EXCHANGE RATE VOLATILITY AND DISAGGREGATED MANUFACTURING EXPORTS: EVIDENCE FROM VIETNAM

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Abstract

The link between export performance and exchange rate policy has attracted attention from the policymakers, academics, and practitioners for an extended period of time, in particular for the developing countries. In particular, within this link, export performance at the disaggregated level has been largely ignored in Vietnam. Vietnam' policy to devalue its currency in recent years has been considered as an important factor to enhance export performance. However, it is argued that such a policy could result in the exchange rate volatility, which in turn is harmful exports. The study is conducted to provide empirical evidence on the link between exchange rate volatility and exports for the manufacturing sectors as well as its industry levels between Vietnam and her 26 key exporting partners during the 2001-2015 period. Potential factors that could affect this relationship such as the global financial crisis; Vietnam's participation to the World Trade Organization (WTO), or even the geographic structure of Vietnam's trading partners are also considered in this study. Findings from this study confirm that a strategy of depreciating Vietnam' currency appears to enhance manufacturing exports, especially at industry levels whereas exchange rate volatility has provided no clear effect on Vietnam's manufacturing exports. However, findings from this study also indicate that effects from such policy may provide different impact on different trading partners to Vietnam depending on their geographic location.

Keywords: Exchange rate volatility, Export Performance; Disaggregated Manufactures, Vietnam

JEL Code: F10, F14, F31

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1. Introduction

An impact from exchange rate volatility on exports has gained a great degree of interest among policy makers, economists, and practitioners (exporters and importers in particular). This impact plays an increasingly important role in many emerging countries in Asia and South America, where exports have been considered as an engine in export-orientated growth models (Kandilov, 2008). It is widely believed that an increase in exchange rate volatility may have a fatal impact on an economy and its trade, and this impact is even more serious in emerging nations where capital markets are likely to be underdeveloped (Prasad, Rogoff, Wei, & Kose, 2003). In the context of Vietnam, a comprehensive understanding of the nature and magnitude of the nexus between exchange rate volatility and exports is of great importance to policy makers. Unfortunately, this important issue has been largely ignored.

In Vietnam, there have been debates on the issue of Vietnam' currency depreciation (or devaluation in a more accurate language) in recent years. Some believe that this strategy would enhance export performance whereas this could result in the exchange rate volatility, which in turn may have a harmful effect on growth. This paper aims to provide empirical evidence to the link between exchange rate volatility and exports at the disaggregated level in Vietnam over the period of 15 years from 2001 to 2015. To our best knowledge, very few studies have been conducted in Vietnam, thus our study attempts to fill this gap. More details, the contributions of this paper are presented as follows. *First*, a panel model is used to consider the relationship of two main variables of interests, being the exchange rate volatility and export with a special focus on manufacturing sectors as well as other ten manufacturing industries between Vietnam and the country's 26 major exporting partners.[1] These 26 partners make up a significant share in Vietnam exports as compared to the world, together with the manufacturing sector playing a substantial role in the Vietnam's export structure. It is argued that in recent year Vietnam has been a preferred destination for the supply chain production by many multinational corporations (MNCs) thanks to the China's currency depreciation (Hooy, Siong-Hook, & Tze-Haw, 2015). *Second*, with regard to exchange rate volatility measurement, this paper takes various alternatives into consideration for the purpose of a comparability as well as a robustness test. *Third*, we reexamine the effect of exchange rate volatility on exports in three different regions (Asia, European, and America) on the view that the

[1] Ten sub-industries of manufacturing sectors are presented in Appendix 1 and Vietnam's 26 exporting partners are shown in Appendix 2.

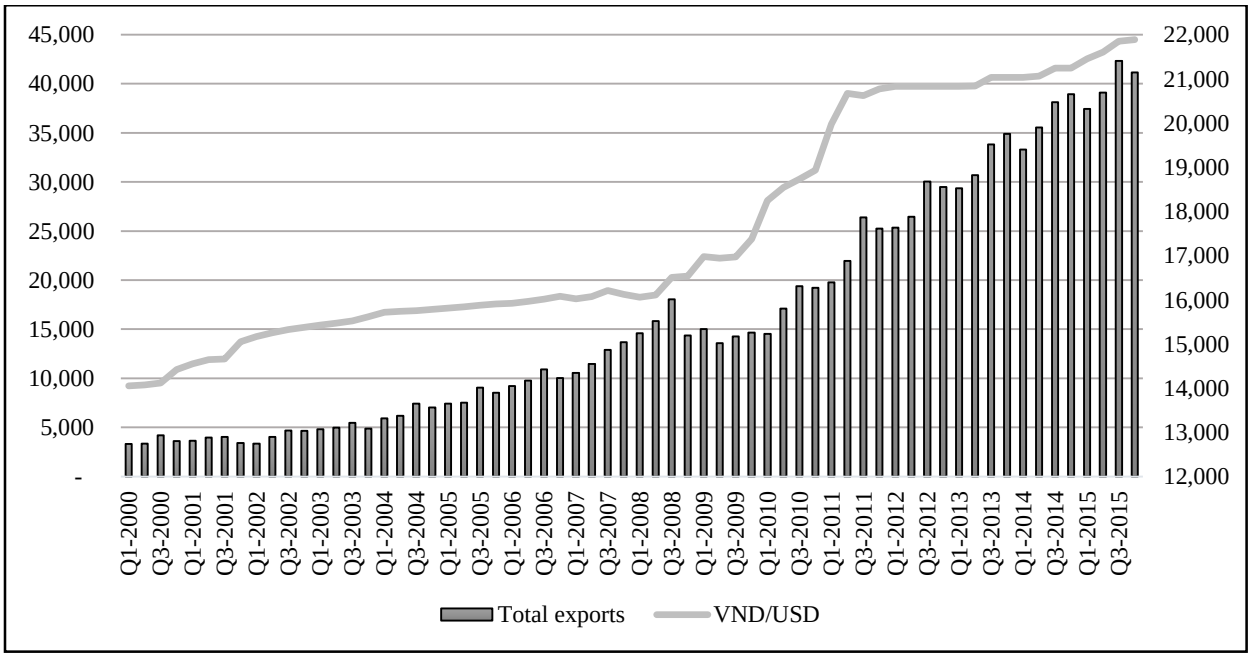
manufacturing exports between Vietnam and the country's partners in different regions may be influenced by such geographic factors as geographic distance, political and economic relationship, and some others. Therefore, separating the entire data into three sub-samples allows to explore whether locations contribute to the impact on the nexus between exchange rate volatility and manufacturing exports in Vietnam.

The structure of this paper is as follows. Following this Introduction, information about manufacturing exports and a trend of exchange rate volatility in Vietnam are briefly discussed in Section 2. Section 3 summarizes relevant theories and empirical studies related to exchange rate volatility and exports. Model specification is presented in section 4. Section 5 presents data description and empirical results, followed by discussions, conclusions, as well as policy recommendations presenting in Section 6 of the paper.

2. Overview of Vietnam's exports and exchange rate volatility

This section provides a contemporary state of total exports in Vietnam over a 2000-2015 period, together with changes experiencing in the exchange rate of Vietnam Dong (VND) against US Dollar (USD).

Figure 1. Quarterly Vietnam's Total Exports and VND/USD



Source: International Financial Statistics (IFS)

Figure 1 presents the quarterly values of Vietnam's exports using a bar chart, with units dominated in million USD and the line depicts the trend in the VND/USD exchange rate from 2000 to 2015. Vietnam's exports experienced an upward trend over the timeframe considered. The total value of exports started at around 3,000 million USD in the first quarter of the year 2000, gradually increased to approximately 18,000 million USD in the third quarter of 2008, and then had a slight decrease during 2009 global financial crisis. After that, the increase was even more significant during the 2009-2015 period than the previous period to end at over 40,000 million USD in 2015. With regard to exchange rates, the line graph showed an upward trend from nearly 10,000 VND per USD in 2000 to approximately 22,000 VND per USD in 2015, indicating the depreciation of VND of more than 120 per cent over the selected period. The most striking note is that after the global financial crisis, the exchange rate depreciated dramatically at just under 16,000 VND per USD in the third quarter in 2008 to almost 21,000 VND per USD in the third quarter in 2011, making it a depreciation of around 30 per cent over the period of three years.

Table 1 indicates the breakdown of total exports and manufacturing exports in four separated years, for illustration purpose, over the period between 2000 and 2015. With respect to the total exports, the period experienced a remarkable soar in total exports from around USD 14.5 billion in 2000 to 162 billion in 2015, an increase over tenfold, and the similar trend was seen in Vietnam's exports with other 26 major countries. These main partners accounted for an overwhelming majority of over 80 per cent in Vietnam's total exports. When it comes to the manufacturing exports, a more amazing pattern was found when the export values rocketed from under USD 10 billion in 2000 to over USD 150 billion in 2015, more than 15 times increase over the course of 15 years. The proportion of manufacturing goods over the total export with major trading partners remains stable of over 80 per cent as their values also run parallel to the total export values. The ratio of manufacturing goods to Vietnam's exports had increased substantially from 63 per cent in the year 2000 to 93 per cent in 2015.

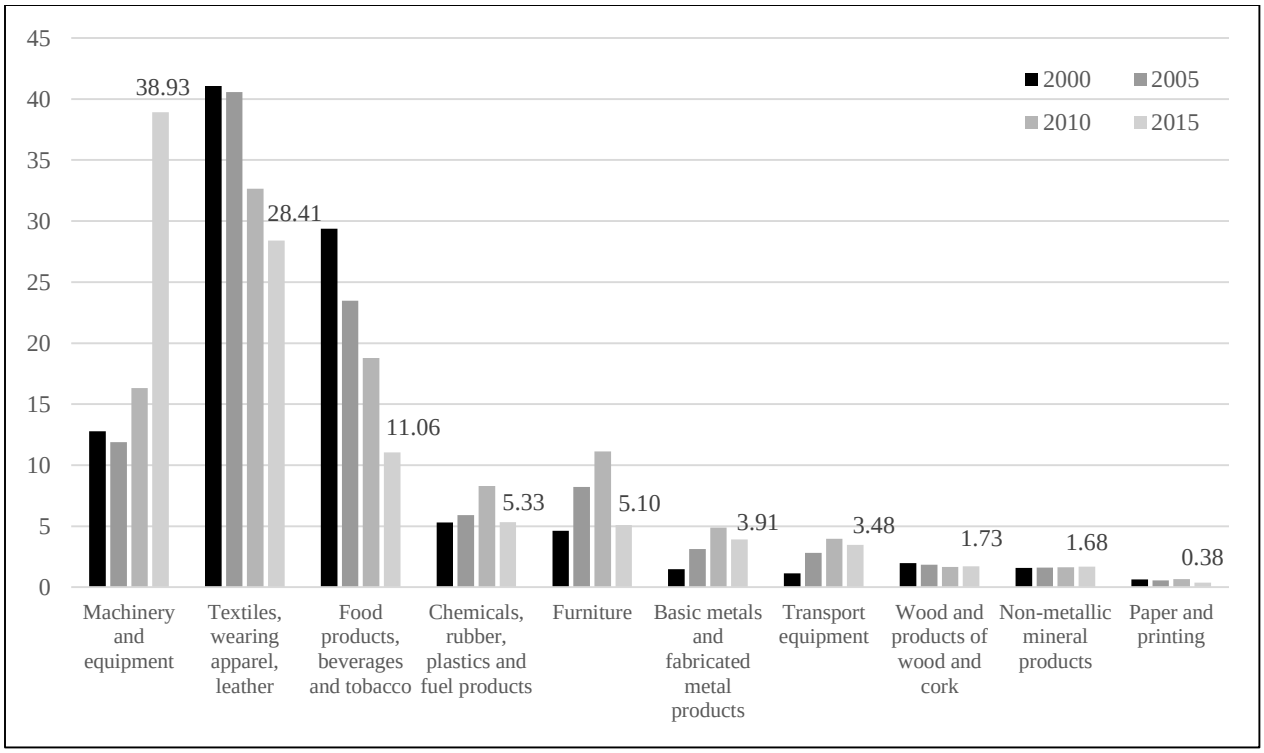
Table 1. The breakdown of total exports and manufacturing exports in Vietnam

Year	*Total exports*			*Manufacturing exports*			Manufacturing /Total exports (%)
	World ($ billions)	Major partners ($ billions)	Percent (%)	World ($ billions)	Major partners ($ billions)	Percent (%)	
2000	14.48	12.33	85.1	9.14	7.40	81.0	63.1
2005	32.45	28.86	88.9	21.77	18.68	85.8	67.1
2010	72.24	61.49	85.1	59.56	49.93	83.8	82.4
2015	162.02	136.91	84.5	150.01	126.86	84.6	92.6

Source: OECD Statistics

A closer look at Vietnam's manufacturing sectors is illustrated in Figure 2, which presents the percentage of exporting values of each industry in the manufacturing sector in four different years during the period from 2000 to 2015. Importantly, these proportions had changed significantly over the period surveyed. In 2000, *Textiles, wearing apparel, leather*, comprising just over two fifths, was the largest industry contributing to the manufacturing exports, and it is followed by *Food products, beverages, and tobacco*, which accounted for nearly a third of total manufacturing exports. The industry had still consisted of a majority of nearly 30% from 2000 to 2010, but in 2015 it was overtaken by *Machinery and equipment* to be the most significant contributor, which witnessed a considerable rise from nearly 13% in 2000 to just under two fifths in 2015. The proportion of *Food products, beverages and tobacco* had gradually declined to end the period at just over one tenth. The share of exporting values of *Chemicals, rubber, plastics and fuel products* was higher by 0.7% than that of *Furniture* in 2000, but the gap was almost marginal in 2015 as the former remained unchanged whereas the later increased slightly. Other industries made up a miniscule part in the total values of manufacturing exports throughout the period.

Figure 2. The exporting share of each industry in the manufacturing sector (%)



Source: OECD Statistics

Based on the above statistics, some observations can be summarized as follows. *First*, the manufacturing sector plays an increasingly important role in Vietnam's exports with regard to values and the share of total exports. *Second*, there has been a significant variation in Vietnam's manufacturing export structures with the trend towards the export of machinery and equipment products. *Third*, the domestic currency VND has experienced a depreciation over the period which has raised the potential link between exchange rate and exports in Vietnam.

3. Literature Review

It has been well documented that exchange rate policy is considered as an important determinant of exports. Some research has stemmed to examine the effect of exchange rate on exports. For example, Hooy et al. (2015) investigated the effect of Renminbi real exchange rate on ASEAN exports to China. Although the real exchange rate was found to be positively related to ASEAN exports, its effects on disaggregated level were mixed. The depreciation of Renminbi real exchange rate had a positive impact on high- and medium-tech finished goods, as well as parts and components exports, and no effects on basic goods, low-tech, resource-based and primary

products. Recently, in the study by Atif, Haiyun, and Mahmood (2017), exchange rate is an essential factor of agricultural exports in Pakistan.

Another stream of research has emerged to assess the impact of exchange rate changes to exports. Various studies have approached this matter at theoretical level. More specifically, it is proposed that if individuals are assumed to be risk-adverse, an increase in exchange rate changes would lead to a higher uncertainty in transaction costs, triggering a decrease in volume of trade (Hooper & Kohlhagen, 1978). In contrast, De Grauwe (1988) made an argument that exchange rate volatility may offer a favored effect on trade volume depending on the extend of risk aversion. The worst possible outcome seems to be most concerned by very risk-averse people so that they would export more to prevent a drastic decrease in their revenue.

Empirically, some studies have utilized the aggregate trade data between one nation and the rest of the world while others have used the disaggregated data among a group of countries or disaggregated data at commodity or sector levels. For example, in the research by Asteriou, Masatci, and Pılbeam (2016), the relationship between exchange rate volatility and trade volume was investigated in four different nations including Mexico, Indonesia, Nigeria, and Turkey with the rest of the world. These authors adopted the autoregressive distributed lag (ARDL) bound testing method to address the long-run association and the Granger causality test to detect the short-run relationship. In the long run, it was concluded that Turkey had solely a marginally negative association between exchange rate volatility and trade volumes. In the short run, Indonesia and Mexico experienced the casual relationship between these two. In their study, Hsu and Chiang (2011) found the negative effect of exchange rate volatility between US and her 13 major trading partners and this finding was still consistent when the sample size was widen up to 30 countries. Regarding to disaggregated data, Choudhry and Hassan (2015) reported the importance of exchange rate fluctuations in the UK imports from Brazil, China and South Africa using the asymmetric ARDL model. The impact of financial crisis on the limk between volatility and imports was also taken into consideration. Thus, policy makers should be cautious in their decision as any policy actions or trade adjustment programs may bring uncertain outcomes if the exchange rate becomes volatile.

Empirical studies on the relationship between exchange rate volatility and trade has employed the disaggregated data at commodity or sector levels. Bahmani-Oskooee, Harvey, and Hegerty (2013) investigated the impact of exchange rate volatility on the bilateral imports and

exports between Brazil and US over a 1971-2010 period with more than a hundred of industries. Several interesting findings are found. *First*, a vast number of selected industries are not affected by the exchange rate fluctuations and the positive links are significantly dominant as compared to the negative expectations. *Second*, the volatility has more significant impacts on small industries that account for smaller shares than larger ones. *Third*, each sector reacts differently in respond to the volatility, which is negatively related to agricultural exports in Brazil and has provided no impacts on importing machinery products in the US. In another analysis, Nishimura and Hirayama (2013) provided empirical evidence of the effect of exchange rate volatility on Japan-China trade. The findings illustrate that although the exchange rate variation does not affect Japan's exports to China, it has a negative influence on the reversed direction of exporting from China to Japan over the reform stage. Based on the cointegration analysis and the bound testing approach, several authors have attempted to investigate the long-run and short-run relationship between exchange rate volatility and trade follows at industry levels between two countries. Typical pairs of countries used in studies include Malaysia and Thailand (Aftab, Syed, & Katper, 2017), Malaysia and Japan (Aftab, Syed, Ahmad, & Ismail, 2015), Malaysia and China (Soleymani & Chua, 2014), Canada and Mexico (Bahmani-Oskooee, Bolhassani, & Hegerty, 2012), US and China (Bahmani-Oskooee & Wang, 2007), to name a few.

One of the most concerned issues among researchers is the measure of exchange rate volatility as there is no universal consensus for this proxy in the study. As a result, multiple proxies have been employed to represent volatility, three of which are widely adopted in empirical studies. The first is the standard deviation of the percentage change of exchange rate (Chit, 2008; Hayakawa & Kimura, 2009). The second measure of volatility is the moving average standard deviation (MASD) of real exchange rate in logarithm terms (Chit, Rizov, & Willenbockel, 2010; De Vita & Abbott, 2004). The third proxy is based on conditional variance of exchange rate using the generalized autoregressive conditional heteroscedasticity (GARCH) model. While some scholars just adopt one proxy, others have used various alternatives as a robustness check. (De Vita and Abbott (2004)) made a comparison among three measures of exchange rate volatility in their study, which examined its effect on UK exports to other 14 European nations. The result indicates that MASD appears to be the most optimal volatility measure in the case of total exports and sub-sector exports from the UK to the whole group of nations, while there are a mix of different alternatives for exports from UK to each individual country.

In Vietnam, some scholars have been attempted to investigate the determinants of Vietnam's exports at aggregated levels. Some determinants are taken into consideration such as foreign direct investment (Xuan & Xing, 2008). Nguyen (2016) approached trade liberalization policy in Vietnam and its link to the level of export sophistication. The finding highlights the fact that non-manufacturing sectors are stronger impacted by trade liberalization as compared to the manufacturing field and that being a WTO membership does not have any impact on the level of export sophistication in Vietnam. In their analysis, Narayan and Nguyen (2016) used Vietnam as an empirical evidence to demonstrate how the variables of the gravity model were dependent on trading partners. The result indicates that the trading activities are more sensitive to rich nations than low income ones.

On balance, although there has been a debate over the nexus between exchange rate volatility and exports in literature, empirical findings also vary across studies due to the methodology differences, the volatility measurements, and the types of data used. In particular, no empirical studies have been conducted in the context of Vietnam. As such, policy in Vietnam lack of support from academic studies. And this is the key purpose of this paper.

4. Model Specification

Following previous studies (Aristotelous, 2001; Chit et al., 2010), the model used for an estimation effects of exchange rate volatility and exports is specified as follows:

$$\ln X_{cmt} = \alpha_{ct} + \beta_1 \ln GDP_{ct} + \beta_2 \ln GDP_{VNt} + \beta_3 \ln RP_{ct} + \beta_4 \ln REXR_{ct} + \beta_5 \mathrm{VOL}_{ct} + \beta_6 D_{WTO} + \beta_7 D_{Crisis} + \varepsilon_{ct}$$

Where X_{cmt} denotes the real export values in thousands of US Dollars of a manufacturing sector m at time t from Vietnam to her exporting partners c. GDP_{ct} and GDP_{VNt} represent real Gross Domestic Product (GDP) in a foreign partner country c and in Vietnam at time t, which are deflated by GDP deflator. The relative price RP_{ct} is the ratio between an index of the prices of import-substitute goods in the importing country and an index of the export prices for the exporting country. This relative price represents the substitution effect as importers frequently compare the price of imports with that of the domestic price level. An alternative measure of relative price in many empirical studies is calculated by the ratio of consumer price index (CPI) of an importing country to the wholesale price index (WPI) of the exporting countries (Doyle, 2001; Sauer & Bohara, 2001). However, the WPI is not readily available for Vietnam. As a result, CPI is used as

an alternative in this study. RP_{ct} is measured by the ratio of CPI of exporting partners to the CPI of Vietnam. The bilateral real exchange rate REXR between Vietnam Dong and partner's currency is measured as the RP_{ct} multiplied by the bilateral nominal exchange rate which is calculated as a number of the Vietnam Dong per a unit of partners' currency. Therefore, an increase in the value of real exchange rate indicates a depreciation of the Vietnam Dong. Finally, a dummy variable D_{WTO} takes the value of 1 since 2007 when Vietnam has officially entered World Trade Organization (WTO) on 11 January 2007 and another dummy D_{Crisis} is equal unit in 2009, the year of global financial crisis.

As previously discussed, there are a wide range of volatility measures adopted in the empirical studies. However, in this paper, for a particular nation, we apply the conditional volatilities of the exchange rates estimated using a General Autoregressive Conditional Heteroscedasticity (GARCH) model for volatility measurement. Additionally, the moving average standard deviation (MASD) of the log of bilateral real exchange rate is an alternative as a robustness check because this proxy is arguably proved to be more appropriate than standard deviation of the percentage changes of exchange rate (De Vita & Abbott, 2004). The MASD is calculated as follows:

$$VOL_{MASD\,ct} = \sqrt{\frac{\sum_{i=0}^{n}(e_{cit-k-1} - e_{cit-k-2})^2}{n}}$$

It is vitally important to adopt the appropriate GARCH model for estimating the exchange rate volatility. The step begins with checking the appearance of ARCH effects by using ARCH-LM heteroscedasticity test, and then selecting the length of the optimal lag for each individual series using the AIC criteria. Although a few studies have attempted to use various lag lengths in the GARCH model (Asteriou et al., 2016), empirical evidence has confirmed the GARCH(1,1) model as the most appropriate measure of exchange rate volatility (Chit et al., 2010; Erdem, Nazlioglu, & Erdem, 2010). In a recent investigation by Vieira and MacDonald (2016), GARCH(1,1) appears to be dominant among various types of ARCH models in measuring the volatility when it is found up to 75 out of 106 ARCH series. In addition, Hansen and Lunde (2005) confirmed that the GARCH(1,1) model is more superior to other complicated GARCH models when they took 330 ARCH-type specifications into consideration. In this sense, the GARCH(1,1) will be utilized in this study for exchange rate volatility measurement.

The GARCH model includes two equations, including (i) mean equation; and (ii) the conditional variance equation. In the condition that the log difference of quarterly exchange rate follows the random walk, the GARCH model is employed for a measurement of volatility. As for GARCH(1,1), these two equations are constructed as follows:

$$e_{ct} = \alpha_0 + \alpha_1 e_{ct-1} + \mu_{ct}, \quad \text{where } \mu_{ct} \sim N(0, h_{ct}), \text{ and}$$

$$VOL_{GARCH} = h_{ct} = \beta_0 + \beta_1 \mu_{ct-1}^2 + \beta_2 h_{ct-1},$$

The conditional variance equation of GARCH(1,1) consists of a constant β_0, an ARCH term μ_{ct-1}^2, and a GARCH term h_{ct-1}. We directly employ the monthly data into the GARCH model and the volatility of each year is an average of monthly conditional variance.

The fixed effects model is used due to the potential appearance of endogeneity. The endogeneity problem can result from two elements. The first one is endogeneity bias. It is possible that the particular country implements policies to reduce the bilateral exchange rate volatility (by begging its currency toward strong currency such as the USD) in order to enhance export performance. The second element is that individual effects may vary over time as a result of omitted macroeconomic shocks.

5. Data & Results

5.1. Data

In this study, we use a panel data to investigate the relationship between the exchange rate volatility and manufacturing exports in Vietnam during the 2001-2015 period, as well as other ten industries of manufacturing sectors of Vietnam. Data was collected from various resources. Specifically, the annually real GDP of Vietnam and her exporting partners are original from World Bank Indicators, while the annually values of manufacturing exports are in Organization and Economic Co-operation and Development (OECD) statistics. Monthly bilateral nominal exchange rate and different kinds of price index such as Consumer Price Index (CPI), GDP deflator are from International Financial Statistics (IFS) and European Central Bank (ECB). Table 2 provides a summary of descriptive statistics of data used in the study.

Table 2. The data description

Variable	Obs.	Mean	Std. Dev.	Min	Max
Partner's GDP	390	6.798	1.427	1.727	9.717
Vietnam GDP	390	6.935	0.527	6.107	7.655
Relative Price	390	0.107	0.275	-0.476	0.754
Bilateral real exchange rate	390	7.703	2.651	0.385	10.705
VOL_MASD100	390	3.110	2.960	0.506	14.165
VOL_GARCH100	390	0.194	0.422	0.007	2.020
Manufacturing exports	390	13.549	1.434	9.057	17.300
Machinery and equipment	390	11.508	2.127	4.446	15.816
Textiles, wearing apparel, leather and related products	390	12.095	1.599	7.626	16.641
Food products, beverages and tobacco	390	11.604	1.702	3.909	14.951
Chemicals, rubber, plastics and fuel products	390	10.577	1.658	5.861	14.102
Furniture, other manufacturing	390	10.188	1.865	4.482	15.096
Basic metals and fabricated metal products, except machinery and equipment	390	9.061	1.847	2.326	12.551
Transport equipment	389	9.286	2.214	2.154	14.460
Wood and products of wood and cork, except furniture	390	8.786	1.793	3.713	13.700
Non-metallic mineral products	390	10.009	1.927	4.166	13.543
Paper and printing	386	7.487	2.001	-1.427	11.523

Note:

1. All variables are in logarithm term, except for volatility measures.

2. VOL_MASD and VOL_GARCH indicate the exchange rate volatility measured by MASD and GARCH approaches, respectively and multiplied by 100.

5.2. Empirical Results

This section presents estimation results indicating the effects of exchange rate volatility on exports between Vietnam and the country' major partners in terms of the total of manufacturing sector and other ten industries for the whole sample as well as the three continents.

Table 3 presents the effects of exchange rate volatility on exports of manufacturing sectors for the whole sample and three geographic regions including Asia, Europe, and America. Overall, the domestic and foreign income are positively related to Vietnam's exports as all coefficients of these two variables are highly significant at the level of 1 per cent. The positive coefficients illustrate that an increase in income in Vietnam and her trading partners would enhance exporting

performance of the manufactured goods for Vietnam. This is consistent with the trade theory that a higher income in foreign nations will lead to an increase in good demands. The results also indicate that the relative price has a positive influence on exports in the case of the whole sample and the European region. This refers that when the consumer price in partner countries are relatively higher than that in Vietnam, resulting in Vietnam' goods to be more competitive, and enhancing Vietnam's exports. With regard to exchange rate policy, the depreciation of the VND would boost manufacturing exports in the whole sample as well as the European region. The exchange rate volatility, measured using the GARCH model, unexpectedly has no effect on Vietnam's exports, even in the estimations by different regions.[2] The coefficients of two dummy variables illustrate the expected signs for the entire sample and the Asian region, implying that participating WTO offers Vietnam a significant benefit in exporting goods.

[2] The similar results are found when MASD is used as an alternative for the exchange rate volatility.

Table 3. The OLS estimation for the whole sample and three regions

Variables	Main partner	Asia	Europe	America
$Ln(GDP_C)$	0.907***	1.678***	1.849***	7.432***
	(0.216)	(0.287)	(0.686)	(1.556)
$Ln(GDP_{VN})$	3.683***	2.216***	3.791***	1.682*
	(0.259)	(0.371)	(0.426)	(0.957)
Ln(RP)	0.729***	0.267	0.847**	-0.136
	(0.178)	(0.243)	(0.323)	(0.512)
Ln(REXR)	0.331**	-0.441	0.572***	0.471
	(0.157)	(0.280)	(0.187)	(0.308)
VOL_{GARCH}	-0.395	0.391	-0.0109	-0.645
	(0.291)	(0.446)	(0.314)	(0.778)
D_{WTO}	0.206**	0.223**	0.173	-0.0694
	(0.081)	(0.113)	(0.107)	(0.171)
D_{Crisis}	-0.161*	-0.302***	-0.159	0.335*
	(0.083)	(0.114)	(0.100)	(0.190)
Constant	-12.30***	-4.587**	-23.13***	-54.23***
	(1.451)	(2.017)	(4.100)	(7.351)
Hausman test	30.09	29.99	12.19	56.78
Model	FE	FE	FE	FE
Observations	390	195	120	75
R-squared	0.889	0.896	0.937	0.945
No of countries	26	13	8	5

Note:

1. The suffix of "Ln" represents variables defined in terms of logarithm.

2. Standard errors are numbers in the parentheses.

3. (*), (**) and (***) indicate the 10, 5 and 1% significance level, respectively.

4. The term "FE" indicates the results estimated by the fixed effects model on the base of the Hausman test.

The results of benchmark estimations for each industry are presented in Table 4. Generally, the estimation confirms the ambiguity of exchange rate policy in Vietnam's exports at the manufacturing industry level. Three industries including (i) *Textiles, wearing apparel, leather and related products*; (ii) *Basic metals and fabricated metal products*; and (iii) *Paper and printing* have gained from the depreciation of bilateral exchange rate, but they could not benefit overall due to the exchange rate volatility. Both the bilateral exchange rate and the volatility have no effects on other two major industries, namely (i) *Machinery and equipment* and (ii) *Food products, beverages and tobacco*. As for five remaining industries, three are positively correlated to the bilateral exchange rate or the depreciation while two industries are negatively affected by the exchange rate volatility as well as the depreciation of the VND.

As previously discussed, the impact of exchange rate volatility may vary across countries in different regions because of the difference in geographic structures. Table 5, 6, and 7 below present the findings for different scenarios. *First,* Table 5 shows estimation results for the Asian region. The exchange rate volatility is found to be positively related to *Machinery and equipment* as well as *Furniture and other manufacturing goods*. In contrast, *Textiles, wearing apparel, leather and related products* and *Basic metals and fabricated metal products* have been negatively affected by the exchange rate volatility. As for the other six industries, empirical evidence is mixed. *Second,* as presented in Table 6, three is no effect of exchange rate volatility on manufacturing industry exports in the European. *Third,* Table 7 indicates the effect of the exchange volatility on Vietnam's exports to the American continent. When the bilateral exchange rate become more volatile, *Food products, beverages and tobacco* as well as *Non-metallic mineral products* would increase their exporting values, while *Machinery and equipment* experiences a decline and there is no conclusion for other industries.

On the ground of findings from various analyses, several conclusions could be drawn. *First,* the Vietnam's manufacturing exports are highly associated with the state of both internal and external economy as well as the appropriateness in implementing exchange rate policy. *Second,* our findings appear to be in line with the literature that the exchange rate volatility are not related to most manufacturing industries even though the geographic structure is taken into account. *Third,* the effects of exchange rate policy vary significantly across industries irrespective of its proportion of total manufacturing exports.

Table 4. The OLS estimation at industry levels for whole sample

Variables	Ln(exma1)	Ln(exma2)	Ln(exma3)	Ln(exma4)	Ln(exma5)	Ln(exma6)	Ln(exma7)	Ln(exma8)	Ln(exma9)	Ln(exma10)
$Ln(GDP_C)$	-0.860*	1.794***	-0.111	0.0692	0.554*	3.984***	2.845***	3.921***	0.744*	2.506***
	(0.461)	(0.215)	(0.389)	(0.139)	(0.305)	(0.408)	(0.579)	(0.288)	(0.431)	(0.542)
$Ln(GDP_{VN})$	7.685***	2.389***	3.880***	3.903***	3.710***	2.119***	3.909***	0.434	4.567***	-0.375
	(0.552)	(0.258)	(0.466)	(0.291)	(0.365)	(0.489)	(0.698)	(0.345)	(0.517)	(0.649)
Ln(RP)	1.559***	0.327*	1.238***	0.972***	1.033***	0.698**	0.314	0.0432	1.315***	-2.339***
	(0.379)	(0.177)	(0.320)	(0.219)	(0.250)	(0.335)	(0.480)	(0.237)	(0.354)	(0.443)
Ln(REXR)	-0.305	0.537***	-0.0708	-0.181**	1.066***	0.671**	0.832**	-0.366*	0.876***	1.201***
	(0.335)	(0.156)	(0.283)	(0.079)	(0.221)	(0.296)	(0.420)	(0.209)	(0.313)	(0.399)
VOL_{GARCH}	0.455	-0.884***	-0.197	-0.601*	0.602	-1.074*	-0.409	-0.404	0.241	-1.876**
	(0.619)	(0.289)	(0.522)	(0.309)	(0.409)	(0.547)	(0.785)	(0.386)	(0.579)	(0.738)
D_{WTO}	0.112	0.175**	0.294**	0.578***	0.349***	0.173	0.0612	-0.0629	0.847***	0.124
	(0.173)	(0.081)	(0.146)	(0.112)	(0.115)	(0.153)	(0.218)	(0.108)	(0.162)	(0.203)
D_{Crisis}	-0.512***	0.0477	-0.0458	-0.123	-0.046	0.0634	-0.32	-0.129	-0.325**	0.133
	(0.177)	(0.083)	(0.149)	(0.113)	(0.117)	(0.156)	(0.222)	(0.110)	(0.165)	(0.210)
Constant	-16.10***	-15.26***	-5.297**	-6.861***	-19.37***	-32.96***	-34.51***	-16.94***	-23.58***	-16.51***
	(3.089)	(1.442)	(2.608)	(1.346)	(2.043)	(2.733)	(3.887)	(1.930)	(2.892)	(3.639)
Hausman test	22.8	50.86	9.3	5.27	32.54	93.79	43.63	92.77	26.27	55.78
Model	FE	FE	FE	RE	FE	FE	FE	FE	FE	FE
Observations	390	390	390	390	390	390	389	390	390	386
R-squared	0.821	0.863	0.648	0.836	0.757	0.738	0.673	0.74	0.772	0.472
No of countries	26	26	26	26	26	26	26	26	26	26

Note:

1. The suffix of "Ln" represents variables defined in terms of logarithm. The term of "exma" indicates manufacturing exports and other terms "i" respectively denotes industries i from 1 to 10, including (1) Food products, beverages and tobacco; (2) Textiles, wearing apparel, leather and related products; (3) Wood and products of wood and cork; (4) Paper and printing; (5) Chemicals, rubber, plastics and fuel products; (6) Basic metals and fabricated metal products; (7) Non-metallic mineral products; (8) Machinery and equipment; (9) Transport equipment; and (10) Furniture.

2. Standard errors are numbers in the parentheses.

3. (*), (**) and (***) indicate the 10, 5 and 1% significance level, respectively.

4. The term "FE" and "RE" indicate the results estimated by the fixed effects model and random model on the base of the Hausman test.

Table 5. The OLS estimation at industry levels for the Asian region

Variables	Ln(exma1)	Ln(exma2)	Ln(exma3)	Ln(exma4)	Ln(exma5)	Ln(exma6)	Ln(exma7)	Ln(exma8)	Ln(exma9)	Ln(exma10)
$Ln(GDP_C)$	1.331**	2.438***	1.665***	0.903**	0.906***	3.081***	2.465***	3.424***	0.741	1.850***
	(0.629)	(0.287)	(0.337)	(0.409)	(0.312)	(0.651)	(0.773)	(0.440)	(0.602)	(0.557)
$Ln(GDP_{VN})$	5.485***	1.330***	0.730*	2.799***	3.512***	2.405***	3.765***	0.592	4.168***	-0.0438
	(0.815)	(0.372)	(0.436)	(0.529)	(0.403)	(0.843)	(1.001)	(0.570)	(0.779)	(0.722)
Ln(RP)	1.851***	0.182	-0.518*	0.427	0.983***	0.0216	0.3	-0.417	1.867***	-2.427***
	(0.533)	(0.243)	(0.285)	(0.346)	(0.264)	(0.552)	(0.655)	(0.373)	(0.510)	(0.473)
Ln(REXR)	-1.096*	-0.465*	0.850**	-0.0206	0.927***	0.308	-0.973	-0.56	-0.348	1.112**
	(0.614)	(0.280)	(0.328)	(0.399)	(0.304)	(0.635)	(0.754)	(0.429)	(0.587)	(0.544)
VOL_{GARCH}	2.568***	-1.215***	0.406	-0.636	1.032**	-2.316**	-0.469	-0.798	-1.183	-3.295***
	(0.977)	(0.446)	(0.523)	(0.635)	(0.484)	(1.011)	(1.201)	(0.684)	(0.935)	(0.866)
D_{WTO}	0.073	0.157	0.138	0.368**	0.0778	0.0779	0.0884	-0.111	1.103***	0.0403
	(0.247)	(0.113)	(0.132)	(0.160)	(0.122)	(0.256)	(0.304)	(0.173)	(0.236)	(0.219)
D_{Crisis}	-0.568**	-0.0462	-0.0649	-0.156	-0.196	0.116	-0.351	-0.353**	-0.609**	0.0817
	(0.251)	(0.115)	(0.134)	(0.163)	(0.124)	(0.260)	(0.309)	(0.176)	(0.240)	(0.223)
Constant	-15.72***	-6.915***	-6.859***	-7.326**	-18.07***	-22.56***	-17.36***	-11.59***	-11.90***	-8.854**
	(4.424)	(2.018)	(2.368)	(2.874)	(2.191)	(4.577)	(5.435)	(3.096)	(4.232)	(3.920)
Hausman test	39.44	37.89	23.35	7.89	22.46	30.44	12.7	36.96	11.74	36.96
Model	FE	FE	FE	FE	FE	FE	FE	FE	FE	FE
Observations	195	195	195	195	195	195	195	195	195	195
R-squared	0.78	0.887	0.747	0.808	0.855	0.755	0.74	0.788	0.784	0.681
No of countries	13	13	13	13	13	13	13	13	13	13

Note:

1. The suffix of "Ln" represents variables defined in terms of logarithm. The term of "exma" indicates manufacturing exports and other terms "i" respectively denotes industries i from 1 to 10, including (1) Food products, beverages and tobacco; (2) Textiles, wearing apparel, leather and related products; (3) Wood and products of wood and cork; (4) Paper and printing; (5) Chemicals, rubber, plastics and fuel products; (6) Basic metals and fabricated metal products; (7) Non-metallic mineral products; (8) Machinery and equipment; (9) Transport equipment; and (10) Furniture.

2. Standard errors are numbers in the parentheses.

3. (*), (**) and (***) indicate the 10, 5 and 1% significance level, respectively.

4. The term "FE" and "RE" indicate the results estimated by the fixed effects model and random model on the base of the Hausman test

Table 6. The OLS estimation at industry levels for the European region

Variables	Ln(exma1)	Ln(exma2)	Ln(exma3)	Ln(exma4)	Ln(exma5)	Ln(exma6)	Ln(exma7)	Ln(exma8)	Ln(exma9)	Ln(exma10)
$Ln(GDP_C)$	0.576	1.831**	2.781**	3.625***	1.750**	5.199***	0.091	3.725***	0.161	8.176***
	(0.453)	(0.718)	(1.091)	(1.139)	(0.724)	(0.992)	(2.438)	(0.779)	(0.455)	(2.411)
$Ln(GDP_{VN})$	6.051***	2.721***	3.713***	3.309***	2.523***	2.549***	4.576***	1.161**	5.228***	-3.652**
	(0.664)	(0.446)	(0.678)	(0.707)	(0.449)	(0.616)	(1.510)	(0.484)	(0.553)	(1.497)
Ln(RP)	-0.902*	0.760**	2.039***	0.539	1.423***	2.306***	1.209	1.398***	2.759***	-4.765***
	(0.528)	(0.338)	(0.514)	(0.536)	(0.341)	(0.467)	(1.143)	(0.367)	(0.436)	(1.135)
Ln(REXR)	0.969**	0.746***	-1.294***	0.533*	-0.202	-0.103	0.858	-0.849***	-0.0977	1.707**
	(0.438)	(0.196)	(0.298)	(0.311)	(0.198)	(0.271)	(0.674)	(0.213)	(0.355)	(0.658)
VOL_{GARCH}	-0.263	0.153	0.721	-0.0752	0.496	0.711	-0.463	0.424	0.485	-0.517
	(0.480)	(0.328)	(0.499)	(0.521)	(0.331)	(0.454)	(1.117)	(0.357)	(0.439)	(1.104)
D_{WTO}	0.12	0.258**	0.118	0.680***	0.204*	0.158	-0.134	-0.0403	0.656***	-0.349
	(0.246)	(0.112)	(0.170)	(0.177)	(0.112)	(0.154)	(0.378)	(0.121)	(0.195)	(0.375)
D_{Crisis}	-0.636***	-0.00216	0.0389	0.079	-0.0763	-0.0818	-0.565	-0.126	-0.442**	0.304
	(0.242)	(0.105)	(0.160)	(0.167)	(0.106)	(0.145)	(0.357)	(0.114)	(0.192)	(0.353)
Constant	-30.24***	-20.59***	-14.08**	-37.13***	-11.90***	-39.79***	-20.94	-15.27***	-15.37***	-51.62***
	(5.271)	(4.291)	(6.525)	(6.809)	(4.327)	(5.930)	(14.890)	(4.659)	(4.478)	(14.420)
Hausman test	1.19	19.15	36.94	9.29	22.8	20.85	13.17	22.43	2.6	10.57
Model	RE	FE	FE	FE	FE	FE	FE	FE	RE	FE
Observations	120	120	120	120	120	120	119	120	120	120
R-squared	0.899	0.876	0.884	0.907	0.854	0.829	0.437	0.762	0.835	0.247
No of countries	8	8	8	8	8	8	8	8	8	8

Note:

1. The suffix of "Ln" represents variables defined in terms of logarithm. The term of "exma" indicates manufacturing exports and other terms "i" respectively denotes industries i from 1 to 10, including (1) Food products, beverages and tobacco; (2) Textiles, wearing apparel, leather and related products; (3) Wood and products of wood and cork; (4) Paper and printing; (5) Chemicals, rubber, plastics and fuel products; (6) Basic metals and fabricated metal products; (7) Non-metallic mineral products; (8) Machinery and equipment; (9) Transport equipment; and (10) Furniture.

2. Standard errors are numbers in the parentheses.

3. (*), (**) and (***) indicate the 10, 5 and 1% significance level, respectively.

4. The term "FE" and "RE" indicate the results estimated by the fixed effects model and random model on the base of the Hausman test

Table 7. The OLS estimation at industry levels for the America region

Variables	Ln(exma1)	Ln(exma2)	Ln(exma3)	Ln(exma4)	Ln(exma5)	Ln(exma6)	Ln(exma7)	Ln(exma8)	Ln(exma9)	Ln(exma10)
$Ln(GDP_C)$	10.11***	4.492**	9.988**	5.005**	6.285*	6.900**	11.06**	-0.171	10.26***	24.88***
	(2.967)	(1.716)	(4.706)	(2.337)	(3.650)	(3.095)	(4.512)	(2.494)	(3.630)	(5.738)
$Ln(GDP_{VN})$	2.847	2.365**	2.696	0.0562	0.625	1.846	1.454	2.748*	-0.162	-10.86***
	(1.826)	(1.056)	(2.897)	(1.438)	(2.247)	(1.905)	(2.777)	(1.535)	(2.234)	(3.571)
Ln(RP)	-0.11	-0.0816	0.912	-1.986**	-1.604	0.648	0.422	0.805	-3.773***	-4.605**
	(0.976)	(0.565)	(1.548)	(0.769)	(1.201)	(1.018)	(1.484)	(0.820)	(1.194)	(1.877)
Ln(REXR)	-1.146*	1.098***	1.343	-0.608	1.687**	0.989	-0.564	-0.0574	2.124***	-2.213*
	(0.588)	(0.340)	(0.933)	(0.463)	(0.724)	(0.614)	(0.895)	(0.494)	(0.720)	(1.137)
VOL_{GARCH}	-3.278**	-0.954	4.210*	-0.0257	1.266	1.571	1.604	-0.847	4.378**	0.738
	(1.484)	(0.858)	(2.354)	(1.169)	(1.826)	(1.548)	(2.257)	(1.247)	(1.816)	(3.294)
D_{WTO}	-0.0208	-0.0183	-0.321	0.465*	0.586	0.0388	0.579	0.0652	-0.0596	0.321
	(0.326)	(0.189)	(0.518)	(0.257)	(0.401)	(0.340)	(0.496)	(0.274)	(0.399)	(0.606)
D_{Crisis}	0.754**	0.314	-0.0472	0.128	0.42	-0.297	-0.503	0.168	0.238	0.675
	(0.362)	(0.209)	(0.574)	(0.285)	(0.445)	(0.377)	(0.550)	(0.304)	(0.443)	(0.761)
Constant	-67.59***	-41.76***	-88.32***	-22.89**	-54.77***	-60.99***	-76.16***	-3.024	-85.52***	-109.5***
	(14.020)	(8.109)	(22.240)	(11.040)	(17.250)	(14.630)	(21.320)	(11.780)	(17.150)	(27.140)
Hausman test	21.18	51.67	43.55	15.3	48.79	42.67	36.53	43.8	46.76	37.74
Model	FE	FE	FE	FE	FE	FE	FE	FE	FE	FE
Observations	75	75	75	75	75	75	75	75	75	71
R-squared	0.929	0.913	0.676	0.887	0.776	0.747	0.805	0.602	0.844	0.597
No of countries	5	5	5	5	5	5	5	5	5	5

Note:

1. The suffix of "Ln" represents variables defined in terms of logarithm. The term of "exma" indicates manufacturing exports and other terms "i" respectively denotes industries i from 1 to 10, including (1) Food products, beverages and tobacco; (2) Textiles, wearing apparel, leather and related products; (3) Wood and products of wood and cork; (4) Paper and printing; (5) Chemicals, rubber, plastics and fuel products; (6) Basic metals and fabricated metal products; (7) Non-metallic mineral products; (8) Machinery and equipment; (9) Transport equipment; and (10) Furniture.

2. Standard errors are numbers in the parentheses.

3. (*), (**) and (***) indicate the 10, 5 and 1% significance level, respectively.

4. The term "FE" and "RE" indicate the results estimated by the fixed effects model and random model on the base of the Hausman test

6. Concluding remarks

An intensive debate has taken place on the impact of Vietnam' currency depreciation on her export performance in recent years. Many may have supported this strategy because it is argued that doing so would enhance export performance whereas others considered that the policy could result in the exchange rate volatility, which in turn is harmful to exports. The study is conducted to shed light on the link between exchange rate volatility and exports between Vietnam and her 26 key exporting partners for the 2001-2015 period using data from the manufacturing disaggregated levels.

Key findings from this empirical study are presented as follows. *First*, with regard to the manufacturing sector, the exchange rate policy of devaluing the VND provides a positive impact on Vietnam's manufacturing exports. While the depreciation of the VND enhances export performance, the exchange rate volatility has no effect on the performance. However, when the geographic element is taken into consideration, the depreciation of VND will enhance Vietnam's exports to the European region whereas evidence is mixed when the Asia as well as the America regions are considered. On balance, findings from this study confirm that, in the context of Vietnam, the level of bilateral real exchange rate between the VND and other currencies is far more importance than the currency volatility to enhance export performance for Vietnam. *Second*, Vietnam's manufacturing exports benefit from an increase in domestic and foreign income, as well as the competitive advantage in relative prices, her participation in the WTO has provided great benefit to Vietnam. *Third*, the global financial crisis hinders the export values of manufacturing sectors in Vietnam as expected. *Fourth,* with regard to ten specific industries, exchange rate volatility has provided negative effect on export performance for Vietnam for most industries whereas mixed evidence is found for some industries.

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Appendix 1. List of Sub-industries

Code	OECD Source	Industry
exma	D10T32	Manufacturing sectors
exma1	D10T12	Food products, beverages and tobacco
exma2	D13T15	Textiles, wearing apparel, leather and related products
exma3	D16	Wood and products of wood and cork, except furniture
exma4	D17T18	Paper and printing
exma5	D19T22	Chemicals, rubber, plastics and fuel products
exma6	D24T25	Basic metals and fabricated metal products, except machinery and equipment
exma7	D23	Other non-metallic mineral products
exma8	D26T28	Machinery and equipment
exma9	D29T30	Transport equipment
exma10	D31T32	Furniture, other manufacturing

Appendix 2. List of Countries

Regions	Countries
Asia	Australia, Cambodia, Hong Kong, China, India, Indonesia, Japan, Korea, Malaysia, Philippines, Russian, Singapore, Thailand
Europe	Belgium, France, Germany, Italy, Netherlands, Spain, Turkey, United Kingdom
America	Brazil, Canada, Mexico, South Africa, United States