Invoicing currency, value-added in imports, and exchange rate pass-through

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Abstract

The theoretical model a la Amiti, Itskhoki, and Konings (2014, AER) suggests that the inclusion of exporters' market share and import intensity in the exchange rate pass-through regression is sufficient to reflect the underlying deep parameters. We suggest using value-added by importing and other countries and invoicing currency ratio as proxies for the import intensity measure. We examine the effect of value-added contributions of importing and other countries on the degree of exchange rate pass-through by examining 33 exporting countries and 13 importing countries for 18 industries between 1995 and 2018. Our results show that exchange rate pass-through decreases for industries with a higher contribution of the importing and other country's value-added.

Keywords: Exchange Rate Pass-through; Global Value Chains; Invoicing Currency; Market Share; Value-Added by Importers.

JEL Classification: F14 (Empirical Studies of Trade); F61 (Microeconomic Impacts of Globalization).

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1 Introduction

With the rapid expansion of internationally fragmented productions or global value chains, the contribution shares of value-added by other countries in a country's export are continuously increasing. The exchange rate sensitivity of export price reflects these value-added components by third countries and, in some cases, even that of the importing country (Ha, Stocker, and Yilmazkuday 2020, Camatte, Daudin, Faubert, Lalliard, and Rifflart 2020, Georgiadis, Gräb, and Khalil 2019). These studies implicitly assume that value-added in foreign countries in the home country's exports are denominated in foreign currencies. Simply put, the sensitivity of export price in a destination country will be less to exchange rate fluctuations if a large part of cost or value-added is denominated in the destination country's currency. However, in practice, the denomination of foreign inputs can also be in the home currency or in the third country's currency. Therefore, the sensitivity of export prices to the exchange rate depends on where the value-added is created and in which currency foreign inputs are invoiced.[1] The latter issue is addressed in the literature on invoicing currency.

The choice of invoicing currency has been an important topic in international finance. Grassman (1973) is one of the earliest studies that provide empirical evidence of invoicing currency use with extensive coverage of international trade for a single country, i.e., Sweden in his study.[2] Goldberg and Tille (2008) examined the determinants of invoicing currency choice with panel data of 24 countries and found the extensive use of US dollars. Invoicing currency decisions, in turn, affects the degree of exchange rate pass-through, see (Amiti, Itskhoki, and Konings 2014, Amiti, Itskhoki, and Konings 2022, Gopinath, Itskhoki, and Rigobon 2010).

In this paper, we contribute to two strands of literature by considering the effects of both value-added and invoicing currency on exchange rate pass-through (ERPT, hereafter). We base our empirical model on Amiti, Itskhoki, and Konings (2014) and include both input intensity and market shares. For the proxy of import intensity, we implement the value added by importing countries and other countries, and invoicing currency ratio of exporting and importing countries.

As a data source for the GVC indices, we rely on the TiVA database, estimated from the OECD's Inter-Country Input-Output (ICIO) tables. The most recent TiVA database covers 66 economies and 45 industries between 1995 and 2018.[3] Invoicing currency ratios for a large

[1] In fact, it is determined by the settlement currency, but we believe invoicing currency and settlement currency coincide for most international transactions.

[2] Quite contrary to the emphasis in the recent literature of the dominant currency, Grassman emphasized the most frequent use of invoicing currency is either the sellers' or buyers' and the less than-believed use of US dollars.

[3] Other possible data sources include the WIOD data. The WIOD was originally funded by the European Commission and then later maintained by the GGDC, University of Groningen, but is no longer maintained.

number of countries are provided in Boz, Casas, Georgiadis, Gopinath, Le Mezo, Mehl, and Nguyen (2022). They collected the invoicing currency ratios of 115 countries for both exports and imports in the last three decades. As evidenced by an annual panel of 13 industries between 1995 and 2018, We examine the effect of value-added contributions of importers and third countries on the degree of exchange rate pass-through. We found that exchange rate pass-through decreases for industries with a higher contribution of the importing country's and the third countries' value-added. This is consistent with the theoretical hypothesis of Amiti, Itskhoki, and Konings (2014) that a higher import intensity decreases the degree of ERPT.

The remaining structure of this paper is organized as follows. The next section briefly discusses how two kinds of literature are related to this study. Section 3 provides the theoretical background on how the empirical model is specified. Section 4 describes how data in this study are constructed. Section 5 provides empirical evidence, and the last section concludes.

2 Literature review

2.1 Exchange rate pass-through

Amiti, Itskhoki, and Konings (2014) introduce a theoretical model in which an exporter procures inputs from both home and foreign countries and sets an invoice currency in either home or destination currency. The export pricing equation can be shown as a product of markup and marginal cost. Then, the sensitivities of markup and marginal cost to exchange rate determine how much an export price responds to a change in exchange rate. They show that the exporter's market share and import intensity can sufficiently explain an exchange rate pass-through behavior.

Regarding import intensity, Chung (2016) examines the UK exporters' choice of invoicing currency with respect to their import intensities. She found that a UK exporter with more imported inputs was more likely to choose local currency pricing. Gopinath, Itskhoki, and Rigobon (2010) investigates the imported products of US firms for the difference in exchange rate pass-through between US dollar invoicing and other currency invoicing. They found that exchange rate pass-through for products invoiced in US dollars, the local currency in their study, were almost zero and just around 20 percent two years later. (Amiti, Itskhoki, and Konings 2022)

Therefore, the most recent year ends in 2014.

2.2 Global value chains

Most studies examine the role of firms participating in GVCs from the perspective of exporters and decompose the gross exports into their domestic and foreign value-added contents. We can split value-added in two parts: domestic and foreign. The domestic valued-added can also be decomposed into three parts; domestic value added sent directly to consumer economy (and directly consumed by the importing partner), domestic value-added sent to third economies (intermediate goods or services re-exported to a third economy), and domestic value-added re-imported in the economy. One of the important distinctions in GVCs is where in a vertical stream of production an exporter is located. The percentage of foreign value added in gross export is used as a measure of backward participation. The backward participation shows how many imported intermediaries are used to produce a unit of exported goods. On the other hand, the percentage of re-exported value added in gross export is used as a measure of forward participation. This measure represents how much exports are re-exported as intermediaries to third country or back to home. The GVC backward and forward participation at the global level between 2000 and 2014 are in the range of 20-25 percent and 15-20 percent, respectively (Borin et al. 2021). At individual country level, there exists a wide discrepancy among exporters. For example, China's GVC backward and forward participations are higher than those of Japan and US, especially in forward participation (Wang et al., 2017). Even within some industries, we observe heterogeneity in sub-industries. For example, sub-industries in low or medium technology manufacturing industry demonstrate a wide range of GVC participation from 30 percent to 60 percent (Cigna, Gunnella, and Quaglietti 2022).

Ahmed, Appendino, and Ruta (2017) estimate the elasticity of exports to the real effective exchange rate (REER) for 46 countries between 1996 and 2012. They find that the elasticity decreased from 0.83 to 0.68 during the period. More interestingly, participation to the GVC has a negative impact on the REER elasticity: between 22% and 30% (the effect is larger for backward GVC than for forward GVC). Tan et al. (2019) estimate the elasticity of exports to the REER and VREER for 8 ASEAN countries between 1995 and 2011. FVA (Foreign Value Added) reduces the effect of exchange rate appreciations on real gross exports by 93% and offset the effect of increased volatility by about 75%. The study finds evidence of a negative relationship between exchange rate appreciation and gross exports for ASEAN-8. Integration into GVCs almost completely offsets this effect: high FVA share in gross exports reduce the effect of exchange rate appreciation/depreciation by 93%. Ha et al. (2020) investigate ERPT estimating structural FAVAR for 55 countries (29 advanced and 26 EMDE) between 1974 and 2017. In this paper, ERPT is defined as the percentage increase in consumer prices associated

with a 1% depreciation of the effective exchange rate, after 1 year following a specific shock. This paper shows a positive correlation between the exchange rate pass-through and the GVC participation (foreign value-added). Camatte et al. (2020) also examine how the transmission of exchange rate to consumer prices are influenced by global value chains, see also Georgiadis et al. (2019).

3 Theoretical background

Based on the models of Atkeson and Burstein (2008) and Halpern, Koren, and Szeidl (2015), Amiti, Itskhoki, and Konings (2014) consider a firm producing a differentiated good i and supplying it to destination market k in period t and obtain export price equation in terms of markup and marginal cost. In a log-differentiated form, the export price in *producer currency*, $P^*_{k,i}$, can be shown as follows:

$$d\log P^*_{k,i} = d\log M_{k,i} + d\log MC^*_i \tag{1}$$

where $M_{k,i}$ and MC^*_i denote the markup and marginal cost for firm i, respectively.

The log-differentiated form of markup is

$$d\log M_{k,i} = -\Gamma_{k,i}(d\log P_{k,i} - d\log P_{s,k}) + \frac{\Gamma_{k,i}}{\rho - 1} d\log \xi_{k,i} \tag{2}$$

where $\Gamma_{k,i}$ is the markup elasticity with respect to the firm's price and therefore is a function of market share, $S_{k,i}$. $\xi_{k,i}$ is quality parameter of the firm and $P_{s,k}$ is the sectoral price index. The subscript s denotes the sector.

The log-differentiated form of marginal cost is

$$d\log MC^*_i = \phi_i d\log \frac{E_m \overline{U}_s}{\overline{V}^*_s} + d\log \frac{C^*_s}{\overline{\Omega}_s} + \epsilon^{MC}_t \tag{3}$$

where ϕ_i is the import intensity of firm i, E_m is the nominal exchange rate, $\overline{U}_s$ and $\overline{V}^*_s$ are the price indexes for the imported and domestic intermediates, respectively[4]. C^*_s is cost index for nonimporting firms and $\overline{\Omega}_s$ is the sector productivity index. ϵ^{MC}_i is a firm-idiosyncratic residual that does not react to the exchange rate.

Proposition 3 of Amiti, Itskhoki, and Konings (2014) states that the first-order approximation to the exchange rate pass-through elasticity into *producer-currency* export price of the firm

[4]Equations (1), (2), and (3) are respectively equations (12), (13), and (14) in Amiti, Itskhoki, and Konings (2014).

is given by

$$\Psi_{k,i} \equiv E\left\{\frac{d\log P^*_{k,i}}{d\log E_k}\right\} = \alpha_{s,i} + \beta_{s,k}\phi_i + \gamma_{s,k}S_{k,i} \tag{4}$$

We can reformulate equation (4) in terms of *local-currency* export price;

$$(1-\Psi_{k,i}) \equiv E\left\{\frac{d\log P_{k,i}}{d\log E_k}\right\} = 1 - \alpha_{s,i} - \beta_{s,k}\phi_i - \gamma_{s,k}S_{k,i} \tag{5}$$

where we interpret the import intensity of firm i, ϕ_i, as value added in the importing country, VAM, and in the other countries, VAT. Therefore, the expected signs of VAM and VAT are negative on the exchange rate pass-through elasticity. These hypotheses are reflected in estimation models as interaction terms with exchange rates as follows.

$$\begin{aligned} lnP_{i,k,s,t} = \alpha + \beta_0 lnE_{i,k,t} + \beta_1 VAM_{i,k,s,t} lnE_{i,k,t} + \beta_2 VAT_{i,k,s,t} lnE_{i,k,t} \\ + \beta_3 MarketShare_{i,k,s,t} lnE_{i,k,t} + \epsilon_{i,k,s,t} \end{aligned} \tag{6}$$

where α corresponds to $(1-\alpha_{s,i})$, VAM and VAT correspond to ϕ_i, and MarketShare to $S_{k,i}$ in equation (5).

4 Data construction

4.1 The value-added in gross imports

In this study, we redefine the GVC from the perspective of importers and decompose the value-added of gross imports to original source countries. The Figure 1 represents the overview of breakdowns of value-added in gross imports. First, the total value-added of gross imports is divided into three components: VAX, VAM, and VAT. The value-added by an exporting country is denoted as VAX. The value-added by an importing country is denoted as VAM and this measure captures re-imports. The value added by third countries, i.e., neither exporting nor importing country, is denoted as VAT.

TiVA provides wide variety of value-added indices by utilizing the OECD's inter-country input-output tables (Guilhoto et al., 2022). $OVA\_GI(so,k,j,i,l)$ is a variable with five arguments: so is a source country, k is an industry of imports, j is an importing country, i is an exporting country, and l is an exporting industry in country i. We sum over exporting industries l for each exporting country i to obtain

$$Val(so,i,j,k) = \sum_{l\in L(i)} OVA\_GI(so,k,j,i,l) \tag{7}$$

We define value added for bilateral exports in industry,k, from exporting country, i, to importing country, j, by exporting country, importing country, and all other countries as in the following equations, respectively, (8),(9), and (10);

$$VAX(i,j,k) = Val(so = i, i, j, k) \tag{8}$$

$$VAM(i,j,k) = Val(so = j, i, j, k) \tag{9}$$

$$VAT(i,j,k) = \sum_{so \neq i,j} Val(so, i, j, k) \tag{10}$$

where so indicates a source country where value is added. So VAX is value-added in the exporting country as the source country and VAM is value-added in the importing country as the source country. VAT is the sum of value-added by all other countries.

4.2 Invoicing currency ratio

Boz, Casas, Georgiadis, Gopinath, Le Mezo, Mehl, and Nguyen (2022) collect the macro-level invoicing currency information from the central banks and the ministries of finance across the globe and investigate how the difference in the invoicing currency tendency of the sample of over 100 countries affects the exchange rate pass-throughs. We use their currency invoicing ratio for both exporting and importing countries. However, the database lacks invoicing currency information on the four countries, of which other variables are otherwise available: Namely, China, Mexico, Singapore, and Viet Nam.

4.3 Import prices and exchange rates

Import unit value

To calculate bilateral import prices, we use the HS92 version of the BACI database from the CEPII. The BACI provides the value and quantity of each HS 6-digit product for a combination of exporter-importer-year. The unit value is calculated by dividing the value by quantity.

Import price index for TiVA industry

The Harmonized System (HS) version revised in 1992 of BACI, CEPII, are used for constructing the import price index. The UN provides the corresponding table between HS classifications and the International Standard Industrial Code (ISIC). For each TiVA industry, there is a set

of corresponding multiple HS 6-digit codes. The industry price index for a pair of an exporting country and an importing country is calculated as the weighted average of these corresponding HS 6-digit codes. For 23 TiVA industries, although only 18 are used in this study due to too many missing observations for trade data, there are 5145 corresponding HS 6-digit codes.

For TiVA industry K, the import price index is calculated as follows

$$P_{ijK} = \frac{\sum_{k \in K} v_{ijk} (\frac{v_{ijk}}{q_{ijk}})}{\sum_{k \in K} v_{ijk}} \tag{11}$$

for exporting country, i, importing country,j, and HS 6-digit product, k.

Exchange rates

The bilateral exchange rate is defined as the value of the exporting country's currency in terms of the importing country's currency. Therefore, an increase in the exchange rate means a depreciation of the importing country's currency.

4.4 Control variables

The exchange rate pass-through equations, which will be defined in the next section, are in reduced forms. In a panel framework, individual and time effects can capture unobserved variables as described in Knetter (1989). Nevertheless, the inclusion of specifically defined foreign costs is expected to improve the overall fitness of regressions. For the data source of the foreign costs, we use 'compensations of employees' (local currency unit), in the World Development Indicators, the World Bank[5]. The labor cost index is normalized to one in 1995 for each industry.

5 Empirical Analysis with Multiple Exporters and Importers

To investigate further the effect of global value chains on the transmission of exchange rates on import prices, one needs to look at bilateral imports with disaggregated value added by individual exporters and importers.

[5]For China, labor cost is replaced by average monthly earnings, 2017 PPP, International Labor Organization and 2017 value is forecasted by polynomial up to the second term. For Malaysia (Philippines), 1995 (1997) of compensation of employees is interpolated by polynomial up to the second term. For Indonesia and Saudi Arabia, labor costs are replaced by the wholesale price index, WDI, and the World Bank. For Qatar, labor costs are replaced by CPI, WDI, and the World Bank.

5.1 Empirical results

First, we estimate the following equation (12), slightly modified version of equation (6).

$$lnP_{i,k,s,t} = \alpha + \beta_0 lnE_{i,k,t} + \beta_1 VAM_{i,k,s,t} lnE_{i,k,t} + \beta_2 VAT_{i,k,s,t} lnE_{i,k,t} \quad (12)$$
$$+\beta_3 MarketShare_{i,k,s,t} lnE_{i,k,t} + \gamma_1 Inv_{i,t}^{\text{USD}} lnE_{i,k,t} + \gamma_2 Inv_{k,t}^{\text{USD}} + \epsilon_{i,k,s,t}$$

Now we have multiple importing countries and multiple exporting countries as well as multiple industries, so that subscripts include exporting country, i, importing country, k, industry s, and year, t.

Table 1 presents the estimated results for the effects of value-added outside of the exporting country and invoicing currency ratio on exchange rate pass-through. The first column presents the simplest exchange rate pass-through specification, including only the bilateral exchange rate as an explanatory variable. The point estimate is 0.478 and statistically significant at the one percent level. It indicates that a one percent depreciation of the exporting country's currency leads to a rise of about a half percentage point in the importing price in the importing country's currency.

From columns (2) through (6), the specifications include additional variables that interacted with bilateral exchange rates. Column (2) additionally includes VAM and VAT. The ratio of value added by third countries is negative and statistically significant, consistent with the theoretical hypothesis, although VAM is not statistically significant. Column (3) finds that the industry market shares of exporting countries do not affect ERPT. From columns (4) through (6) add the invoicing currency ratio of importing countries. However, the invoicing currency ratios of importing countries do not appear statistically significant in any specifications. Throughout all specifications, VAT is always statistically significant, except for column (6).

In Table 2, we replace the invoicing currency ratio of importing countries,$USDImport$, with the invoicing currency ratio of importing countries. Interestingly, VAM turns out to be statistically significant. In addition, the invoicing currency ratio of exporting countries is also statistically significant in all three columns.

This is only the interim version; we are currently working on the estimations.

Table 1: Exchange rate pass-through with global value chains and importing country's invoicing

VARIABLES	(1) Full Panel	(2) Full Panel	(3) Full Panel	(4) Full Panel	(5) Full Panel	(6) Full Panel
lner	0.478***	0.510***	0.511***	0.259**	0.256**	0.241**
	(0.119)	(0.120)	(0.119)	(0.106)	(0.103)	(0.102)
c.vat#c.lner		-0.118**	-0.118**	-0.130**	-0.130**	-0.0705
		(0.0421)	(0.0421)	(0.0572)	(0.0572)	(0.108)
c.vam#c.lner		-0.0310	-0.0331	0.403	0.604	0.408
		(0.174)	(0.170)	(0.372)	(1.237)	(0.375)
c.Mshare#c.lner			-0.0111	-0.0286	-0.0286	-0.0286
			(0.0314)	(0.0343)	(0.0343)	(0.0343)
c.USDImport#c.lner				0.00154	0.00159	0.00184
				(0.00125)	(0.00127)	(0.00125)
c.vam#c.USDImport#c.lner					-0.00360	
					(0.0185)	
c.vat#c.USDImport#c.lner						-0.00102
						(0.00199)
Constant	4.916***	4.923***	4.923***	5.099***	5.099***	5.097***
	(0.0464)	(0.0468)	(0.0465)	(0.0605)	(0.0607)	(0.0596)
Observations	101,621	101,181	101,181	63,909	63,909	63,909
R-squared	0.316	0.318	0.318	0.346	0.346	0.345
Number of d_ex_im_ind	6,520	6,510	6,510	4,935	4,935	4,935

Note: The robust standard errors with clusters at the import country level are in Parentheses. Statistical significance are indicated by *** for p¡0.01, ** for p¡0.05, and * for p¡0.1

Table 2: Exchange rate pass-through with global value chains and exporting country's invoicing

VARIABLES	(1) Full Panel	(2) Full Panel	(3) Full Panel
lner	0.615***	0.622***	0.651***
	(0.130)	(0.130)	(0.140)
c.vat#c.lner	-0.136**	-0.139**	-0.225**
	(0.0512)	(0.0513)	(0.0755)
c.vam#c.lner	-0.448*	-0.691**	-0.455*
	(0.222)	(0.234)	(0.224)
c.Mshare#c.lner	0.0431	0.0444	0.0436
	(0.0411)	(0.0405)	(0.0412)
c.USDExport#c.lner	0.00145**	0.00121**	0.000462
	(0.000492)	(0.000492)	(0.000572)
c.vam#c.USDExport#c.lner		0.0154**	
		(0.00546)	
c.vat#c.USDExport#c.lner			0.00323*
			(0.00160)
Constant	5.159***	5.155***	5.151***
	(0.0698)	(0.0720)	(0.0641)
Observations	61,949	61,949	61,949
R-squared	0.2939	0.2944	0.2955
Number of d_ex_im_ind	5,487	5,487	5,487

Note: The robust standard errors with clusters at the import country level are in Parentheses. Statistical significance are indicated by *** for p¡0.01, ** for p¡0.05, and * for p¡0.1

6 Conclusion

With the sample of 33 exporting countries and 13 importing countries for 18 TiVA industries between 1995 and 2018, we find evidence that the value-added components of importing and other countries in a country's exports have a significant effect on the exchange rate pass-through. The more value added in an importing country and other countries decreases the transmission of a change in exchange rate to the import price. Our findings complement those of De Soyres et al. (2021), who examined the effect of the value added to the ERPT in exporting countries.

We found evidence that the breakdown of value-added among the originating countries is essential in understanding how import prices respond to a change in the exchange rate. If exporting countries are more self-sufficient in obtaining intermediary products from local suppliers, a change in the exchange rate is more likely to reflect on the import prices in the destination country. On the other hand, import prices are less responsive to a change in the exchange rate if exporting countries source more inputs from the destination country. More specifically, in this study's framework, the ERPT on import prices is smaller if an importing country has exported parts and components to an exporting country that exports final products back to the importing country after integrating or assembling intermediate products of the importing country in its final exports.

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A Appendix A: TiVA database

The TiVA database contains value added for each source countries for a trade flow from an exporting country to an importing country.The current version in 2022 cotains the sample from 1995 to 2018.

A.1 exporting countries

Exporting countries are 34 in the sample, but there is always one importing country among these countries. So in the regression analysis, there are (different sets of) 33 exporting countries. AUT, BEL, BRA, CAN, CHN, CZE, DNK, EST,FIN, FRA, DEU, GRC, HUN, IRL, ITA, JPN, KOR, LVA, LTU, LUX, NLD, NOR, POL, PRT, SGP, SVK, VNM, SVN, ESP, SWE, CHE, THA, GBR, USA, WLD

A.2 importing countries

The following 13 countries are used as importers. BRA, CAN, CHN, DEU, FRA, GBR, ITA, JPN, KOR, MEX, POL, THA, USA

B Appendix B: Data constructions

B.1 Nominal Effective Exchange Rate

Bilateral nominal exchange rate series are taken from the IFS, IMF. Exchange rate is defined as exporter's currency value of the importer's currency so that an increase in exchange rate is a depreciation of the importer's currency.

B.2 Global Labor Cost

Data Source: For the construction of the Global labor cost, we used (i) compensation of employees (local currency unit), WDI, World Bank. We replaced a country series of the first database with the following three database by the priority given in the order if the series misses more than one year. Alternative data are the followings: (ii) average monthly earnings (2017PPP), ILO; (iii) Wholesale price index, WDI, WB; and (iv) consumer price index, WDI, WB. If a country series in database (i) or (ii) misses only one year, we replaced the missing year data by the forecast from the regression of the series on the time trend and the squared time trend.

In particular, the following replacements are made. For China, the ILO's average monthly earnings is used and the data in 2017 is forecasted. For Malaysia, the data in 1995 is forecasted. For Philippines, the data in 1997 is forecasted. For Indonesia and Saudi Arabia, the wholesale price index by the WDI is used. For Qatar, the consumer price index is used.

The global labor cost for each industry is constructed by the geometric average of labor costs in countries listed in the appendix A with Japan's imports weights.

C Appendix C: Data constructions for multiple importers

C.1 TiVA industries

D01T02 Agriculture, hunting, forestry
D10T12 Food products, beverages and tobacco
D13T15 Textiles, textile products, leather and footwear
D16 Wood and products of wood and cork
D17T18 Paper products and printing
D20 Chemical and chemical products
D21 Pharmaceuticals, medicinal chemical and botanical products
D22 Rubber and plastics products
D23 Other non-metallic mineral products
D24 Basic metals
D25 Fabricated metal products
D26 Computer, electronic and optical equipment
D27 Electrical equipment
D28 Machinery and equipment, nec
D29 Motor vehicles, trailers and semi-trailers
D31T33 Other transport equipment
D58T60 Manufacturing nec; repair and installation of machinery and equipment
Note: The numbers in industry label corresponds to the industry classifications in the ISIC revision 4.

C.2 Import Price index constructed for TiVA industries

The Harmonized System (HS) version revised in 1992 of BACI, CEPII, are used for constructing the import price index. The corresponding table between HS classifications and International Standard Industreal Code (ISIC) is provided by the UN. For each TiVA industry, there is the set

of corresponidng multiple HS 6-digit codes. The industry price index for a pair of an exporting country and an importing country is calculated as the weighted average of these corresponindg HS 6-digt codes. For 23 TiVA industries, although only 16 are used in this study due to too many missing observations for trade data, there are 5145 corresponding HS 6-digit codes.

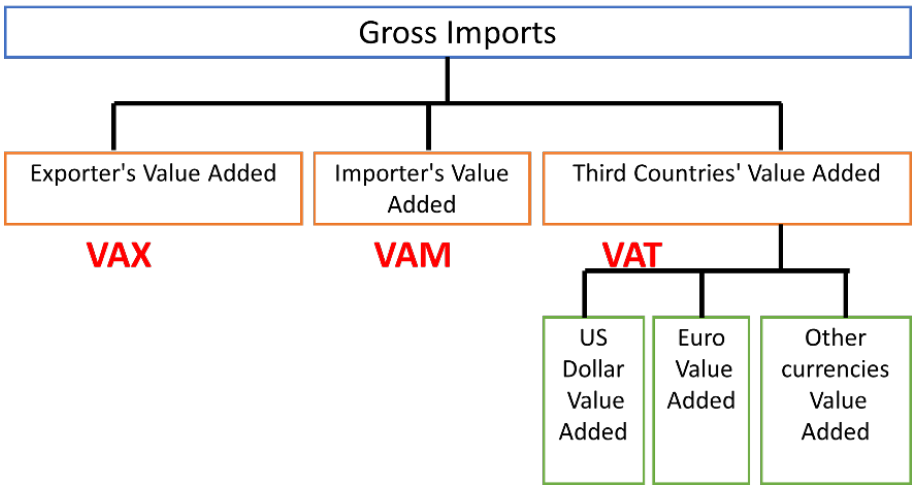
C.3 Labor Cost

See the description in appeindix subsection B.2

C.4 Consumer Price Index

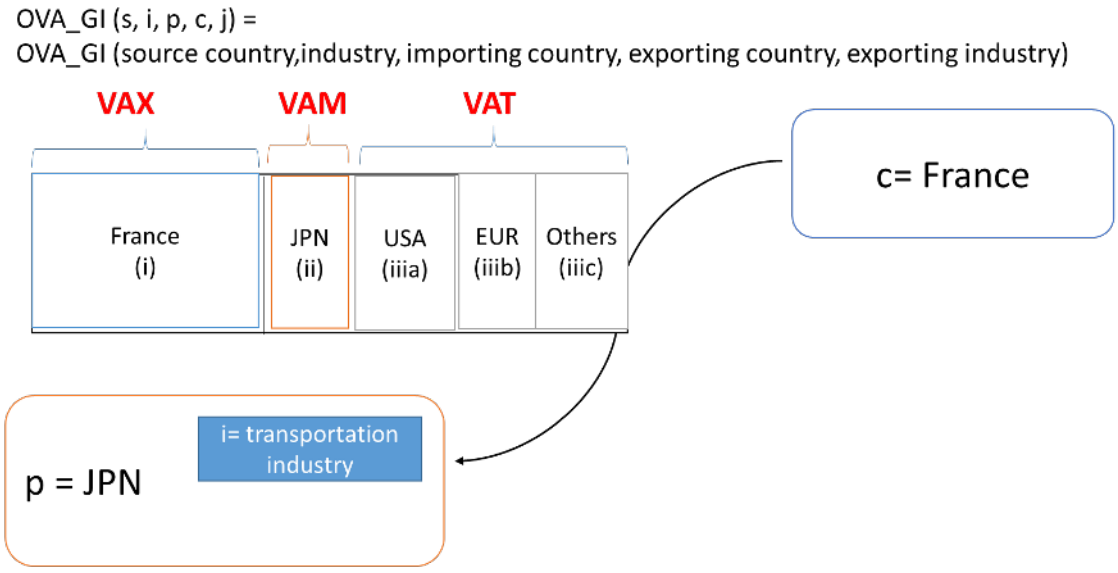
Consumer price index are retrieved from the World Development Indicators, the World Bank. The WDI file is downloaded in July 2022. The value of 2010 is normalized to be 100.

Figure 1: Decompositions of value added in nominal import



Note: the figure is created by the authors.

Figure 2: The concept of GVC index



Notes: The figure is created by the authors. Data: The origin of value added in gross import value is decomposed into three parts: (i) exporters' value added (VAX); (ii) importers' (Japan) value added = reimports (VAM); (iii) third countries' value added (VAT).This can be further decomposed to iiia) US (VAT_US), iiib) Euro 11 (VAT_EUR), and iiic) all other combined (VAT_OT).