rate movements on trade in services are indeed reflected in the negative and significant short-term and medium-term coefficients. This implies that 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 do not appear play a significant role. These findings underscore the prevalence of dominant currency pricing in international trade, especially in manufacturing goods, which frequently use services as intermediate inputs. Moreover, including additional GVC-related controls does not substantially alter the magnitude of the regression coefficients for the original bilateral and dollar exchange rates.

[10] The database covers input-output linkages between 189 countries in 26 sectors. See Lenzen et al. (2012) for a database description.

Table 8: The Role of Exchange Rates through Forward Linkages

	Contemporaneous		*Cumulative*	
	[1]	[2]	[3]	[4]
$\Delta e_{ij,t}$	0.242***	0.237***	0.216***	0.210***
	(0.055)	(0.054)	(0.082)	(0.082)
$\Delta e_{\$j,t}$	0.477***	0.454***	0.476	0.447***
	(0.082)	(0.074)	(0.119)	(0.110)
$\text{FW}^{j}_{ij,t}$	-0.021		0.109	
	(0.229)		(0.286)	
$\text{FW}^{\$}_{ij}, t$	-0.633***		-0.477**	
	(0.197)		(0.281)	
Observations	66,865	66,865	66,865	66,865
R^2	0.186	0.186	0.186	0.186
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 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. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

6 Conclusion

This paper, which introduces 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, with the elasticity of the latter being twice the size of the former. This suggests that dominant currency pricing is likely more prevalent than producer currency pricing. In addition, exchange rate elasticities vary significantly across individual sectors, reflecting their unique characteristics—such as production function (nonstorability and intangibility), market structures, barriers to entry and trade, and the joint location of the production and consumption of services.

We augment the global analysis by specifically examining trade flows from and to the United States, where we again find evidence for dollar pricing in most sectors (except for Travel and Other business services). Using two measures of tourist flow volumes, we find relatively stronger evidence supporting producer currency pricing in this sector. Furthermore, we observe 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 effect of bilateral exchange rates is more pronounced when trade flows involve emerging markets, compared to advanced economies, while the USD exchange rate elasticity is lower for importers in the euro area than for other importers. Finally, we discover that downstream dollar exchange rate shocks, which act as a demand shifter through forward linkages, have a significant effect on the competitiveness of imported services

that are re-exported, thereby affecting the overall value of services imports.

Our main resul—that services trade has a stronger association with dollar exchange rate fluctuations than with bilateral exchange rat—has important implications on external adjustment. Although the relative importance of DCP is less pronounced in services trade than in manufacturing trade, countries that specialize more in services export may expect to see slightly stronger effects of currency depreciation in boosting exports compared to those specializing in manufacturing export. However, such difference depends on the specific service sectors the country exports.

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A Appendix: The Bilateral Trade in Services Database

This Appendix outlines the Bilateral Trade in Services Database (BiTS), a database providing detailed international bilateral trade flows in services using the latest version of the original data from multiple sources, ensuring comprehensive coverage of countries and time periods without the use of estimated or extrapolated data. For more details, please refer to Li et al. (forthcoming).

The database encompasses consistent data on bilateral services trade for 245 countries and 12 broad services sectors and the unallocated category, further divided into 30 distinct subcategories, spanning 1985-2022. Notable improvements in this update include the careful mapping into a common categorization following BPM6, the extension of time coverage, the inclusion of more granular subcategories within the services sector, the implementation of systematic hierarchical checks across all levels of services subcategories, and methodology updates.

A.1 Data Sources

Data in BiTS is primarily sourced from the WTO-UNCTAD-ITD Annual Trade in Services Database (which will be referred to as the WTO database throughout this document for simplicity), and it is supplemented by data from UN COMTRADE and Eurostats historical records. The WTO database serves as the primary source for trade in commercial services, drawing data from Eurostat, the OECD, the International Monetary Fund (IMF), and various national statistical sources spanning from 2005-2022, and is updated annually in July. It presents exports and imports of commercial services in line with the Extended Balance of Payments Services Classification (EBOPS 2010), which is based on the sixth edition of the IMF Balance of Payments and International Investment Position Manual (BPM6), but more detailed. The data is broken down by services sector and subcategory and by partner country when available.

Since the WTO database begins in 2005, we have collected bilateral data for earlier years, dating back to 1985 from COMTRADE spanning 2000-2020 and Eurostat covering 1985-2003, both reported in the format of the fifth edition of Balance of Payments and International Investment Position Manual (BPM5, EBOPS 2002). While other databases such as UNCTAD and WTO-OECD Balanced Trade in Services (BaTIS) database also contain substantial data on bilateral services trade, they were not included for the following reasons. Firstly, the BPM6 annual statistics hosted by UNCTAD, a joint effort with the WTO, largely overlap with the data in the WTO database. Secondly, BaTIS, a result of the collaboration between the OECD and WTO, is an analytical database that contains estimated trade flows using a set of gravity-based models and adjustments based on the available official statistics, and it is balanced by calculating a symmetry-

index weighted average between the reported and mirror flows. This approach does not align with our objective of aggregating only original data on bilateral services trade.

A.2 Methods

Before combining the bilateral services trade data from all three sources, we undertake a series of hierarchical consistency checks and mirroring procedures within each data source.

- *Hierarchical consistency checks.* Given that EBOPS employs a hierarchical classification, vertical hierarchical consistency checks including imputation and reconciliation processes are necessary across all services categories, from the lowest (most-disaggregated) level to more aggregated levels.

  Specifically, we *impute* the missing higher-level branches when a lower-level category is available for a specific year-reporter-partner combination, and following the general practices,[11] we replace (*reconcile*) the value of higher-level category with the sum of reported bilateral flows from lower-level entries if one of the following conditions is met: 1) when all subcategories are reported and the summed value is not zero, or 2) when the subcategories are partially reported and the summed value is greater than the reported higher-level value.

  For instance, consider the reconciliation process within the *travel* sector. It comprises two sub-sectors: business travel and personal travel. If data is available for both subcategories, we replace the *travel* sector value with the sum of *business travel* and *personal travel* values. If only one category is available (either *business* or *personal travel*) and its value exceeds the reported *travel* value, we replace the *travel* value with the value of the available subcategory. This methodology is consistently applied even in cases where multiple layers of disaggregated subcategories exist within certain sectors, such as *personal travel* which includes education-related travel and health-related travel, starting from the most granular level of aggregation. However, we don't replace the *travel* value if both of the reported values for *personal travel* and *business travel* are zeros.

  One special case is the category of *other modes of transport* under the transport sector, which undergoes an additional comparison and reconciliation process, due to the existence of an alternative extended classification in both the BPM5 and BPM6 classifications.[12]

[11] The rules for hierarchical reconciliation are primarily based on insights from general practices, including the Trade in Services Database (TSD), the International Trade and Production Database for Estimation (ITPD-E), and the WTO-OECD Balanced Trade in Services (BaTIS).

[12] The SC3 category has baseline subcategories (SC31, SC32, etc.) and the extended classification subcategories (SC3A, SC3B, etc.). In the ideal world, the sum of subcategories under both classifications shall be the same. We apply our reconciliation techniques to get the values of subcategories under each of the classifications and add them

- *Mirroring process.* A mirroring process is performed to maximize data coverage and to address situations where the reported export data by one country do not align with reported import data by its trading partner. Discrepancies often arise due to differences in data collection methods, reporting standards, and classification systems between trading partners, as well as the complicated structure of multinational companies.[13] Due to the absence of tariffs on services trade, importing countries do not have financial motivations to monitor the inflow of services imports. However, data on services exports is typically gathered through compulsory surveys conducted by national statistical agencies and/or central banks, making it more reliable than import data. For this reason, we prefer to use exporter reported services trade flows as the base value and use reported imports to create mirror flows and thereby fill in missing values of exports. Nevertheless, we also provide, as a companion dataset, the importer-reported trade with mirrored exporter-reported data filling in the missing values.

- *Conversion of BPM5 classification to BPM6.* An essential step in compiling the processed data from these three sources involves converting BPM5 classification to BPM6 classification. Following the conversion matrix provided by the IMF's Statistics Department, most BPM5 categories within each services sector are matched with BPM6, with the exceptions of the insurance services and charges for the use of intellectual property sectors. Once the conversion from BPM5 to BPM6 classification is complete, a hierarchical consistency check is conducted again for those categories within each services sector that align with the BPM6 classification.[14]

  In cases where data for a country-pair-year is covered by multiple data sources, our preferential order of data usage is WTO data, followed by COMTRADE data, and then Eurostat data. Within each source, we prioritize original flows over mirror flows. For consistency, we do not draw on different sources to maximize coverage of subcategories within each country-pair-year, but only rely on a single source.

- *Unaccounted values and zero trade flows.* After consolidating the processed data according to

up to get two values for SC3 total baseline and SC3 total extended classification. In this case we compare the reported SC3 values with two different reconciled totals and take the largest value.

[13] Governments of advanced economies have been putting efforts in understanding bilateral services trade, however, asymmetries are prevalent due to different methodologies of collecting and harmonizing services trade data. For example, the UK Office for National Statistics (2020) summarizes the UK services trade data asymmetries with selected partner countries for 2016 2018. Notably, UK's estimates of exports to the United States were £23.5 billion higher than the United States' estimates of imports from the UK, and UK estimates of imports from the United States were £19.9 billion lower than the United States' estimates of exports to the UK.

[14] For example, the *Postal services* and *Telecommunication services* are included into the *Communication services* under BPM5. To make classification consistent with BPM6, we include *postal services* into the *Transport services* category, and *Telecommunication services* into *Telecommunications, computer, and information services. Merchanting* is present in the BPM5 classification (under *Other Business Services*), but is removed to be consistent with BPM6. Having done this reallocation of different subcategories, we once again perform the *hierarchical consistency checks* for the affected upper-level services categories as described above.

these selection preferences, we also conduct geographic consistency checks. A residual region, designated as XRR, is created to account for unallocated exports when the original world total exceeds the sum of bilateral flows. Conversely, the world total is rebalanced if it is lower than the sum of bilateral flows.

It is important to note that all zero trade flows in services reported in our database stem directly from the original data sources and are not the result of any imputation.

A.3 Data Coverage

The database contains bilateral services trade flow data for 245 countries, with the addition of a global total and a residual region, which holds unallocated imports and exports associated with each country. The data, reported in million US dollar, spans from 1985 to 2022 and comprehensively covers 12 services industries, further delineated into 28 subcategories. For transparency and better understanding of the compilation methods, a variable "Data source" is included to provide detailed information about the data sources. Table 9 presents the distribution of observations from various sources.

Table 9: Distribution of Data Sources

Data source	**Percent**
WTO original	43.43
WTO mirrored	26.56
COMTRADE original	8.88
COMTRADE mirrored	7.44
Eurostat original	3.63
Eurostat mirrored	3.45
Rebalanced World	1.14
Residual region	5.48

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