ERIA Discussion Paper Series

The Exchange Rate and Exporting: Evidence from the Indonesian Manufacturing Sector

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March 2019

Abstract: *This paper examines the impact of the exchange rate on export performance using plant- and product-level data for the Indonesian manufacturing sector over the period 2008–2012. It addresses both the impacts of the level and volatility of the exchange rate on the value, scope, and composition of exported products. The study finds that the exchange rate affected the export values for the period of analysis, confirming the importance of the exchange rate level and volatility. The findings show that high exchange rate volatility tends to reduce the exporters' product scope, minimising uncertainty. Meanwhile, the impact on product concentration within firms encourages exporters to specialise, concentrating on exporting only on a few products that, presumably, are the exporters' core-competence products. This particular finding underlines the importance of product competition in the export market as another factor affecting the scope and concentration of exporter products. That is, tougher competition in the destination market reduces the mark-up across products and induces an exporter to skew its sales toward its best-performing/core-competence products. The study underlines the importance of policy for hedging the volatility of the exchange rate, which means developing the financial markets to provide sufficient resources or mechanisms for this.*

***Keywords*:** non-tariff measure, regulations, regional integration, RCEP, TPP, ASEAN

***JEL Classification*:** F13, F14, F15

1. Background

Factors affecting export performance, or export participation, have long been the attention of researchers, acknowledging the significance of exporting in advancing the industrialisation of countries. Not only does it provide foreign revenue for a country from the macro perspective but exporting also motivates productivity improvement and innovation at the micro/firm and industry levels. Discussion to date, however, has skewed toward addressing the supply-side factors of exporting. Little attention has been given to demand-side factors or macroeconomic variables that affect a country's export performance. This paper addresses this topic, examining the impact of the exchange rate on export performance using plant- and product-level data for Indonesian manufacturing over the period 2008–2012.

The exchange rate is critical for exporting, essentially because of two reasons. First, it affects the expected profitability of exported products and, hence, it affects not only the overall export value of a firm but the distribution of the firm's exported product portfolio. In a recent study, Chatterjee et al. (2013) provide a model for this, focusing on the impact of the level of the exchange rate. Second, exchange rate volatility affects the risk valuation of exporting, which in turn may affect a firm's decision of whether or not to respond to export demand. While in general, the direction of the exchange rate level is clear, it is not for volatility. More recent works suggest that it depends on several other factors, such as the availability of measures for hedging or the extent of credit constraints in the firm or industry.

The lack of empirical evidence on the impact of volatility is one motivation for this paper. Another motivation is to add evidence for the exploration of the impact of the exchange rate using micro-level data at the plant and product levels. The paper examines the impact on performance to cover the value, scope, and choices of a firm's exported products. The investigation, therefore, covers not only the impact on the scale but also on the dynamics of exporting within firms.

This paper is organised as the follows. Section 2 briefly reviews the literature on the impact of the exchange rate on exports. Section 3 outlines the methodology, including some descriptions of the data and variables used. Section 4 presents and discusses the estimation results, and Section 5 concludes.

2. Analytical Framework

The choice of export destination could be affected by the exchange rate between the destination and the origin countries. This is despite US dollar-invoicing practices being typical in exporting activities because most exported products are, in the end, consumed or used for production inputs in an importing country and valued using the local currency. This study, therefore, considers the exchange rate between the origin and destination country, either its level or volatility, as one of the potential determinants of the export destination.

Chatterjee et al. (2013) developed a model to explain how a multiproduct firm adjusts the price, product scope, and distribution of sales across the products (or the product mix) amongst the exported products of the firm. The model addresses the impact of the level of the exchange rate. It postulates that since a firm produces a number of exported products, an exchange rate devaluation will increase the price of products closer to the firm's core competence more than that of products far from the firm's core competence. The quantity impact follows, with a weaker impact on products closer to the firm's core competence and a stronger impact on products far from the firm's core competence.

Consistent with this, an exchange rate devaluation increases the scope of products being exported. Exchange rate depreciation increases the profitability of all goods produced by the exporter, and, because of this, products that initially were not chosen as exported products now become profitable for export and hence are inserted in the list of products eligible for export. Thus, the scope of exported products could be expanded in the event of an exchange rate devaluation.

An exchange rate devaluation provides an incentive for a firm/exporter to increase its sales of products that are far from the firm's core competence. This is because there is a varying impact on the price and quantity of the mix of products being exported. The model postulates that the price effect (i.e. increase in price) is concentrated in products closer to the firm's core competence, which means the quantity impact is minimal for these products. This is in contrast to products far away from the firm's core competence; the increase is the lowest and, therefore, the quantity impact is the highest for the group of exported products that are far from the firm's core competence. The distribution of exporting sales, therefore, is changed because of the exchange rate devaluation, becoming more skewed towards the non-core products.

As for the impact of exchange rate volatility on exporting, earlier analytical framework predicts a negative relationship; that is, higher volatility reduces the extent of

exporting. This comes directly through the higher uncertainty and additional costs faced by exporters, who are assumed as risk-averse agents (e.g. Ethier (1973); Cote (1994)).[1] In this framework, hedging is assumed either not possible or very costly.

Evidence on the impact of the volatility, however, is mixed. A survey by McKenzie (1999) concluded that the impact may depend on market specifics, while studies done by Greenaway and Kneller (2007) and Byrne et al. (2008) identified that the impact is either significant but very small or insignificant. The impact is also suggested to depend on the level of financial development in the country of export origin. An insignificant or small effect is found by Broda and Romalis (2011), who focused on examining the volatility in rich countries with developed financial markets. In contrast, a substantial negative effect was found by Grier and Smallwood (2007) for the case of developing countries.

The non-negative relationship between exchange rate volatility and export, explored by more recent theoretical and empirical works, is possible if exporters can protect themselves from the negative effect by swiftly adjusting to the sudden change in the exchange rate or by hedging (Chit et al. 2010). In other words, non-negativity is possible if there are factors that are able to mitigate the negative impact of the volatility.

De Grouwe (1988) showed that the impact is ambiguous when firm exports all of its output, depending on the net effect between the substitution and income effects arising as a response to the increase in volatility. The substitution effect decreases export activities to less risky ones, while the income effect will draw resources in to the export sector when the expected utility of export revenues is reduced as a result of the higher exchange rate risk imposed by higher exchange rate volatility (Chit et al. 2010: 242). Thus, if the income effect is greater than the substitution effect, the (overall) impact of the volatility on exporting is positive.

Consistent with this is the model developed by Broll and Eckwert (1999), which demonstrates the flexibility to choose by a firm with a large domestic market. In the model, the firm can easily reallocate its share of sales between the domestic and foreign markets in an environment with a volatile exchange rate. Adding to the analysis on the ability to adjust, De Grauwe (1994) showed that a firm could actually benefit from exchange rate volatility if it could – presumably quickly – adjust output in response to the change in price.

Hedging becomes important in mitigating the negative effect of exchange rate volatility because it reduces the extent of uncertainty for the potential earnings of exporters.

[1] See, for example, Clark (1973), Hooper and Kohlagen (1978), and Kawai and Zilcha (1986) for the other models within this framework.

Room for hedging is provided by the size and maturity of the financial market in the country of export origin. Exporters in countries with well-developed financial markets – exposed to substantial numbers of measures for hedging – should allow exporters (in those countries) to hedge against the exchange rate risk, hence reducing the negative impact of the volatility on exporting (Hericourt and Poncet, 2013). While this mechanism seems to be straightforward, evidence of it has not really been established in the literature.[2]

The importance of financial markets in the analysis implies that the impact of the volatility may depend on whether firms/exporters are financially constrained. The argument for this hypothesis can be derived from another mechanism, relying more on the idea that exchange rate volatility may be another source of sunk costs for exporting (Greenaway and Kneller, 2007). Here, an exporter may invest more in exporting in the event of a real depreciation, using the gains from the depreciation; but once this investment is made, it cannot be recovered, making it irreversible. In this case, if the exporter is financially constrained, the risk exposed by the irreversibility, from the volatility, is higher and may cause it not to engage in exporting even if there are real opportunities. A well-developed financial market means the extent of the credit constraint faced by the exporter is relaxed, which means it is 'shielded' by the risk imposed by the irreversibility.

3. Methodology

Data

The data used for the estimations combine the plant-product matched data of medium and large establishments in the Indonesian manufacturing sector with exported product-level data and plant identifiers. The plant-product matched data are drawn from the census conducted by the statistical agency (*Badan Pusat Statistik*, BPS) while the exported product-level data are drawn from Indonesian Customs through the BPS. The merging of the two datasets is made possible using the unique plant ID provided by the exported product-level data. Because the exported product-level dataset is unique, the availability is restricted only to the period 2008–2012, which is the period used by this study.

[2] While, again, evidence on this is scarce, macroeconomic literature provides hints to support this hypothesis. Aghion et al. (2009) showed that the negative impact of real exchange rate (RER) volatility (on productivity) decreases with the level of development in the financial market in a country. Benhima (2012) showed that the RER is more detrimental in countries with a high share of foreign currency in their national debt, using data from 76 emerging countries over the period 1995–2004. Benhima's study is more direct in suggesting the importance of credit constraints.

The plant-product matched data are the product of another combination of datasets. The format of this dataset is increasingly being used by researchers in recent years, and the data are also merged using the unique plant ID. The plant-level dataset is the more familiar dataset used by many researchers since the 1990s, and it is known to be reliable. It covers plants with 20 or more employees and includes rich information at the plant level, including the value of shipments (both domestic and export shipments), ownership (foreign, domestic, and government) information, employment, and costs, etc. The survey asks the sales destination of the plant (whether it sells to domestic or exporting markets, or to both).

The product codes in the product-level data and the exported product-level data are the same, using nine-digit Indonesia product classifications (*Klasifikasi Kode Barang*, KKI). The first four digits of the product classification coincide with the four-digit ISIC classifications.

Empirical Models

This study conducts econometric estimation testing of the impact of the variables representing the export destination market defined above on export performance. Before doing so, it is important for the study to provide some insights on the impact from some descriptive statistics. The descriptive analysis is conducted by examining the distribution of the performance variables for major exporting countries and/or industries (by two- or three-digit of ISIC classifications). The descriptive analysis tries to pick up whether there are some non-random patterns in the distribution. The descriptive analysis also provides several basic facts about the average exporting performance of plants with a focus on the export destination.

The importance of the export destination market on export performance variables is estimated using the following general functional form, with i,j,k,c,t denoting the plant, product, export destination, and time, respectively.

Equation (1):

$$Export_{ijct} = f(exchange\ rate_{ct}, exchange\ rate\ volatility_{ct}\ GDP_{ct}, \frac{GDP}{capita}_{ct}, tariff_{kct}, Z_{it})$$

Both the subscript j and k denote the product, but they represent the product at different HS-code levels; that is, j represents it at the 10-digit level, while k represents it at the 6-digit level.

$Export$ is defined as the value of product j (in US dollars) sold to destination country c in time t. $Exchange\ rate$ ($RER10_{ct}$) is proxied by the bilateral real exchange rate of country c with respect to Indonesia, indexed using 2010 as the base year in order to normalise the different value of the RER across countries.[3] The RER is defined as the nominal exchange rate between Indonesia and the destination country *c*, normalised by the relative price index between the two countries. Formally, it is

$$RER_{c,IDN} = \frac{\frac{NER_c}{NER_{IDN}}}{\frac{CPI_{IDN}}{CPI_c}}$$

$$RER_{c,IDN} = \frac{\left(\frac{NER_c}{NER_{US}} \times \frac{NER_{US}}{NER_{IDN}}\right)}{\frac{CPI_{IDN}}{CPI_c}}$$

where $\frac{NER_c}{NER_{US}}$ and $\frac{NER_{US}}{NER_{IDN}}$ are the nominal the nominal exchange rates between country *c* with the United States (US) and between the US and Indonesia, respectively. $\frac{CPI_{IDN}}{CPI_c}$ is the relative price between Indonesia and country *c*, proxied by the consumer price index (*CPI*).

Meanwhile, $exchange\ rate\ volatility$ ($NERV_{ct}$) is proxied by the daily change in the nominal exchange rate of the destination country *c* with the US dollar, measured annually for each *t* in the data period or, formally (where *d* denotes day)

$$NERV_{ct} = \sqrt{\frac{\sum_{d=1}^{T}(\Delta ln(NER)_{cd} - \overline{(\Delta ln(NER)_{cd}}^{2}}{T-1}} \quad , \quad \text{with} \quad \Delta ln(NER)_{cd} = ln(NER)_{cd}) - ln(NER)_{cd-1}).$$

Equation (1) includes GDP_{ct}, $\frac{GDP}{capita}_{ct}$, and $tariff_{kct}$ to control for market size, consumer tastes and preferences, and export barriers in the destination country *c*, respectively. GDP_{ct} is measured in its real value at the 2010 USD constant price, while $\frac{GDP}{capita}_{ct}$ is measured by dividing GDP_c by the mid-year population of country *c*.

$tariff_{kct}$ is proxied by the effective tariff rate defined by the six-digit HS-2012 code. The effective tariff rate is preferred instead of the nominal one because it tends to reflect the rate set by free trade agreements. This study uses tariff rates extracted from the WITS database as well as from the TRAINS and WTO–IDB databases, in an attempt to have the

[3] This is as postulated by Mayer et al. (2014).

most complete entry of tariff rates for the estimation database. The rates from TRAINS and the WTO–IDB database are combined using their simple and weighted averages at the country level. The weights used are the shares of Indonesia's imports of HS 6-digit products in each of the destinations, *c*. Thus, this study has tsa_s1_c and twa_s1_c as the average and weighted average of the tariff rates sourced from WITS, respectively, and tsa_s3_c and twa_s3_c as the average and weighted average of the tariff rates sourced from TRAINS and the WTO–IDB, respectively

In addition to these, the equation also includes a set of control variables drawn from firm characteristics (i.e. Z_{it}) especially in order to ensure exogeneity. Included in the set are size, age, productivity, ownership (foreign and domestic), capital intensity, skill intensity, and imported input intensity.

Equation (1) is estimated by a fixed-effect panel estimation method using various fixed effects and/or combinations of the fixed effects. The experiments always use year fixed effects, and, given all fixed-effects combinations, the experimented estimations thus use at least two fixed effects. In addition to year fixed effects, the other fixed effects considered and experimented are the following:

- plant,
- the choice of the destination country or destination region,
- the choice of the product at the 10-digit or 6-digit HS code,
- the interaction of the plant and destination country/destination region, and
- the interaction of the plant and destination country and product at the 10-digit HS.

Equation (1) examines the importance of the variable of the export destination factor using information derived from plant, product, and destination country variation. While indeed very useful, it may mask the importance of the 'gravity' theoretical argument for international trade, where distance and other macroeconomic variables are the key variables derived by theory. This study thus re-estimates equation (1), but only for the i,c,t dimension, and for this, the data on exports, tariff, and market power for each product are then aggregated to the country level. The re-estimated equation (1a) is thus

$$Export_{ict} = f(exchange\ rate_{ct}, exchange\ rate\ volatility_{ct}\ GDP_{ct}, \frac{GDP}{capita}_{ct}, tariff_{ct}, Z_{it})$$

As noted, this study is also interested in checking the impact of the exchange rate on the scope and portfolios of exported products at the firm level. This is done by estimating the following equation using a general functional form at the i,c,t dimensions, that is:

equation (2) for the scope of exported products,

$$Scope_{ict} = f\left(exchange\ rate_{ct}, exchange\ rate\ volatility_{ct}\ GDP_{ct}, \frac{GDP}{capita}_{ct}, tariff_{ct}, Z_{it}\right)$$

and equation (3) for the concentration of exported products,

$$Concentration_{ict} = f\left(exchange\ rate_{ct}, exchange\ rate\ volatility_{ct}\ GDP_{ct}, \frac{GDP}{capita}_{ct}, tariff_{ct}, Z_{it}\right)$$

Product scope is measured by counting the total number of products exported to each country destination *c* by plant *i*. This is similar for the product concentration, which measures the skewness of a product in a product-mix (a basket of products) exported to each country destination *c* by plant *i*. This study uses the Herfindahl index to measure the skewness.

4. Estimation Results

Tables 1 and 2 present the results of the estimation of equations (1) and (1a), respectively. [4] The results reported in the table are based on fixed-effect panel-data estimations using interactive fixed effects, that is, the interaction between plant (i) and product (j) and destination country(c) fixed effects for equation (1), and the interaction between plant (i) and destination country (c) fixed effects for equation (1a). In addition to the interactive fixed effects, estimations of each of the equations include year fixed effects in them to control for overtime changes within the period of the observations. The results presented in the tables are some of around 700 specifications analysed by this study. The estimations use robust standard errors to correct for potential heteroscedasticity. The experiment also estimates the use of the other fixed effects (other than year fixed effects) that enter the equation separately.

The experiment introduces various possibilities of the specification and/or the use of alternative measures (e.g. four alternative tariff rates, TSA_S1_c, TWA_S1_c, TSA_S3_c, and TWA_S3_c) and a few plant-level variables (i.e. alternative measures of capital intensity and labour productivity). The experiment finds severe collinearity between $ln(GDP)_c$ and

[4] The basic statistics of the data used for these estimations are provided in Appendix Table A1.

$ln(GDPPC)_c$. Therefore, it introduces these two variables separately. The experiment finds that $RER10_c$ statistically performs better if it is specified to enter the equation together with $NERV_c$, although $NERV_c$ is actually a more robust and consistent variable than $RER10_c$ if it enters the equations separately.

Table 1. Determinants of Export Value, Using Disaggregated Products (dimensions i,j,c,t)

VARIABLES	(26) l_fobhsusd(id_ijc)	(27) l_fobhsusd(id_ijc)	(28) l_fobhsusd(id_ijc)	(29) l_fobhsusd(id_ijc)	(30) l_fobhsusd(id_ijc)	(31) l_fobhsusd(id_ijc)
l_cgdp10	0.833***	0.782***	0.584***			
	[0.141]	[0.159]	[0.172]			
l_cgdppc10				0.976***	0.939***	0.775***
				[0.146]	[0.164]	[0.172]
rer10	-1,66E-05		-0.00393***	-1,81E-05		-0.00379***
	[1.47e-05]		[0.00125]	[1.47e-05]		[0.00122]
nerv		-12.44***	-8.929*		-11.75***	-8.507*
		[4.486]	[4.594]		[4.490]	[4.585]
tsa_s3_idn	-0.00325*	-0,00222	-0,00184	-0.00312*	-0,00208	-0,00175
	[0.00171]	[0.00175]	[0.00176]	[0.00171]	[0.00175]	[0.00175]
Year-effects	Yes	Yes	Yes	Yes	Yes	Yes
FE: plant x hs12_10d x destination coun	Yes	Yes	Yes	Yes	Yes	Yes
Plant-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	110.568	95.159	95.070	110.568	95.159	95.070
R-squared	0,852	0,852	0,852	0,852	0,852	0,852
Adj. R2	0,781	0,781	0,782	0,782	0,782	0,782

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, *<0.1
Plant-level control: l_rcapin_e (capital intensity, measured by energy intensity), l-rlp_o (real labor productivity), l_size (# of labor), own_dom (private-domestic share of ownership), own_f (foreign share of ownership), skill1 (skill intensity), impin (import intensity), and l_age1 (relative, since 2000).
Source: Authors' calculation.

Consider first the results reported in Table 1 (for equation (1)). The exchange rate is found to affect export values. The estimates of $RER10_c$ and $NERV_c$ are negative and statistically significant. The importance of the exchange rate, however, does not depend merely on the level, but it needs to come together with the (over time) variation of the exchange rate volatility. As shown, $RER10_c$ is only significant when it enters the equation jointly with $NERV_c$; in most cases, $RER10_c$ is not statistically significant if it enters separately.

Thus, consistent with the experience of other countries using similar methods (e.g. Chatterjee et al. (2013)), a depreciation of exchange rate depreciation leads to an increase in the value of exported products. This finding indicates that an exchange rate depreciation, in general, lowers the price of goods exported by Indonesian exporters, which fits with the model developed by Chatterjee et al.

As predicted, volatility also matters. In fact, the results suggest that it is more important than the level; that is, when these two variables enter separately, only $NERV_c$ is

statistically significant, while $RER10_c$ is not, and the estimate of $NERV_c$ is significantly larger than that of $RER10_c$. Thus, for Indonesian manufacturing, the more volatile the exchange rate, the lower the value of the exports. This is similar to the other findings from developing countries as reviewed earlier.

Analytically, this reflects two potential situations: (i) there are not many opportunities or mechanisms for hedging that the exporters can use; and (ii) the exporters are financially constrained. All of these are signals of a not fully developed financial market. Similar to other developing countries, the financial markets in Indonesia indeed are not yet at an advanced state; they are still developing. The findings, therefore, provide support to the theory of hedging as an important mechanism for mitigating the negative impact of exchange rate volatility on exports. As for the extent of financial constraint, the study needs to explore the data for this.

It is worth commenting here on the results of the control variables that represent the other market destination factors. Market size in the export destination country is an important determinant. Estimates of $\ln(GDP)_c$ are positive and highly statistically significant across all specifications. Not only size but the tastes and preferences of consumers in the destination country also matter. Estimates of $\ln(GDPPC)_c$ are positive and also highly statistically significant in all specifications. The estimates of $\ln(GDPPC)_c$ imply that a higher income level in the destination country leads to a higher value of exports going to that country, suggesting the possibility of higher demand for more sophisticated, or more differentiated, products from consumers in the country.

Tariffs are suggested to reduce the value of exports, accord to the theoretical prediction. The estimates of the tariff variables TSA_S3_c are all negative. The impacts of tariffs, however, are not strong in affecting the extent of exporting. Many of the estimates are not statistically significant, and when they are statistically significant, the significance level is marginal only at the 10% level.

The discussion above refers to the estimations using data dimensions $i, j, c, and\ t$ and the interaction of the plant, product, and destination as fixed effects. Let us now turn to the estimation results using the aggregated data dimension (i, c, t) and only the interaction of the plant and destination as the fixed effects (Table 2). As explained, estimation using the aggregated data dimension is necessary in order to underline the importance of the 'gravity' theoretical argument for international trade, where distance and other macroeconomic variables are the key variables derived by theory.

Table 2. Determinants of Export Value, Using Disaggregated Products (dimension i,c,t)

VARIABLES	(74) l_fobhsusd(id_ic)	(80) l_fobhsusd(id_ic)	(86) l_fobhsusd(id_ic)	(92) l_fobhsusd(id_ic)	(98) l_fobhsusd(id_ic)	(104) l_fobhsusd(id_ic)
l_cgdp10	1.098***	1.045***	0.848***			
	[0.156]	[0.179]	[0.193]			
l_cgdppc10				1.433***	1.365***	1.213***
				[0.162]	[0.185]	[0.194]
rer10	3,27E-06		-0.00392***	-5,58E-07		-0.00363***
	[1.18e-05]		[0.00139]	[1.19e-05]		[0.00135]
nerv		-19.50***	-16.38***		-18.24***	-15.50***
		[4.826]	[4.928]		[4.824]	[4.912]
tsa_s1_idn_bas	0,00156	0,00187	0,00209	0,00178	0,00209	0,00227
	[0.00181]	[0.00184]	[0.00183]	[0.00180]	[0.00182]	[0.00182]
Year-effects	Yes	Yes	Yes	Yes	Yes	Yes
FE: plant x destination country	Yes	Yes	Yes	Yes	Yes	Yes
Plant-level control	Yes	Yes	Yes	Yes	Yes	Yes
Observations	58.743	48.506	48.455	58.743	48.506	48.455
R-squared	0,84	0,841	0,841	0,841	0,841	0,841
Adj. R2	0,776	0,778	0,778	0,776	0,778	0,779

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, *<0.1
Plant-level control: l_rcapin_e (capital intensity, measured by energy intensity), l-rlp_o (real labor productivity), l_size (# of labor), own_dom (private–domestic share of ownership), own_f (foreign share of ownership), skill1 (skill intensity), impin (import intensity), and l_age1 (relative, since 2000).
Source: Authors' calculation.

The finding for the relationship between the exchange rate and the export value is the same. In fact, it is stronger based on the aggregated data. Compared with the earlier results, the statistical significance of $NERV_c$ substantially improves to become significant at the 1% level in all specifications, including when it enters the equation together with $NERV_c$. Moreover, the magnitude is significantly greater for this variable now. All this suggests there is some important heterogeneity in the impact of the volatility originating from product heterogeneity. In other words, not all products are sensitive to the exchange rate risk. This is important information for policymakers, suggesting they could bear more risk in investing to support the export of some particular products.

The findings on the other variables are also the same. The estimates of $\ln(GDP)_c$ and $\ln(GDPPC)_c$ are positive and statistically significant. As for the tariff variable (TSA_S1_c), all estimates exhibit positive signs, which does not accord the theoretical prediction. This could be because there is not enough variation within the data period used by this study. Thus, the negative relationship on tariffs seems to have only been produced by the specifications with the more detailed/disaggregated data, i.e. with dimension (i, j, c, t) and with interactive plant–product–country fixed effects.

Table 3 presents the results of the estimation of equation (2).[5] The results reported in the table are based on fixed-effect panel-data estimations using the interactive plant (i) and destination country (c). The estimations include year fixed effects in order to control for overtime changes within the data period. The results presented in the tables are some of around 1,400 experimented specifications. The estimations use robust standard errors to correct for potential heteroscedasticity. The experiment also estimates the use of other fixed effects (other than year fixed effects) that enter the equation separately.

Table 3. Determinants of Exported Product Scope, Using Disaggregated Products (dimension i,c,t)

	(75)	(81)	(87)	(93)	(99)	(105)
VARIABLES	l_nprod_c(id_ic)	l_nprod_c(id_ic)	l_nprod_c(id_ic)	l_nprod_c(id_ic)	l_nprod_c(id_ic)	l_nprod_c(id_ic)
l_cgdp10	0,0408	0,0428	0,00553			
	[0.0518]	[0.0586]	[0.0640]			
l_cgdppc10				0.130**	0.121**	0,0997
				[0.0532]	[0.0600]	[0.0634]
rer10	4,89E-06		-0,000673	4,07E-06		-0,000434
	[7.94e-06]		[0.000504]	[7.94e-06]		[0.000488]
nerv		-5.712***	-5.034***		-5.592***	-5.137***
		[1.621]	[1.642]		[1.622]	[1.640]
tsa_s1_idn_bas	-0,000274	-0,000367	-0,000332	-0,000243	-0,000345	-0,000326
	[0.000575]	[0.000587]	[0.000587]	[0.000575]	[0.000588]	[0.000588]
Year-effects	Yes	Yes	Yes	Yes	Yes	Yes
FE: plant x destination country	Yes	Yes	Yes	Yes	Yes	Yes
Plant-level control	Yes	Yes	Yes	Yes	Yes	Yes
Observations	58.743	48.506	48.455	58.743	48.506	48.455
R-squared	0,8	0,801	0,802	0,8	0,801	0,802
Adj. R2	0,72	0,723	0,723	0,72	0,723	0,723

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, *<0.1
Plant-level control: l_rcapin_e (capital intensity, measured by energy intensity), l-rlp_o (real labor productivity), l_size (# of labor), own_dom (private–domestic share of ownership), own_f (foreign share of ownership), skill1 (skill intensity), impin (import intensity), and l_age1 (relative, since 2000).
Source: Authors' calculation.

Exchange rate volatility seems to matter more than the exchange rate level. Estimates of $RER10_c$ are often insignificant, even when it is introduced separately as in the previous equation. Meanwhile, estimates of the volatility ($NERV_c$) are robust; they are negative and statistically significant at the 1% confidence level in all experimented specifications. The findings suggest that exporters in the Indonesian manufacturing sector tend to reduce their exported-product scope if there is high uncertainty in the movement of the exchange rate. In other words, the risk imposed by the exchange rate forces exporters to specialise.

It is worth mentioning here that higher GDP per capita tends to increase product scope, as suggested by the positive sign for the estimated $\ln(GDPPC)_c$, although the impact

[5] The basic statistics for the data used for the estimation of equations (2) and (3) are provided in Appendix Table A2.

is suggested to be only moderate. Product scope thus increases with higher levels of development, reflecting more complex or sophisticated demand for products in the more developed countries.

Table 4 presents the results of the estimation of equation (3). The results reported in the table are based on fixed-effect panel-data estimations using the interactive plant (i) and destination country (c). The estimations include year fixed effects in order to control for over time changes within the data period. The results presented in the tables are some of around 1,400 experimented specifications. The estimations use robust standard errors to correct for potential heteroscedasticity. The experiment also estimates the use of the other fixed effects (other than year fixed effects) that enter the equation separately.

Table 4. Determinants of the Concentration of Exported Products or Exporters, Using Disaggregated Products (dimension i,c,t)

	(78)	(84)	(90)	(96)	(102)	(108)
VARIABLES	hhi(id_icnpc4)	hhi(id_icnpc4)	hhi(id_icnpc4)	hhi(id_icnpc4)	hhi(id_icnpc4)	hhi(id_icnpc4)
l_cgdp10	0,0738	0,0786	0,0544			
	[0.0505]	[0.0557]	[0.0608]			
l_cgdppc10				0,0259	0,0351	0,00672
				[0.0535]	[0.0582]	[0.0618]
rer10	4.63e-06***		-0,000484	4.69e-06***		-0,000638
	[9.91e-07]		[0.000463]	[1.01e-06]		[0.000451]
nerv		2,503	3,142		2,582	3.406*
		[1.916]	[2.025]		[1.911]	[2.002]
tsa_s1_idn_bas	0,000478	0,000571	0,000611	0,000466	0,000565	0,000614
	[0.000394]	[0.000397]	[0.000399]	[0.000394]	[0.000395]	[0.000398]
Year-effects	Yes	Yes	Yes	Yes	Yes	Yes
FE: plant x destination country	Yes	Yes	Yes	Yes	Yes	Yes
Plant-level control	Yes	Yes	Yes	Yes	Yes	Yes
Limited sample	Nprod_c >= 4	Nprod_c >= 4	Nprod_c >= 4	Nprod_c >= 4	Nprod_c >= 4	Nprod_c >= 4
Observations	9.351	8.178	8.171	9.351	8.178	8.171
R-squared	0,732	0,736	0,736	0,732	0,736	0,736
Adj. R2	0,613	0,62	0,62	0,613	0,62	0,62

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, *<0.1
Plant-level control: l_rcapin_e (capital intensity, measured by energy intensity), l-rlp_o (real labor productivity), l_size (# of labor), own_dom (private–domestic share of ownership), own_f (foreign share of ownership), skill1 (skill intensity), impin (import intensity), and l_age1 (relative, since 2000).
Source: Authors' calculation.

The impact of the exchange rate on product concentration within a firm (exporter) is not very clear as the estimates of the exchange rate variables are not stable. The estimates of $RER10_c$ are generally statistically very significant and positive, but this is not always the case across the experimented specifications, while the estimates of $NERV_c$ are not always positive. Nevertheless, taking the statistically significant results as an indication of the likely

impact, the exchange rate, both in level and volatility, is suggested to be positively related to product concentration within exporters in Indonesian manufacturing during the period of analysis. Thus, an exchange rate depreciation and higher volatility encourage exporters to specialise; to concentrate on exporting only on few numbers of products, which presumably are the exporters' core-competence products.

This, however, does not match the theoretical prediction, such as that proposed by Chatterjee et al. (2013) for the impact on the level. In this model, an exchange rate depreciation provides an incentive for the firm/exporter to increase the sales of products far from the firm's core competence, which implies a predicted negative relationship. The positive relationship could be the impact of another factor(s) affecting the choice of exported products, one of which could be product competition in the export market. Mayer et al. (2014) developed a model of multiproduct firms that highlights how the differences in the market size and geographical features of the export destination affect the within-firm distribution of export sales across destinations (or the exporting product-mix). The effect is driven by the extent of competition in the destination market. Tougher competition in the destination market reduces the extent of mark-up across products in a firm's exported product-mix and induces the firm to skew its sales towards its best-performing products, which are the firms' core competence products. The model, thus, predicts that the sales of products closer to the firm's core competence increase if there is an increase in the extent of product competition in the export destination market, which is exactly the as indicated by the results here.

5. Summary and Policy Implications

This paper examines the impact of the exchange rate on export performance using plant- and product-level data for the Indonesian manufacturing sector over the period 2008–2012. It addresses both the impact of the level and volatility of the exchange rate. The impact of the latter, especially using micro-level data, has been very small in the literature, and this study, therefore, enriches the literature with more evidence on the role of the exchange rate in exporting. The study considers the impact on the value, scope, and composition of exported products. The level of exchange rate affects exporting because it changes the expected profitability of the exported products, while the volatility of the exchange rate is expected to affect exporting through its role in changing the valuation of the risk from exporting.

The estimations suggest that the exchange rate affects the export values for the exports of the Indonesian manufacturing sector over the period of analysis. The results confirm that both the exchange rate level and volatility affect exporting. Thus, a depreciation of exchange rate depreciation leads to an increase in the value of exported products. This shows that the exchange rate depreciation lowers the price of goods exported by Indonesian exporters, which fits with the model developed by Chatterjee et al. (2013) and is similar with the findings from the Brazilian manufacturing sector.

The impact of exchange rate volatility is suggested to be more important than the level of the exchange rate. Thus, for Indonesian manufacturing, the more volatile the exchange rate, the lower the value of the exports. This is also similar to other findings from developing countries as reviewed earlier.

The finding on exchange rate volatility reflects two potential situations: (i) there are not many opportunities or mechanisms for hedging that the exporters can use; or (ii) exporters are financially constrained. All of these are signals of an underdeveloped financial market. Similar to other developing countries, financial markets in Indonesia indeed are not yet at an advanced stage; they are still developing. The findings, therefore, provide support to the theory of hedging as an important mechanism for mitigating the negative impact of exchange rate volatility on exporting. As for the extent of financial constraints, the study needs to explore the data for this.

As for the impact on product scope, exchange rate volatility seems to matter more than the level. The estimates of the exchange rate level are often are not statistically significant, although the signs are as predicted by theory, while the estimates of exchange rate volatility are negatively related to product scope and are robust. The finding suggests that exporters in the Indonesian manufacturing sector tend to reduce their exported-product scope if there is high uncertainty in the movement of the exchange rate. In other words, the risk imposed by the exchange rate forces the exporters to specialise.

The impact of the exchange rate on product concentration within a firm (exporter) is not very clear, as the estimates of exchange rate variables are not stable. Nevertheless, the results seem to suggest that the exchange rate, both its level and volatility, is positively related to product concentration within exporters in the Indonesian manufacturing sector during the period of analysis. Exchange rate depreciation and volatile exchange rate volatility thus encourage the exporters to specialise; to concentrate on exporting only on few numbers of products, which presumably are the exporters' core-competence products. While this does not match the theory, especially for the impact on the level (e.g. Chatterjee et al. 2013), it fits

with another theoretical model (e.g. Mayer et al. (2014)) that underlines the importance of product competition in the export market as another factor affecting exported product scope and concentration. That is, tougher competition in a destination market reduces the extent of mark-up across products in a firm's exported product mix and induces the firm to skew its sales toward its best-performing products, which are the firms' core-competence products. The prediction of this model is the opposite to the one by Chatterjee et al.

The findings from this study are useful for policymakers. First, the most useful perhaps is an understanding that it is not only the level (of the exchange rate) that matters, but also the volatility of it. To date, in many developing countries, policymakers – including central bankers – believe that only the level of the exchange rate matters, which typically results in either maintaining some constant low-level of depreciation over time or keeping the exchange rate at relatively the same level if there is high pressure for appreciation. This study finds that volatility matters, and it suggests that the impact could even be more important than the level. The impact of the volatility could be quite serious if it is not handled properly; an exchange rate with too high volatility without a sufficient hedging mechanism could result not only in a decline in exporting but also in unrealised new exports – either to new export destinations or of new exported products. Thus, managing the fluctuation of the exchange rate deserves at least the same attention from policymakers as its level.

Second, the government may use the information about the relationship between the exchange rate and exported product scope or composition should it want to pursue an objective regarding exporting. For example, for Indonesia, based on the results of this study, the government should aim for low exchange rate volatility if it wishes to broaden (diversify) the types of exported products – this is because high volatility encourages firms to specialise in their exported products. Third, the finding of a negative impact of exchange rate volatility suggests that it is important for the Indonesian government to develop its financial market. As theory suggests, this will increase the availability of hedging mechanisms that are able to dampen the negative impact of the volatility.

References

Aghion, P., P. Bacchetta, R. Rancière, and K. Rogoff (2009), 'Exchange Rate Volatility and Productivity Growth: The Role of Financial Development', *Journal of Monetary Economics* 56, 4, pp.494–13.

Benhima, K., (2012), 'Exchange Rate Volatility and Productivity Growth: The Role of Liability Dollarization', *Open Economies Review*, 23(3), pp.501–29.

Broda, C. and J. Romalis (2011), 'Identifying the Relationship between Trade and Exchange Rate Volatility', in T. Ito and A.K. Rose (eds.), *Commodity Prices and Markets, East Asia Seminar on Economics 20*. Chicago, IL: University of Chicago Press, pp.79–110.

Broll, U. and B. Eckwert (1999), 'Exchange Rate Volatility and International Trade', *Southern Economic Journal*, 66(1), pp.178–85.

Byrne, J.P, N. Fiess, and R. MacDonald (2008), 'US Trade and Exchange Rate Volatility: A Real Sectoral Analysis', *Journal of Macroeconomics*, 30(1), pp.238–59.

Chatterjee, A., R. Dix-Carneiro, and J. Vichyanond (2013), 'Multi-product Firms and Exchange Rate Fluctuations', *American Economic Journal*, 5(2), pp.77–110.

Chit, M.M., M. Rizov, and D. Willenbockel (2010), 'Exchange Rate Volatility and Exports: New Empirical Evidence from the Emerging East Asian Economies', *The World Economy*, 33(2), pp 239–63.

Clark, P.B. (1973), 'Uncertainty, Exchange Risk, and the Level of International Trade', *Economic Inquiry* 11(3), pp.302–13.

Cote, A. (1994), 'Exchange Rate Volatility and Trade', Bank of Canada Working Paper, No. 94-5, Ottawa: Bank of Canada.

De Grauwe, P. (1988), 'Exchange Rate Volatility and the Slowdown in Growth of International Trade' *IMF Staff Papers*, 35(1), pp.63–84.

De Grauwe, P. (1994), *The Economics of Monetary Integration*. New York, NY: Oxford University Press.

Ethier, W. (1973), 'International Trade and the Forward Exchange Rate Market', *American Economic Review*, 63(3), pp.494–503.

Greenaway, D. and R.A. Kneller (2007), 'Firm Heterogeneity, Exporting and Foreign Direct Investment', *Economic Journal*, 117(517), pp.134–361.

Grier, K.B. and A.D. Smallwood (2007), 'Uncertainty and Export Performance: Evidence from 18 Countries', *Journal of Money, Credit and Banking*, 39(4), pp.965–79.

Hericourt, J. and S. Poncet (2013), 'Exchange Rate Volatility, Financial Constraints, and Trade: Empirical Evidence from Chinese Firms', *The World Bank Economic Review*, 29(3), pp.550–78.

Hooper, P. and S. W. Kohlhagen (1978), 'The Effect of Exchange Rate Uncertainty on the Prices and Volume of International Trade', *Journal of International Economics*, 8(4), pp.483–511.

Kawai, M. and I. Zilcha (1986), 'International Trade with Forward-futures Markets under Exchange Rate and Price Uncertainty', *Journal of International Economics* 20(1–2), pp. 83–98.

Mayer, T., M.J. Melitz, and G.I. Ottaviano (2014), 'Market Size, Competition, and the Product Mix of Exporters', *American Economic Review*, 104(2), pp.495–536.

McKenzie, M.D. (1999), 'The Impact of Exchange Rate Volatility on International Trade Flow', *Journal of Economic Surveys*, 13(1), pp.71–106.

Table A1. Summary Statistics for the Export Database (for the estimation of equation (1))

Variable	Description	Unit	Obs	Mean	Std. Dev.	Min	Max
fobhsusd	Export	1000 US$	209,629	601,403	4,567,774	1	450,000,000
gdp	GDP	Constant 2010 US$	201,557	2.52E+12	4.06E+12	3.18E+07	1.55E+13
gdp_pcap	GDP per capita	Constant 2010 US$	201,557	28,295	19,756	230	144,246
rer	Real exchange rate	LCU/IDR	165,735	0.0766	0.3393	2.75E-05	2.0760
icomp	Market power	%	107,341	8.21	15.24	0	100
ahs	Effectively applied tariff	%	23,158	5.59	10.03	0	513.60
size	Number of workers	Persons	209,629	1,714	4,338	20	32,977
own_dom	Private domestic ownership	%	209,622	59.54	46.76	0	100
own_f	Foreign ownership	%	209,629	39.35	46.49	0	100
skill1	Skill intensity	%	209,629	17.78	16.60	0	96.01
impin	Import intensity	%	202,863	31.21	36.97	0	100
age1	Firm relative age	year	209,629	9.19	3.21	1	13
rcapin_e	Capital intensity (energy based)	Constant 2000, 1000 IDR	205,920	13,494	112,049	0	1.53E+07
rcapin_w	Capital intensity (non-wage value added based)	Constant 2000, 1000 IDR	205,920	120,248	902,645	-105,234	1.67E+08
rlp_o	Real labor productivity (output)	Constant 2000, 1000 IDR	205,920	301,384	1,644,447	28	1.94E+08
rlp_va	Real labor productivity (value added)	Constant 2000, 1000 IDR	205,920	132,041	904,376	10	1.67E+08

Source: BPS (statistical agency *Badan Pusat Statistik*).

Table A2. Summary Statistics for the Product-scope Database (for the estimation of equation (2))

Variable	Description	Unit	Obs	Mean	Std. Dev.	Min	Max
nprod_c	Number of products	Unique 10 digit HS 2012	86,266	2.43	4.00	1	218
gdp	GDP	Constant 2010 US$	82,393	1.89E+12	3.41E+12	3.18E+07	1.55E+13
gdp_pcap	GDP per capita	Constant 2010 US$	82,393	25,513	19,974	230	144,246
rer	Real exchange rate	LCU/IDR	67,403	0.0786	0.3357	2.75E-05	2.0760
icomp	Market power	%	79,252	1.70	1.68	0	6
ahs	Effectively applied tariff	%	56,385	6.23	5.87	0	35.98
size	Number of workers	Persons	86,266	1,070	2,579	20	32,977
own_dom	Private domestic ownership	%	86,262	65.40	45.31	0	100
own_f	Foreign ownership	%	86,266	33.30	44.82	0	100
skill1	Skill intensity	%	86,266	18.10	16.07	0	96.01
impin	Import intensity	%	84,209	28.13	35.81	0	100
age1	Firm relative age	year	86,266	9.15	3.20	1	13
rcapin_e	Capital intensity (energy based)	Constant 2000, 1000 IDR	85,418	13,723	99,584	0	1.53E+07
rcapin_w	Capital intensity (non-wage value added based)	Constant 2000, 1000 IDR	85,418	96,601	1,011,472	-105,234	1.67E+08
rlp_o	Real labor productivity (output)	Constant 2000, 1000 IDR	85,418	303,467	1,906,721	28	1.94E+08
rlp_va	Real labor productivity (value added)	Constant 2000, 1000 IDR	85,418	108,060	1,012,421	10	1.67E+08

Source: BPS (statistical agency *Badan Pusat Statistik*).

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