Invoicing Currency, Exchange Rate Pass-through and Value-Added Trade: An Emerging Country Case

Hülya SAYGILI

August 2019

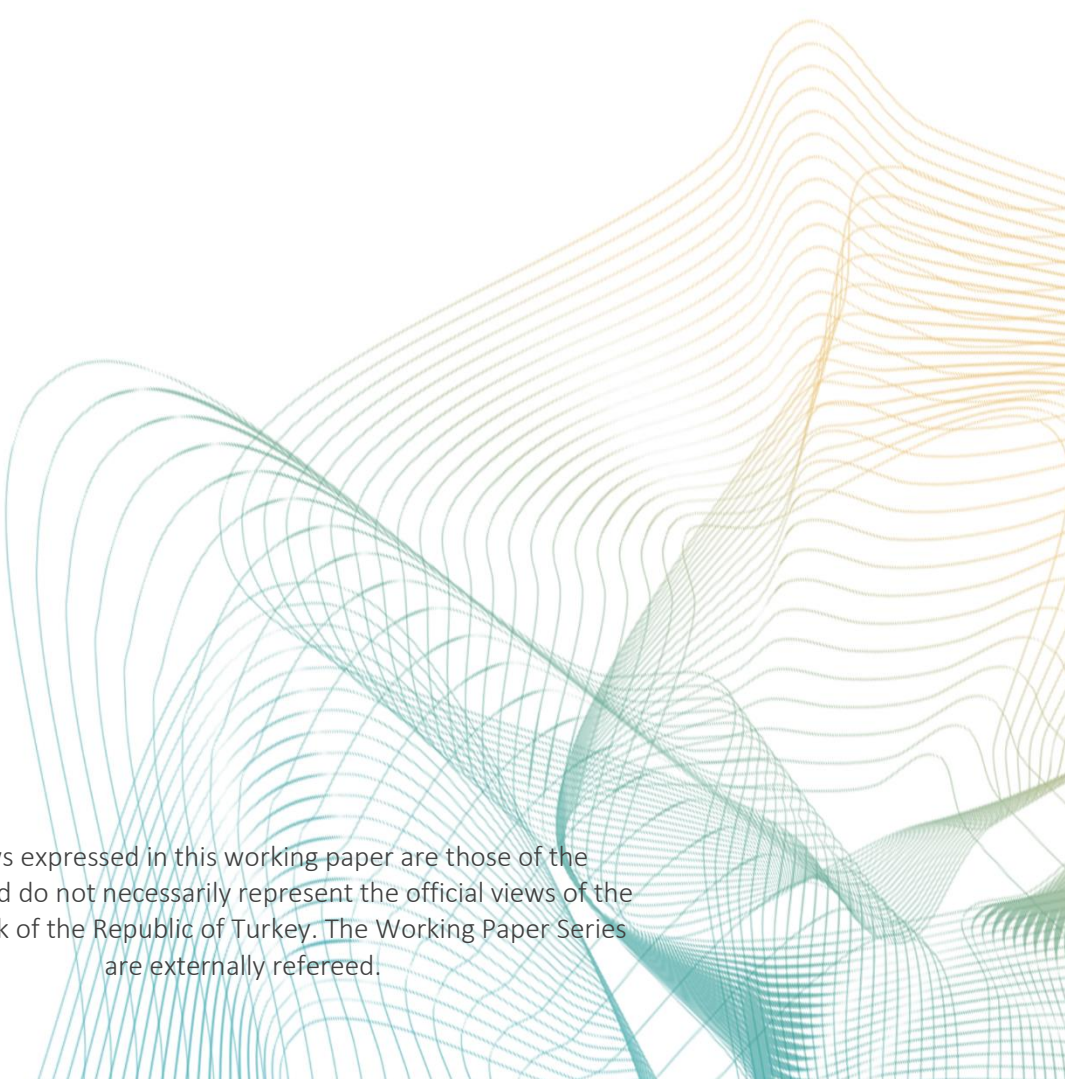# Invoicing Currency, Exchange Rate Pass-through and Value-Added Trade:

An Emerging Country Case

Hülya Saygılı

Central Bank of the Republic of Turkey

Abstract

We explore the role of invoicing currency and global production integration on exchange rate pass-through to import and export prices, using 3-digit product level data classified by end-use and 2-digit sector level data displaying varying integration to global value-added trade from an emerging country, Turkey. The results show that, overall, rates of exchange rate pass-through to export prices are higher than those to import prices. The pass-through is significantly higher for local currency-priced goods. The rate of pass-through to the US dollar and euro-priced goods depends on the type of products traded and value-added trade. For consumption and capital goods, pass-through rates are significant and relatively high when they are priced in the US dollars. For intermediate goods the pass-through to euro-priced goods are higher than those to the US dollar-priced goods. In addition, sectors displaying a low or high association with global value chains tend to have a higher exchange rate pass-through than those placing in the middle range and the rate is slightly higher for sectors having lower global linkage.

Keywords: exchange rate pass-through, currency of invoicing, imported input, value-added trade.

JEL Codes: F3, F4, F1

Non-Technical Summary

The choice of invoicing currency has policy implications for the international spillover of macroeconomic shocks, exchange rate pass-through and thus effectiveness of monetary policy if there are nominal rigidities in an economy. The pass-through will be lower if goods are invoiced in the currency of the local or destination country; higher if they are invoiced in the currency of producer country.

This study investigates the link between pass-through, invoicing currency and trade in intermediate goods. In addition, apart from the literature, it incorporates global value chain phenomenon into the debate. Does the globalization of production have a role in the pass-through process and currency choice for invoicing? Also the study diverges from the literature by approaching the question from an emerging country, Turkey perspective.

Results reveal strong evidences on the significance of pass-through to both export and import prices with the rate being relatively higher for export price. Within the currency groups, there is evidence that exchange rate pass-through to import prices is significantly higher for goods that are invoiced in the local currency. The pass-through to the US dollar and euro-priced goods depends on the type of products and value-added trade. Coefficient estimates are relatively lower for intermediate goods. Trade in intermediate goods and global value chain lower the pass-through to the US dollar-priced goods in particular. Finally, results suggest that firms with low and high linkages with global production have higher price sensitivities, than those in the middle range. And the sensitivity is higher for the sectors in lower quantile.

1. **Introduction**

How do exchange rate movements affect domestic economy? Does currency denomination of international trade matter in determining the impact of exchange rate changes? Earlier studies have shown that with nominal rigidities, the choice of invoicing currency has policy implications for the international spillover of macroeconomic shocks, exchange rate pass-through and thus effectiveness of monetary policy.[1] If there exists a level of rigidity in prices, the currency in which goods are priced determines how domestic prices will react to changes in exchange rates: The pass-through will be lower if goods are invoiced in the currency of the local or destination country; it is higher when they are invoiced in the currency of producer country.

There is a significant research effort in understanding the link between exchange rate movements and prices. Recent studies have shifted the focus on the relevance of the currency choice in the pass-through process and factors leading firms to choose different currencies for invoicing in different markets.[2] Bleaney (1997) reports that while in the short run both the US dollar and yen real exchange rates are significant on Japanese export prices only the impact of yen persists. Gopinath et al. (2010) find that the pass-through to the US imports priced in dollars is significantly lower than those priced in non-dollars. For Fabling and Sanderson (2015) there is little evidence for the differential pass-through behavior within currency groups particularly when key firms are considered. More recently, the results in Devereux et al. (2017) are in support of

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[1] Betts and Devereux (1996), Corsetti and Pesenti (2005), Devereux and Engel (2002), Devereux and Engel (2003), Devereux et al. (2004), Devereux et al. (2017), Fabling and Sanderson (2015), Goldberg and Tille (2016), Gopinath et al. (2010), Parsons and Sato (2006).

[2] Chung (2016), Devereux et al. (2017), Fabling and Sanderson (2015), Gopinath et al. (2010), Parsons and Sato (2006).

Gopinath et al. (2010) and suggest that exchange rate pass-through is significantly lower for goods priced in local (Canadian) currency.

The literature has postulated several explanations on the exporter's invoicing currency choice.[3] According to Gopinath et al. (2010) there is a significant difference in invoiced currency choice with respect to the homogeneity of the goods imported: Homogeneous goods are more likely to be priced in local currency. Fabling and Sanderson (2015) examine the link between exporting firm performance, exchange rate pass-through and currency choice. Auer and Schoenle (2016), Garetto (2016) and Devereux et al. (2017) put the emphasis on firms' market share and report that there is a U-shaped relationship between the market share and pass-through.[4] In other words, very small and very large exporters have higher rate of pass-through and invoice in the foreign currency, while large importers likely to invoice in local currency leading a lower pass-through.

Chung (2016) puts the attention on the increasing share of intermediate goods in international trade and both theoretically and empirically examines whether exporters' dependence on imported inputs determines their invoicing currency choice. The study shows that exporters that depend more on foreign currency-denominated imported inputs are less likely to price in their home currency. Amiti at al. (2016), in line with Chung, suggest that strategic complementarity relationships may play a significant role in firms pricing decisions.

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[3] In addition, Goldberg and Tille (2013) consider a theoretical bargaining model for both the exporter and importer in the determination of currency of invoicing. In Goldberg and Tille (2016) larger transactions are more likely to be priced in the destination currency. In Cao et al. (2015) firms selling the same good to domestic and export markets, often in different currencies, to difference out the common marginal cost component in the prices. For Floden and Wilander (2006) currency choice is a function of cost and demand. Hwang et al. (2016) test the impact of firms bargaining power, product heterogeneity, macroeconomic volatility, banking system and transaction costs on currency choice.

[4] Also, Berman et al. (2012) and Amiti et al. (2014) also report a differential reaction to exchange rate movements across the firms displaying different performance and market share.

OECD (2012) notes that technological progress, costs, access to resources, market and trade policy reforms have facilitated the geographical fragmentation of production processes across the globe in a way that tasks are assigned to the production units according to their comparative advantages. Within the global value chain (GVC) components move across borders multiple times until the production is completed. Due to this back-and-forth trade relationship, today more than a half of world manufactured imports is composed of intermediate goods (primary goods, parts and components, and semi-finished products), and more than 70 % of world services imports is composed of intermediate services (OECD, 2012). Such a structural integration of production across countries leads domestic macroeconomic dynamics to become more sensitive to international disturbances of productivity, demand and thus global inflation.

In this study, we would like to investigate links between pass-through, invoicing currency and trade in intermediate goods, following the empirical approaches in Gopinath et al. (2010), Chung (2016) and Devereux et al. (2017). Apart from the literature, we would like to incorporate the globalization, in particular international fragmentation of production phenomenon into the debate. Does the globalization of production have a role in the pass-through process? Does the exporters' and importers' currency choice for invoicing in sectors with high degree of globalization have different implications on exchange rate pass-through? We also would like to diverge from the literature by approaching the question from an emerging country perspective. Considering the fact that there may be significant differences in the share of intermediate goods in imports and exports which may generate non-negligible implications, especially for an emerging country, we conduct the analyses for both export and import prices.

Thus, one of our key contributions to the literature lies in the analysis of the impact of invoicing currency choice on the exchange rate pass-through on prices of the products used for

different purposes. To do that in the first stage of the analysis we use 3-digit product level data in Broad Economic Categories (BEC) so that goods are classified according to their end-use: consumption, intermediate and capital goods. We, then, examine if there is a systematic difference between the rate of pass-through for intermediate goods, one of the indicators of the GVC and for the other types of goods. We are also interested in if the pattern of pass-through vary with the use of different currency denomination.

Next, we incorporate the Trade in Value Added (TiVA) database, formed on OECD/WTO national input-output tables (the World Input-Output Database) in to our analysis. TiVA enables researchers to map and measure bilateral back-and-forth production sharing globally. In other words, this database allows tracking of intermediate inputs as they cross geographic boundaries and industrial processing stages on their way to foreign and/or possibly domestic final demands. The advantage of using TiVA indicator compared to the intermediate goods trade, is that it can measure the link between countries, even between sectors in a finer way. There are several indicators in TiVA database and we used the one called foreign value-added in gross exports, a widely accepted indicator for globalization. Indicators are available in International Standard Industry Classification (ISIC Rev.4).

Contrary to the existing literature focusing mainly on developed countries such as the US, Canada and Japan, we focus on a developing country, Turkey, with a well-developed trade linkages. Earlier Parson and Sato (2006) examine the price-setting behavior of East Asian exporters and show that pass-through is far less prevalent in some countries in East Asia, a conclusion contrary to the results for developed countries.

Turkey has achieved an outstanding record of import and export growth since the establishment of a Customs Union (CU) with the European Union (EU) in 1995.[5] The remarkable performance is mainly attributed to the successful participation of Turkish firms in GVC (Kaminsky and Ng, 2006; Saygılı and Saygılı, 2011; Gros and Selçuki, 2013; Türkcan, 2014; World Bank, 2014). The OECD-WTO TiVA database suggests that Turkey's GVC participation index (% share in total gross exports) increased by 8.4 % from 2005 to 2015. This increase was higher than the average for both developed (4.1 %) and developing (6.5 %) countries. Similar findings are also reported in Pomfret and Sourdin (2018): value-chain and network trades have been growing rapidly in emerging markets, and Turkey has displayed above the average performance among emerging European countries. Hence it would be interesting to analyze the links between pass-through, globalization and currency choice for an outperforming emerging country.

Results reveal strong evidences on the significance of pass-through to both export and import prices with the rate being relatively higher for export price. Within the currency groups, there is evidence that exchange rate pass-through to import prices is significantly higher for goods that are invoiced in local currency. The pass-through to the US dollar and euro-priced goods depends on the type of products and value-added trade. Coefficient estimates are relatively lower for intermediate goods. Trade in intermediate goods and GVC lower the pass-through to the US dollar-priced goods in particular. Finally, results suggest that firms with low and high linkage with global production have higher price sensitivities, than those in the middle range. And the sensitivity is higher for the sectors in lower quantile.

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[5] Volume of foreign trade increased almost six fold from 2005 to 2018.

The paper proceeds as follows: Section 2 outlines the statistical properties of the data, Section 3 presents the empirical models and results, while Section 4 concludes.

2. Data and Descriptive Statistics

The analysis are conducted using Turkish data covering 2007-2017. We use data at 3-digit product level in Broad Economic Categories (BEC) in which goods are classified according to their end-use. Also by using 2-digit sector level data in International Standard Industrial Classification (ISIC) Rev. 3.2, we could classify sectors according to their foreign value-added share in exports to investigate the relationship between global value-added trade and pass-through. The import and export values classified according to their invoicing currencies are obtained from Turkish Statistical Institute (TurkStat) on an annual basis.

Table 1: Summary statistics- currency invoice and partner shares in aggregate imports.

	Currency of invoice (%)		Import shares (%)
US dollar	61.23	United States	5.66
Euro	32.73	EU15	31.65
TL	4.29		
CHF	0.56	Switzerland	2.00
GBP	0.52	United Kingdom	2.50
RUB	0.01	Russia	10.30
CNY	0.01	China	10.10
Other	0.54	Other	37.66

Source: TurkStat.

Table 1 shows that approximately 61 % of imports are invoiced in the US dollars, 33 % in euro and about 4.3 % in Turkish Lira (TL). As for the exports, about 47 % is invoiced in euros, 45 % in the US dollars and 3.8 % in TL (Table 2). Table 1 and 2 show that the US dollars are the most preferred currency for imports while euro plays a dominant role in exports.

Table 2: Summary statistics- currency invoice and partner shares in aggregate exports.

	Currency of invoice (%)		Export shares (%)
US dollar	45.24	United States	4.00
Euro	47.18	EU15	38.11
TL	3.67		
Iraq dinar	0.00	Iraq	6.00
GBP	3.27	United Kingdom	6.40
UAE dirham	0.00	UAE	3.50
RUB	0.14	Russia	3.20
Other	0.54	Other	44.70

Source: TurkStat.

Note that share of the US in total imports and exports are 6 and 4 %, respectively. On the other hand, the US dollars play a dominant role in imports and take a significant share in exports. That reveals the fact that the US dollars also act as a vehicle currency in trade with non-US and non-European countries. For example, China and Russia each has a share of 10 % in total imports. However, shares of the currencies of these countries in total imports are barely 1 %, suggesting that vast majority of imports from these countries are likely to be invoiced in US dollars.

Table 3 and 4 present information on the currency of invoice in imports and exports, respectively for the products classified according to their end-use. Our data reveals that majority of the imports consists of intermediate goods (72 %) followed by capital (15 %) and consumption goods (12 %). Meantime 49 % of exports composes of intermediate goods, while consumption and capital goods take 40 and 11 % of exports, respectively.

Table 3 reports that in terms of the total value of imports, majority of intermediate (about 66 %) and consumption goods (about 48 %) imports are invoiced in terms of the US dollars, while majority of capital goods (about 49 %) imports are invoiced in euros. The highest rate of TL invoiced imports is 14 % and belongs to the consumption goods, followed by capital (3.5 %) and intermediate goods (2.5 %).

Table 3: Summary statistics-sector shares in total imports and currency invoice: BEC Classification.

	BEC Code	Share in total imports	Currency of invoice (%)			
			US Dollar	Euro	TL	other
Intermediate goods		**58.36**	**66.22**	**29.37**	**2.50**	**1.90**
Unprocessed materials of food and beverages	111	1.60	86.95	10.26	1.05	1.75
Processed materials of food and beverages	121	0.90	86.75	10.81	1.21	1.23
Unprocessed materials incidental to industry	21	5.70	91.33	7.48	0.80	0.39
Processed materials incidental to industry	22	32.92	62.87	33.72	2.05	1.36
Processed fuels and oils	322	6.01	95.79	2.41	1.73	0.06
Parts of investment goods	42	5.38	38.46	56.15	2.45	2.94
Parts of transportation vehicles	53	5.67	18.13	76.92	2.50	2.44
Capital goods		**15.34**	**44.59**	**49.10**	**3.48**	**2.83**
Capital goods (except transportations vehicles)	41	12.84	39.81	52.81	3.56	3.82
Transportation vehicles incidental to industry	521	2.51	49.38	45.38	3.40	1.84
Consumer goods		**8.37**	**47.89**	**33.31**	**14.17**	**4.62**
Unprocessed consumption of food and beverages	112	0.42	85.29	8.32	3.04	3.34
Processed consumption of food and beverages	122	0.72	28.91	56.04	8.44	6.61
Transportation vehicles not incidental to industry	522	0.18	49.50	37.23	8.22	5.04
Durable consumption goods	61	1.81	45.70	35.62	15.23	3.45
Semi-durable consumption goods	62	2.68	57.03	28.22	11.82	2.93
Non-durable consumption goods	63	2.56	20.92	34.44	38.28	6.37
Not Classified						
Gasoline	321	0.60	97.46	1.57	0.93	0.04
Automobiles	51	3.51	1.87	82.39	15.08	0.66
Other goods not elsewhere specified	7	0.30	73.70	23.05	0.30	2.95

Source: TurkStat.

Table 4: Summary statistics-sector shares in total exports and currency invoice: BEC Classification.

	BEC Code	Share in total exports	Currency of invoice (%)			
			US Dollar	Euro	TL	other
Intermediate goods		**49.79**	**56.66**	**38.29**	**3.92**	**1.13**
Unprocessed materials of food and beverages	111	0.21	66.30	19.93	12.26	1.51
Processed materials of food and beverages	121	1.13	85.39	12.82	1.30	0.49
Unprocessed materials incidental to industry	21	2.81	76.89	20.68	1.87	0.56
Processed materials incidental to industry	22	33.60	57.11	36.27	3.97	2.65
Processed fuels and oils	322	0.10	93.94	0.76	5.30	0.00
Parts of investment goods	42	3.05	31.97	62.92	2.87	2.25
Parts of transportation vehicles	53	5.71	19.88	77.95	0.73	1.44
Capital goods		**10.92**	**25.87**	**70.57**	**1.96**	**1.61**
Capital goods (except transportations vehicles)	41	5.60	36.51	57.13	3.39	2.97
Transportation vehicles incidental to industry	521	5.32	15.22	84.01	0.53	0.24
Consumer goods		**32.62**	**41.70**	**48.36**	**4.68**	**5.26**
Unprocessed consumption of food and beverages	112	3.88	60.08	32.07	4.36	3.49
Processed consumption of food and beverages	122	4.33	63.05	30.29	4.67	1.99
Transportation vehicles not incidental to industry	522	0.17	21.78	74.98	3.05	0.19
Durable consumption goods	61	8.27	49.88	37.53	7.72	4.87
Semi-durable consumption goods	62	9.98	22.91	62.76	3.58	10.74
Non-durable consumption goods	63	5.98	32.48	52.54	4.70	10.28
Not Classified						
Gasoline	321	1.55	97.89	0.01	2.10	0.00
Automobiles	51	5.45	4.68	88.21	0.11	7.01
Other goods not elsewhere specified	7	0.48	58.96	21.07	19.34	0.63

Source: TurkStat.

In terms of the total value of exports majority of intermediate (about 57 %) goods exports is invoiced in terms of the US dollars, while majority of consumption (about 48 %) and capital goods (about 71 %) exports are invoiced in euros (Table 4). Only, about 5 % of consumption goods and 4 % of intermediate goods exports are invoiced in TL.

In Table 5, in terms of the total import value, in 9 out of 15 sectors, more than 50 % of imports are invoiced in the US dollars. For example, 97 % of coke and refined petroleum products, 85 % of agriculture and hunting, 83 % of office, accounting and computing machinery imports are invoiced in the US dollars. Euro is the dominant invoicing currency in imports of motor vehicles (85 %), machinery and equipment (66 %), rubber and plastics (61 %), electrical machinery (59 %), fabricated metal products (57 %) and paper and paper products (52 %). Share of TL as an invoicing currency in imports vary between 15 % (wearing apparel) and 0.2 % (basic metals).

The bottom part of Table 5 shows that about 55 % of total imports involves with global production networks. This finding also explains the higher share of intermediate goods in imports (Table 3). The US dollars are the most preferred invoicing currency by both group of sectors but the share is noticeably high (62 %) for sectors with low foreign value-added content. Imports are invoiced relatively more in euros in high foreign value-added content sectors. About 5 % of imports are invoiced in TL in both groups.

A similar variation is also observed in Table 6. In terms of the total export values, share of exports in the US dollars is above 50 % in 11 out of 18 sectors. More than 50 % of exports are invoiced in euros in textiles, wearing apparels, rubber and plastics, fabricated metals, machinery equipment, electrical machinery, and motor vehicles. Share of TL in exports vary between 15 % in mining and 0.4 % in motor vehicles.

Table 5: Summary statistics-sector shares in total imports and currency invoice: ISIC Rev3.2 Classification.

			Currency of invoice (%)			
	ISIC Code	Share in total imports	US Dollar	Euro	TL	other
Agriculture, hunting and related service activities	1	3.34	84.51	12.63	1.94	0.92
Food products and beverages	15	2.14	62.08	31.06	3.61	3.26
Textiles	17	2.62	70.22	26.97	1.60	1.22
Wearing apparel; dressing and dyeing of fur	18	1.09	55.57	25.06	14.92	4.45
Paper and paper products	21	1.61	46.82	52.33	0.45	0.41
Coke, refined petroleum products and nuclear fuel	23	6.61	97.38	1.24	1.35	0.03
Chemicals and chemical products	24	14.14	49.24	38.64	9.98	2.13
Rubber and plastics products	25	2.05	30.39	61.14	6.33	2.15
Basic metals	27	11.89	79.13	19.50	0.19	1.19
Fabricated metal products	28	1.83	36.74	57.15	3.59	2.52
Machinery and eqp. n.e.c.	29	9.16	26.14	65.51	3.04	5.32
Office, accounting and computing machinery	30	1.48	82.66	12.48	4.31	0.55
Electrical machinery and apparatus n.e.c.	31	3.80	37.95	58.66	1.56	1.83
Radio, television and communication eqp. and apparatus	32	3.58	59.49	31.49	8.33	0.69
Motor vehicles, trailers and semi-trailers	34	8.38	5.80	84.95	7.76	1.50
Averages						
Foreign VA content of exports in first quantile		8.88	61.76	30.45	5.51	2.28
Foreign VA content of exports in forth quantile		54.61	47.03	44.94	5.60	2.43

Source: TurkStat and OECD for TiVA indicator.
Notes: Sectors with less than 1% share are not shown.

Table 6: Summary statistics-sector shares in total exports and currency invoice: ISIC Rev3.2 Classification.

	ISIC Code	Share in total exports	Currency of invoice (%)			
			US Dollar	Euro	TL	other
Agriculture, hunting and related service activities	1	3.69	59.46	32.87	6.20	1.47
Mining and quarrying	14	1.04	71.13	13.50	15.37	0.00
Food products and beverages	15	6.34	68.02	25.76	3.96	2.26
Textiles	17	9.33	37.11	50.24	5.12	7.52
Wearing apparel; dressing and dyeing of fur	18	8.89	16.85	69.68	1.54	11.94
Paper and paper products	21	1.10	49.75	40.66	5.08	4.52
Coke, refined petroleum products and nuclear fuel	23	3.85	95.67	0.85	3.47	0.00
Chemicals and chemical products	24	4.67	58.84	34.44	5.72	1.00
Rubber and plastics products	25	1.10	37.09	57.48	2.73	2.70
Other non-metallic mineral products	26	2.95	59.79	32.23	3.29	4.69
Basic metals	27	13.45	72.08	21.45	5.49	0.98
Fabricated metal products, expt. machinery and eqp.	28	4.38	40.38	52.01	3.44	4.17
Machinery and eqp. n.e.c.	29	8.00	28.40	62.28	3.98	5.34
Electrical machinery and apparatus n.e.c.	31	3.91	41.48	49.10	2.44	6.97
Radio, television and communication eqp. and apparatus	32	1.58	62.16	34.40	1.24	2.19
Motor vehicles, trailers and semi-trailers	34	13.45	5.92	90.30	0.42	3.35
Other transport eqp.	35	1.82	64.30	34.87	0.53	0.30
Furniture; manufacturing n.e.c.	36	3.61	60.73	30.26	8.12	0.89
Averages						
Foreign VA content of exports in first quantile		26.29	38.45	51.20	4.08	6.28
Foreign VA content of exports in forth quantile		45.06	44.81	48.66	3.22	3.31

Source: TurkStat and OECD for TiVA indicator.
Notes: Sectors with less than 1% share are not shown.

Table 6 reports that about a half of exports are realized through global networks and euro is the most preferred invoicing currency. Different from Table 5 exports of sectors with high foreign value-added content are invoiced relatively more in the US dollars.

3. Empirical analysis

3. 1. *How do exchange rate changes affect import and export prices?*

We follow the general approach[6] and use the following empirical model to analyze the impact of exchange rate movements on import (M) and export (X) prices:

$$dlp_{ist} = \alpha + \beta dle_{pt} + \gamma\, Z_{pt} + \varepsilon_{ist}, \text{ i=M, X} \tag{1}$$

Here; s, p and t denote for sector/product, partner and time respectively; α, β, and γ are the parameters to be estimated. $dlp_{ist} = \ln(P_{ist}) - \ln(P_{ist-1})$ is the log difference in unit prices in TL. Product and sector level imports and exports prices were obtained from TurkStat. Similarly, $dle_{pt} = \ln(E_{pt}) - \ln(E_{pt-1})$ is the log difference in bilateral nominal exchange rate (expressed as units of importer's currency per unit of the exporter currency) so that increase represents depreciation in domestic currency. Exchange rates were taken from the Central Bank of Turkey. Z_{pt} includes controls for the US and Euro area CPI and GDP growth, Turkish CPI growth and product or sector dummies. Both CPI and GDP data were taken from Eurostat. Finally ε_{st} is an error term.

The coefficient β is the main interest and shows the average degree of pass-through when there is a 1 % change in the exchange rates. When β=0, unit prices are unaffected by the change in bilateral exchange rates. For import (export) prices, if β=1 (β=-1), import (export) unit prices in TL respond one-to-one with the bilateral exchange rates. More generally, 0< |β|<1, so that at least part of the exchange rate movements are passed on to the unit prices.

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[6] Craig and Sato (2006), Gopinath et al. (2010), Choudhri and Hakura (2015), Fabling and Sanderson (2015), and Devereux et al. (2017).

Equation 1 can be modified as follows to account for the implications of pass-through for

the goods used for different purposes: Consumption (C), capital (CP) and intermediate (I) goods.

$$dlp_{ist} = \alpha_0 + \alpha_1 * D_j + \beta_1 dle_{pt} + \beta_2 dle_{pt} * D_j + \gamma\, Z_{pt} + \varepsilon_{ist}, \quad \text{i=M, X ; j=C, CP, I} \qquad (2)$$

where D_C, D_{CP}, and D_I are dummies that take the value of one if the product is consumption, capital

or intermediate goods otherwise zero, respectively. In this case β_1 measures the degree of pass-

through for products other than j, while β_2 represents the differencing impact. Then, pass-through

to the product j prices will be $\beta_j = \beta_1 + \beta_2$.

Table 7 presents the results for overall pass–through and for each of the BEC product types.

Positive coefficient in import function implies an increase in prices with the rise in exchange rates

or depreciation in domestic currency; negative coefficient in export function suggest a fall in prices

with the depreciation in domestic currency. The overall exchange rate pass-through to import

prices is approximately 18 %, while it is -20 % to export prices. Export prices seem to be more

sensitive to the changes in exchange rate.

Table 7: Exchange rate pass-through estimates for BEC (Equation 1)

	For import prices			For export prices		
	β_1	β_2	$\beta_p = \beta_1 + \beta_2$	β_1	β_2	$\beta_p = \beta_1 + \beta_2$
Overall	0.182***	…	…	-0.195***	…	…
Consumption goods	0.208***	-0.070	0.138***	-0.228***	0.085***	-0.143***
Capital goods	0.175***	0.080	0.255**	-0.186***	-0.064	-0.250***
Intermediate goods	0.172***	0.022	0.194***	-0.181***	-0.034	-0.215***

Notes: The pass-through coefficients for the different products are obtained using interaction terms, and therefore there is one set of coefficients for the other types of explanatory variables. Each regression included BEC product and time fixed effects. Standard errors are clustered at the BEC level. ***, **, * denote significance at 1%, 5% and 10% level, respectively.

The pass-through coefficients for different types of goods are significant and absolute

values lie between zero and 1. However, except for the one case (consumption goods export

prices) estimated β_2 coefficients are not significant, suggesting that the pass-through does not significantly differ depending on the product type. Given that, the pass-through to consumption goods price is lower than the other types of goods and the difference is statistically significant to export prices. Capital goods prices (both import and export) are more sensitive than intermediate goods prices.

Compared to the earlier studies, over all our findings for Turkey are lower than those found for developed countries such as Canada (Devereux et al., 2017) and New Zealand (Fabling and Sanderson, 2015), but higher than those for East Asian countries including Indonesia, Malaysia, Philippines and Thailand (Parsons and Sato, 2006). Considering that Turkey is an emerging country with good trade linkages, these are plausible outcomes.

3.2. How effective are importers' and exporters' currency choice for invoicing on the exchange rate pass-through?

In the first and second specification β coefficients do not vary according to the invoicing currency. To assess the implications of different invoicing currency choices for the pass-through dynamics, in line with Devereux et al (2017) model above can be modified as follows:[7]

$$dlp_{ist} = a_0 + a_1 * D_D * D_j + a_2 * D_E * D_j + a_3 * D_{TL} * D_j + \beta_1 dle_{pt} + \beta_2 dle_{Dt} * D_D * D_j +$$

$$\beta_3 dle_{Et} * D_E * D_j + \beta_4 dle_{TLt} * D_{TL} * D_j + \theta_{st} Z_{pt} + \varepsilon_{st}, \quad i=M, X; j=C, CP, I. \tag{3}$$

Here, D_D, D_E, and D_{TL} are dummies that take the value of one if the product is priced in the US dollars, euros or TL otherwise zero, respectively. In this case β_1 measures the degree of pass-through for products priced in currencies other than the US dollars, euros and TL. Then, pass-

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[7] Gopinath et al. (2010), Devereux et al. (2017) and Fabling and Sanderson (2015).

through to the US-dollar-priced, euro-priced and TL-priced products will be $\beta_D = \beta_1 + \beta_2$, $\beta_E = \beta_1 + \beta_3$ and $\beta_{TL} = \beta_1 + \beta_4$, respectively.

Results from the estimation of specification (3) are reported in Table 8. First and fifth columns report the results for overall data, in other words when no product dummies but only currency dummies are included. Overall, goods priced in the US dollars, euros and TL have higher pass-through than the goods priced in other currencies. Except for one case (capital goods import price) pass-through is higher for TL-priced goods than those for both US dollar and euro-priced goods. In all cases the difference between the coefficient estimates are statistically significant.

The trade pricing theory predicts that imported goods priced at local currency are less sensitive to changes in exchange rates. Results in Gopinath et al. (2010) for the US imports and Devereux et al (2017) for Canadian imports provides empirical evidences in line with the theory. Our findings suggest that use of local currency makes it more likely to reflect any movements in exchange rates on import prices. Meantime, exchange rate movements are passed on to export prices at a higher rate if goods are invoiced in local currency. Similar results are obtained in Bleaney (1997) for Japanese real export prices and Fabling and Sanderson (2015) for New Zealand exports.

Fabling and Sanderson (2015) explain that degree of price stickiness generates a mechanical link between invoice currency and exchange rate pass-through and if nominal prices are most stick in the invoice currency then it is possible to have higher coefficient for local currency priced goods. For the Turkish case Table 1 and 2 show that the share of TL as the invoice currency is considerably lower than local currency shares reported in the studies above. Also it is

highly likely that number of trade partners agree to price in TL are quit limited and specific. Difficulties in conducting international trade contracts in TL may lead rigidities in prices. [8]

Besides, after 2005 with the implementation of stabilization programs as a response to the 2000/2001 financial crises Turkish economy demonstrated an outperforming trend in growth and trade. As a result it is observed that the value of TL fluctuated relatively at a higher rates which may result in prices to be more sensitive to changes in values of TL.

Table 8: Exchange rate pass-through and currency choice for BEC classifications (Equation 3)

	Imports				Exports			
	Overall	C	Cp.	I	Overall	C	Cp.	I
β_1	0.274***	0.201***	0.184***	0.231***	-0.280***	-0.220***	-0.200***	-0.227***
	(0.039)	(0.030)	(0.029)	(0.036)	(0.024)	(0.016)	(0.018)	(0.024)
β_2	0.122**	0.437	0.972***	-0.271	-0.218***	-0.293	-0.681***	-0.003
	(0.058)	(0.290)	(0.247)	(0.218)	(0.048)	(0.199)	(0.139)	(0.215)
β_3	0.300***	0.337***	0.519**	0.270***	-0.315***	-0.224***	-0.583***	-0.330***
	(0.031)	(0.058)	(0.246)	(0.061)	(0.029)	(0.062)	(0.068)	(0.061)
β_4	-1.059***	-0.946***	-1.175***	-0.926***	1.073***	0.870***	1.201***	0.958***
	(0.100)	(0.083)	(0.292)	(0.132)	(0.063)	(0.067)	(0.083)	(0.069)
β_D	0.396***	0.638**	1.155***	-0.039	-0.498***	-0.513**	-0.881***	-0.230
β_E	0.574***	0.538***	0.703***	0.501***	-0.595***	-0.444***	-0.783***	-0.558***
β_{TL}	-0.785***	-0.745***	-0.991***	-0.694***	0.793***	0.650***	1.000***	0.731***
$\beta_{TL} + \beta_D$	-0.388***	-0.107***	0.164***	-0.734***	0.296***	0.138***	0.119***	0.501***
$\beta_{TL} + \beta_E$	-0.210***	-0.207***	-0.288***	-0.194***	0.198***	0.206***	0.217***	0.174***
$\beta_E - \beta_D$	0.178**	-0.100	-0.452**	0.540***	-0.097*	0.069	0.098	-0.327

Notes: The pass-through coefficients for the different products are obtained using interaction terms, and therefore there is one set of coefficients for the other types of explanatory variables. Each regression included BEC product and time fixed effects. C, Cp. and I stand for consumption goods, capital goods, and intermediate goods respectively. Standard errors are clustered at the BEC level. ***, **, * denote significance at 1%, 5% and 10% level, respectively

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[8] I would like to thank to referee for bring up this point.

Overall, for both imports and exports, the pass-through for euro-priced goods is significantly higher than those for the US dollar-priced goods (columns 1 and 5). Across the product types, for consumption goods it seems that pass-through for both US dollar and euro-priced goods are significantly differ from those for other currencies (except TL), but there is no significant difference between the impact of changes in these two currencies. For capital goods, the pass-through is significantly higher on the US dollar-priced imported goods, while there is no significant difference in pass-through to either US dollar or euro-priced exported capital goods.

The case of intermediate goods is interesting for the purpose of the study, since the results for intermediate goods also hinges information on the link between production chains, invoicing currency and pass-through behavior. Investigation of columns 4 and 8 reveals that pass-though is higher for TL-priced goods. Neither import nor export responds significantly for the US dollar-priced intermediate goods, while pass-through to euro-priced intermediate goods could be more than a half %. There may be several explanations for the non-significance of pass-through for the US dollar-priced intermediate goods including the use of the US dollars as a vehicle currency, flexibility or competitiveness in the US dollar-priced goods markets, use of the US dollars in both exports and imports of a particular goods so that no need for currency exchange, etc.[9]

Further insights from the analyses may be obtained by comparing the estimated pass-through coefficients across the product types. Capital goods prices seem to be the most sensitive to the changes in exchange rates. For imports estimated coefficients for the US dollars, euro and TL-priced goods are systematically lower for intermediate goods. For exports, outcome is little bit mix: estimated coefficient for the US dollar-priced goods is not significant on intermediate goods

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[9] Goldberg and Tille (2008) argue that use of the dollar in trade flows that do not involve the United States reflects trade in homogeneous products where firms need to keep their price in line with their competitors'.

but the estimated coefficient for euro and TL-priced goods are systematically lower for consumption goods.

3.3. Does the globalization of production across the countries have a role in the pass-through process?

Table 7 and 8 report some evidence on the differing impact of exchange rate movements on prices of products used for different purposes: The pass-through to intermediate goods prices displays relatively different pattern. The results suggest that the global production linkages may affect pass-through dynamics.

At this stage of our analysis we would like to incorporate TiVA data and test directly the importance of GVC on the pass-through dynamics. There are several indicators in TiVA database. The one called foreign value-added in gross exports is used often as an indicator for globalization. Indicators are available for 36 ISIC industries, between 2005 and 2016. We took the period average of the selected indicator for each sector and ranked them to find the sectors in upper and lower quantile of the globalization range. In order to assess the implications of GVC for the pass-through dynamics directly we modified Equation 1 as follows:

$$dlp_{ist} = a_0 + a_1 GVC_{stq} + \beta_1 dle_{pt} + \beta_2 dle_{pt} * GVC_{stq} + \gamma Z_{pt} + \varepsilon_{ist}, \text{ i=M, X; q=1, 4} \qquad (4)$$

Here we define a dummy variable GVC that takes value of 1 if the computed shares are in the lower or upper quantile. In this case β_1 measures the degree of pass-through for sectors having above (below) or lower (upper) quantile degree of GVC. The coefficient β_2 measures the difference in the responses. Then, the pass-through to prices of sectors examined will be $\beta_{GVC} = \beta_1 + \beta_2$.

The results from the estimation of Equation 4 are reported in Table 9. On the import side, although difference coefficients are not significant, sectors in low and high quantile GVC tend to have a higher pass-through compared to those in the middle range and the rate is relatively higher for the sectors in low quantile. This is an interesting result and suggests that there is a U-shaped relationship between the GVC and the exchange rate pass-through.[10]

On the export side there is evidence that pass-through on export prices significantly gets lower with an increase in GVC. Together with the results in Table 7, this result implies that firms involving with GVC, tend to reduce consumption goods export prices.

Table 9: Exchange rate pass-through and globalization (Equation 4)

	Lower quantile		Upper quantile	
	Imports	Export	Imports	Export
β_1	0.255***	-0.232***	0.266***	-0.247***
	(0.017)	(0.023)	(0.022)	(0.016)
β_2	0.041	-0.044	0.001	0.009**
	(0.039)	(0.030)	(0.034)	(0.048)
β_{GVC}	0.296***	-0.276***	0.267***	-0.237***

Notes: The pass-through coefficients for the different level of GVC are obtained using interaction terms, and therefore there is one set of coefficients for the other types of explanatory variables. Each regression included ISIC sector and time fixed effects. Standard errors are clustered at the ISIC level. ***, **, * denote significance at 1%, 5% and 10% level, respectively

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[10] Auer and Schoenle (2016), Garetto (2016) and Devereux et al. (2017) report a U-shaped relationship between foreign supplier market share and exchange rate pass-through: both small and very large exporting firms tends to have higher pass-through than firms with intermediate market size. Note that a similar pattern can be observed between the GVC and exchange rate pass-through.

3.4. Does the exporters' and importers' currency choice for invoicing in sectors with high degree of globalization have different implications on exchange rate pass-through?

Equation 3 and 4 can be combined as follows to examine the relevance of invoicing currency and GVC for the pass-through.

$$dlp_{ist} = a_0 + a_1 D_D * GVC_{stq} + a_2 D_E * GVC_{st} + a_3 D_{TL} * GVC_{stq} + \beta_1 dle_{pt} + \beta_2 dle_{Dt} * D_D * GVC_{stq} + \beta_3 dle_{Et} * D_E * GVC_{stq} + \beta_4 dle_{TLt} * D_{TL} * GVC_{stq} + \theta_{st} Z_{pt} + \varepsilon_{ist},$$

i= M, X; q=1, 4   (5)

GVC and currency dummies are interacted with the exchange rates to capture how different is the pass-through to different invoicing currencies in those sectors in low and high quantile range of globalization. Accordingly, pass-through to the US dollar-priced, euro-priced and TL-priced sectors with low or high level of GVC will be $\beta_{D\_GVC} = \beta_1 + \beta_2$, $\beta_{E\_GVC} = \beta_1 + \beta_3$ and $\beta_{TL\_GVC} = \beta_1 + \beta_4$, respectively.

Table 10 supports the results in Table 9: Sectors in low and high quartile range of GVC display higher pass-through and rates are relatively high for sectors in the low quantile range. In addition, in all but one case (US dollar-priced goods in export) the pass-through is significantly differs for the US dollar, euro and TL-priced goods. Globalization amplify the rate of pass-through to TL-priced goods the most; euro-priced goods the least. For the US-priced goods in exports, pass-through difference is not significant for sectors in high GVC range. This finding is also consistent with the findings in Table 8: pass-through to the US dollar-priced intermediate goods exports is insignificant.

Table 10. Exchange rate pass-through, invoicing currency and globalization of production (Equation 5)

	Lower quantile		Upper quantile	
	Imports	Export	Imports	Export
β_1	0.291***	-0.265***	0.308***	-0.281***
	(0.020)	(0.023)	(0.025)	(0.022)
β_2	0.400**	-0.449***	0.334**	-0.241
	(0.166)	(0.131)	(0.145)	(0.185)
β_3	0.285**	-0.249***	0.259***	-0.251***
	(0.056)	(0.072)	(0.057)	(0.089)
β_4	-1.086***	1.059***	-1.085***	1.001***
	(0.093)	(0.049)	(0.071)	(0.134)
β_{D_GVC}	0.692***	-0.714***	0.642***	-0.521***
β_{E_GVC}	0.577***	-0.514***	0.567***	-0.532***
β_{TL_GVC}	-0.794***	0.794***	-0.778***	0.721***
$\beta_{TL\_GVC} + \beta_{D\_GVC}$	-0.102	0.081	-0.136	0.199*
$\beta_{TL\_GVC} + \beta_{E\_GVC}$	-0.217***	0.280***	-0.211***	0.189***
$\beta_{E\_GVC} - \beta_{D\_GVC}$	-0.115	0.200	-0.075	-0.010

Notes: The pass-through coefficients for the different level of GVC are obtained using interaction terms, and therefore there is one set of coefficients for the other types of explanatory variables. Each regression included ISIC sector and time fixed effects. Standard errors are clustered at the ISIC level. ***, **, * denote significance at 1%, 5% and 10% level, respectively

4. Conclusion

In this paper, we examine the linkage between exchange rate-pass-through, invoicing currency choice in international trade and global trade in value-added. We used 3-digit product level BEC data and 2-digit sector level ISIC Rev.3.2 data to detect how the use of different invoicing currencies and being attached to global value-chain affect pass-through to import and export prices in an outperforming emerging country, Turkey. In our model of trade pricing, pass-through of exchange rates to import and export prices vary depending on the product type. Also, we extend the model by accounting for the choice of currency invoicing and the extent of global value chain.

There is evidence on the high pass-through to domestic currency-priced goods. Compared to the results for developed countries, size of the pass-through coefficients are larger no matter which currency is used for invoicing. There are indications on the reducing pass-through affects with the trade in value-added or production sharing. This result is evident particularly for those goods priced in the US dollars, which is at the same used as a vehicle currency in trade between non-US and non-European countries. The results suggest that trade linkages and invoiced currency choice are important to understand exchange rate pass-through: stronger integration to world market and widespread preference of invoiced currency may smooth out the adjustments in prices as a response to the exchange rate movements.

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Appendix

Table A1: Exchange rate pass-through and currency choice for BEC classifications (Equation 3, Excluding TL)

	Imports				Exports			
	Overall	C	Cp.	I	Overall	C	Cp.	I
β_1	0.151***	0.167***	0.175***	0.183***	-0.161***	-0.185***	-0.187***	-0.189***
	(0.028)	(0.029)	(0.027)	(0.030)	(0.016)	(0.018)	(0.015)	(0.018)
β_2	0.240**	0.468	0.976***	-0.226	-0.331***	-0.325	-0.693***	-0.038
	(0.053)	(0.288)	(0.244)	(0.221)	(0.045)	(0.198)	(0.137)	(0.216)
β_3	0.388***	0.359***	0.522**	0.303***	-0.400***	-0.247***	-0.591***	-0.356***
	(0.033)	(0.059)	(0.242)	(0.061)	(0.032)	(0.065)	(0.067)	(0.061)
β_D	0.391***	0.635**	1.151***	-0.043	-0.492***	-0.510**	-0.880***	-0.227
β_E	0.539***	0.526***	0.697***	0.486***	-0.561***	-0.432***	-0.778***	-0.545***
$\beta_E - \beta_D$	0.148**	-0.109	-0.454**	0.529***	-0.069*	0.077	0.102	-0.318

Notes: The pass-through coefficients for the different products are obtained using interaction terms, and therefore there is one set of coefficients for the other types of explanatory variables. Each regression included BEC product and time fixed effects. . C, Cp. and I stand for consumption goods, capital goods, and intermediate goods respectively. Standard errors are clustered at the BEC level. ***, **, * denote significance at 1%, 5% and 10% level, respectively

Table A2. Exchange rate pass-through, invoicing currency and globalization of production (Equation 5, Excluding TL)

	Lower quantile		Upper quantile	
	Imports	Export	Imports	Export
β_1	0.253***	-0.232***	0.253***	-0.232***
	(0.013)	(0.018)	(0.017)	(0.015)
β_2	0.434**	-0.479***	0.383**	-0.283
	(0.164)	(0.129)	(0.141)	(0.187)
β_3	0.314***	-0.274***	0.300***	-0.287***
	(0.055)	(0.074)	(0.057)	(0.090)
β_{D_GVC}	0.687***	-0.710***	0.635***	-0.516***
β_{E_GVC}	0.567***	-0.506***	0.553***	-0.519***
$\beta_{E\_GVC} - \beta_{D\_GVC}$	-0.120	0.205	-0.082	-0.004

Notes: The pass-through coefficients for the different level of GVC are obtained using interaction terms, and therefore there is one set of coefficients for the other types of explanatory variables. Each regression included ISIC sector and time fixed effects. Standard errors are clustered at the ISIC level. ***, **, * denote significance at 1%, 5% and 10% level, respectively

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