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Imported Intermediate Inputs and Plants' Export Dynamics Evidence from Indonesian Plant-product-level Data

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Abstract: *This paper asks the question of whether the use of imported intermediate inputs leads to an expansion of plant-level export scope. Using a panel dataset constructed from Indonesian plant-product-level data, the number of plant exports is regressed on the number of intermediate inputs imported by the plant. The results of the instrumental variable estimation support the hypothesis that importing leads to export expansion. The results also indicate that importing intermediate inputs from East Asian countries promotes the expansion of export to advanced countries.*

Keywords: Firm-level data; globalisation; exporting, importing of intermediate inputs.

JEL Classification: F23, F63, L52

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1. Introduction

Promoting firms to export is an important policy challenge for developing countries because export growth and dynamics are essential for sustainable economic development. Seeking effective ways for export promotion, researchers and policymakers have been interested in exploring the determinants of firms' export decisions. The findings of theoretical and empirical studies suggest that they include the existence of fixed (sunk) costs to enter foreign markets (e.g. Roberts and Tybout (1997) and Bernard and Jensen (2004)) and firm productivity (e.g. Melitz (2003)). More recently, the relationship between the use of imported intermediate inputs and exporting has been intensively examined both theoretically and empirically as the Melitz model has been widely extended and rigorous micro-level datasets have become available (e.g. Kugler and Verhoogen (2009, 2012); Goldberg et al. (2010); Bernard, Redding, and Schott (2011); Kasahara and Lapham (2013); Hallak and Sivadasan (2013)).

This study examines the role of imported intermediate inputs when firms start new exports of products that have not been exported by them. The underlying questions to be asked are whether importing intermediate inputs helps firms to start new exporting and, if so, whether the quality/technology provided by the imported intermediate inputs is required to increase the demand of their output in foreign markets amongst other channels through which importing leads to an expansion of firms' export scope. These questions are important especially for policymakers in developing countries. For developing countries relying on export-oriented industries based on cheap labour, the economic development of other neighbouring, less-developed countries poses a competitive threat not only in domestic markets but also in neighbouring regional markets. In such an environment, facilitating imported intermediate inputs could be an important policy measure to maintain competitiveness and also could promote new exporting not only in neighbouring regional foreign markets but also other foreign markets in developed countries where the quality/technology provided by imported intermediate inputs is required.

The relationship between exporting and importing is examined in this study using a plant-product-level dataset for the Indonesian manufacturing sector. There are

some reasons why this study examines Indonesian manufacturing plants. First, Indonesia is a middle-income country where manufacturing exports has been an important driver of economic growth. However, there is concern that the country loses the comparative advantages facing catch-up by latecomers from neighbouring and other countries. Therefore, it is important to promote the development of not only traditional but also new export industries. Second, it is sometime pointed out that the high cost of doing business constrains Indonesian manufacturing exports (e.g. Soesastro and Basri (2005) and Basri and Patunru (2012)). In this respect, trade liberalisation has been expected to ease the problem. Third, the Indonesian manufacturing sector has been increasingly liberalised, especially after the 1997 economic crisis, encouraged by commitments such as the ASEAN Free Trade Agreement and other preferential trade agreements (Widodo, 2008). Therefore, Indonesian manufacturing plants are considered to have adjusted their mix of exports and imports in response to these developments. Finally, trading partners with which Indonesia has concluded preferential trade agreements include developed countries (e.g. Japan and the Republic of Korea (henceforth, Korea)) and developing countries (e.g. ASEAN countries). This study provides an understanding of how trade liberalisation impacts manufacturing exports in a middle-income country and evaluates the effects of the preferential trade agreements.

In the econometric analysis, the export scope, which is measured by the number of exported products, is regressed on the scope of imported intermediate inputs measured by the number of imported intermediate inputs. Taking account for the possible endogeneity problem arising from the relationship between firms' export and import decisions, the empirical model is estimated using an instrumental variables approach as in related previous studies (Damijan, Konings and Polanec, 2014; Bas and Strauss-Kahn, 2014; Feng, Li, and Swenson, 2016).

In the next section, the literature on firms' export behaviour and the association between export and import scopes are reviewed. Section 3 explains the empirical methodology and the dataset examined in this study. Finally, Section 4 provides some concluding remarks.

2. Literature Review

There are at least three possible channels in which importing intermediate inputs affects firms' decisions on export scope (Bas and Strauss-Kahn, 2014). First, importing lower-priced intermediate inputs than in domestic markets may increase the expected export revenue ('direct-cost channel'). For example, Fan, Li, and Yeaple (2015) developed a theoretical model in which the scope of imported intermediate inputs and the quality of output are endogenously determined. Lowered costs thanks to input tariff reductions enable firms to cover the fixed cost of upgrading the quality of output, leading to a shift in their sales to (foreign) markets where demand for quality is relatively strong.

Second, importing intermediate inputs may lead to productivity improvement ('indirect productivity channel'). As indicated by heterogeneous firm models based on Melitz (2003), firms with higher productivity are more likely to enter foreign markets because they can overcome the fixed costs to export. There are also empirical studies that provide evidence that importing intermediate inputs enhances firms' productivity (e.g., Broda and Weinstein (2006); Amiti and Konings (2007); Kasahara and Rodrigue (2008); Gopinath and Neiman (2014); Halpern, Koren, and Szeidl (2015)). For example, Amiti and Konings (2007) examine data on Indonesian manufacturing and suggest that input tariff reductions lead to an improvement in productivity in manufacturing plants importing intermediate inputs.

Third, there is a channel in which the quality/technology embedded in imported intermediate inputs plays an important role in increasing demand in foreign markets ('quality/technology channel'). There are several studies indicating that this channel is more plausible than the direct-cost channel through the lowered prices of intermediate inputs. Goldberg et al. (2010) examined the impact of trade liberalisation on Indian manufacturing firms and find that increased access to new imported intermediate input varieties is an important factor for domestic product growth as well as the cheaper prices of imported intermediate inputs. Kugler and Verhoogen (2009) found a stylised fact that importers tend to pay higher prices for inputs in Colombian manufacturing sectors. Examining Chinese customs data, Manova and Zhang (2012) found that successful exporters tend to use higher quality inputs to produce higher quality goods.

Furthermore, Bas and Strauss-Kahn (2015) provided supporting evidence that, responding to input tariff reductions, Chinese firms importing intermediate inputs from and exporting to developed countries increase the prices of inputs and exports.

There are only a few related empirical studies that directly examine the relationship between the scope of exports and the scope of imported intermediate inputs (Bas and Strauss-Kahn, 2014; Damijan, Konings and Polanec, 2014; Feng, Li, and Swenson, 2016).[1] In an empirical analysis, Bas and Strauss-Kahn (2014) examined a panel dataset for French manufacturing firms and regress the number of exported varieties (product-country pairs) on the number of imported varieties and other control variables.[2] The control variables include total factor productivity in order to control for the effect through the indirect productivity channel. The coefficient on the number of imported inputs is estimated as significantly positive, indicating that there exists a channel other than the indirect productivity channel.

Feng, Li, and Swenson (2016) examined transaction-level data for Chinese manufacturing firms. Their empirical results also confirm that the number of exported varieties is associated with the number of imported varieties.[3] Furthermore, Feng, Li, and Swenson (2016) compared the impacts of imported intermediate inputs from the G7 countries and others. Their results suggest that imports from the G7 countries facilitate exports to the G7 countries. This indicates that quality/technology is embedded in the intermediate inputs imported from advanced countries and is important for sales in advanced countries' markets.[4]

[1] There are also studies that examine the impact of input trade liberalisation on exporting (Bas, 2012; Chevassus-Lozza, Gaigné, and Mener, 2013) and which examine the impact of input trade liberalisation or new imported intermediate inputs on product creation (Goldberg et al., 2010; Choi and Hahn, 2013; Colantone, and Crino, 2014).
[2] The exported and imported varieties variables are expressed in logarithmic form (log [x+1]).
[3] In the estimated model, a productivity variable is included in the analysis of the robustness check.
[4] This result can also be explained by the argument by Kasahara and Lapham (2013) that sunk costs for exporting and importing are complementary.

3. Data and Methodology

3.1. Estimation Strategy

Is the use of imported intermediate inputs a crucial factor for manufacturing plants for expanding the scope of their exports? To answer this question, the following panel data model of the number of products exported by a plant ($\#EX_{it}$) is estimated:

$$\#EX_{it} = \beta_0 + \beta_1 \#IM_{it} + \beta_2 Dim + \beta_3 TFP + \gamma X_{it} + \delta_t + \zeta_i + \eta_{it}.$$

where $\#IM_{it}$ is the number of imported intermediate inputs used in plant *i* in year *t*.[5] X_{it} is a set of control variables, and δ_t, ζ_i, and η_{it} are year-specific effects, plant-specific effects, and an error term, respectively. If β_1 is significantly positive, it suggests that an expansion in the scope of imported intermediate inputs leads to an expansion in the scope of exports. The parameter estimates in the equation may suffer from simultaneous bias because the scope of exports and imported intermediate inputs are likely to be determined simultaneously. Therefore, the equation is estimated by an instrumental variable approach.

Kasahara and Lapham (2013) argue that the sunk and fixed costs of exporting and importing are complementary. This indicates that the firm- or plant-level import status is an important determinant of export status regardless of the number of imports. In this case, the number of exports and the number of imported intermediate inputs are not always correlated. In order to account for this possibility, the independent variables in the equation include a dummy variable (Dim) that takes a value of one if a plant is importing intermediate inputs and is zero otherwise. If β_1 is significantly positive after including Dim, it indicates that there exists a channel through which the number of imports affects the number of exports other than a channel in which importing reduces the sunk costs of exporting.

[5] A similar model is estimated by Feng, Li, and Swenson (2016), who examine data for Chinese firms. In their model, the range of imported intermediate inputs is measured as the number of combinations of the product and source country.

The regression equation also includes a productivity variable (TFP) as an independent variable in order to control for the impact of importing through productivity improvement.[6] Additionally, there are other several factors that may influence the plant-level scope of exports. One is the real exchange rate. The real exchange rate appreciation deteriorates the international competitiveness of domestic manufacturers and negatively influences the scope of plant exports. The impact of the change in the real exchange rate partially depends on what a manufacturing plant is producing, and the scope of products varies over time even within the plant. To account for these, a plant-level real exchange rate index is measured using the following equation:

$$RERI_{it} = \frac{\sum_{j=1}^{n} w_{ijt} REER_{jt}}{\sum_{j=1}^{n} w_{ijt} REER_{j,2005}},$$

where $REER_{jt}$ is the industry-level real effective exchange rate for industry *j*, and w_{ijt} is the share of products that are categorised into products of industry *j* in the total sales of plant *i* in year *t*. Therefore, the numerator is a weighted average of the real effective exchange rate in year *t*, while the denominator is a weighted average assuming that the plant produces same products with the same share in 2005 as in the current year *t*.

Trade policy is also one of the factors. The output tariff reduction induces tougher competition in domestic markets. Responding to this, some plants may take an outward-looking strategy, leading to an expansion of export scope. The impact of the output tariff change also depends on what a plant is producing. The output tariff reduction is measured as the difference from the tariff level in the base year 2000:

$$OTR_{it} = \sum_p w_{ipt} OT_{p,2000} - \sum_p w_{ipt} OT_{pt},$$

where OT_{pt} is a tariff rate on product *p* in year *t*, and w_{ipt} is the share of product p in the total sales of plant *i* in year *t*. Therefore, the second term on the right-hand side is

[6] Total factor productivity is estimated by a methodology suggested by Wooldridge (2009). For the estimation, a module prodest is used in Stata (Mollisi and Rovigatti, 2017).

a weighted average of the output tariffs in year t, and the first term is a weighted average assuming that the plant produces the same products with the same share as in 2000. The OT_{pt}, or the product-level tariff rate, is calculated as a weighted average of the effective tariff rates using the average import share of the corresponding trading partners as weights. Finally, to control for the size of manufacturing activity, the plant size, measured as the output (in log form) and the number of products produced by the plant, is included.

3.2. Instrumental Variables

In the regression model of the export scope, the number of imported intermediate inputs may be endogenous because a plant would determine the scope of exports and imports simultaneously. Therefore, in the estimation of the model, the number of imports is instrumented mainly by three variables. These are the number of intermediate inputs ($\#Input$) and two variables of tariff reduction on imported intermediate inputs (ITR_{it}^{m} and ITR_{it}^{e}), pp.

$$ITR_{it}^{m} = \sum_p \omega_{ipt} IT_{p,2000}^{m} - \sum_p \omega_{ipt} IT_{pt}^{m},$$
$$ITR_{it}^{e} = \sum_p \omega_{ipt} IT_{p,2000}^{e} - \sum_p \omega_{ipt} IT_{pt}^{e},$$

where IT_{pt}^{m} and IT_{pt}^{e} are, respectively, the most-favoured-nation (MFN) and effective rates on product *p* in year *t*, and ω_{ipt} is the share of product p in total intermediate inputs in plant *i* in year *t*. Therefore, the second term on the right-hand side is a weighted average of input tariffs in year t, and the first term is a counterfactual weighted average assuming that the plant uses the same products as inputs with the same share as in 2000. The product-level effective tariff rate is calculated as a weighted average of effective tariff rates using the average import share of the corresponding trading partners as weights.

3.3. Data for the Indonesian Manufacturing Sectors

The model explained above is estimated using a panel dataset for 2000–2012, which is constructed from various data sources. The main sources are plant-product-level datasets from manufacturing surveys conducted by BPS-Statistics (Indonesian

statistical agency). The annual surveys cover manufacturing plants with 20 or more workers. The data contain information on the number of workers, capital stock, total remuneration, and other plant-level variables to create the control variables explained above. The plant-product-level datasets are modules of the survey data. One dataset contains information on production and another contains information on intermediate inputs for each plant. The values of the exported products and imported intermediate inputs are available by product. The information enables us to count the number of products exported and imported by a plant.

In the datasets, a product is defined at the nine-digit Indonesian Commodity Classification (*KKI*), in which manufacturing products are classified into around 16,000 categories. The first four digits of the *KKI* for a product are same as the four digits of the Indonesian Standard Industrial Classification (*KBLI*) to which the product is classified as a product of the corresponding industry.[7] The real effective exchange rate ($REER_{jt}$) at the two-digit *KBLI*-level (or ISIC level) is used for each product and taken from RIETI (2017).[8] The HS numbers corresponding to the *KKI* numbers are identified using a concordance table between the nine-digit country-specific HS codes and the nine-digit *KKI* codes. This enables us to calculate the product-level MFN and effective tariff rates at the *KKI* nine-digit level (OT_p, IT_p^m and IT_p^e).[9]

4. Estimation Results

4.1. Basic Estimation

Before showing the estimation results of the export scope equation, I start by presenting the estimation results of the production scope equation (Column 1 in Table 1). In the equation, the number of products ($\#Prod$) produced by a plant is regressed

[7] The classification is a modified version of the International Standard Industrial Classification, Revision 3.
[8] For details of the calculation of the real effective exchange rates, see Sato at al. (2015).
[9] In the case where one *KKI* code corresponds to more than one HS code, the tariff rate is calculated as a simple average of the tariff rates for the HS codes. The MFN and effective tariff rates at the nine or ten-digit level of HS are taken from the legal text of the IJ-EPA for Japan and the World Bank WITS dataset and the WTO-TAO dataset for other countries.

on the number of intermediate inputs ($\#Input$, including both imported and locally procured intermediate inputs) and other independent variables. The coefficient on $\#Input$ is significantly positive, suggesting that plants using more intermediate inputs produce more products. The coefficient on Dim is significantly positive, suggesting that importers tend to produce more products regardless of the number of imported intermediate inputs. On the other hand, the insignificant coefficient on $\#Im$ suggests that the number of products is not correlated with the number of imported intermediate inputs.

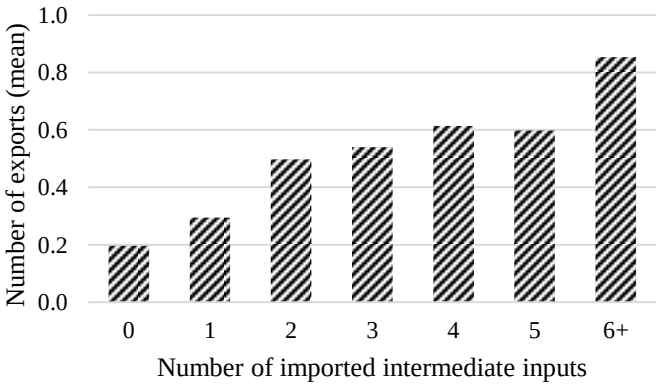
Unlike the number of products explained above, the number of exports is correlated with the number of imported intermediate inputs (columns 2 and 3). Column 2 shows the result of the fixed effects regression, while column 3 shows the results of the fixed effects regression with instrumental variables, in which the number of imported intermediate inputs ($\#Im$) is instrumented by the number of inputs ($\#Input$) and the input tariff reduction variables (IT_{pt}^{m} and IT_{pt}^{e}). In these regressions, the coefficient Dim is not statistically significant. The coefficient on $\#Im$ is significantly positive at the 10% and 5% levels in columns 2 and 3, respectively. These suggest that plants using more kinds of imported intermediate inputs export more kinds of products. This tendency can also be confirmed in Figure 1. The figure shows the average number of plant-level exported products by the number of imported intermediate inputs. The more kinds of imported intermediate inputs plants use, the higher the average number of exported products.

Table 1. Export Scope and Imported Intermediate Inputs

Column	(1)	(2)	(3)	(4)
Dependent variable	$\#Prod$	$\#Ex$	$\#Ex$	$\#Ex$
Estimation	FE	FE	FEIV	Pool-IV
	b/[se]	b/[se]	b/[se]	b/[se]
$\#Im$	-0.020	0.013	0.030	-0.005
	[0.016]	[0.008]*	[0.013]**	[0.008]
Dim	0.099	0.033	0.001	0.268
	[0.039]**	[0.021]	[0.030]	[0.020]***
$\#Input$	0.077	0.003		
	[0.004]***	[0.002]		
$\#Prod$		0.173	0.173	0.168
		[0.009]***	[0.009]***	[0.002]***
TFP	-0.014	-0.007	-0.007	-0.056
	[0.010]	[0.005]	[0.005]	[0.005]***
$RERI$	0.086	-0.076	-0.078	0.081
	[0.051]*	[0.037]**	[0.037]**	[0.019]***
OTR^e	0.003	0.002	0.002	0.006
	[0.002]	[0.001]	[0.001]	[0.001]***
$Ln\ (Output)$	0.047	0.017	0.017	0.092
	[0.005]***	[0.003]***	[0.003]***	[0.001]***
Plant-fixed-effect	Yes	Yes	Yes	
Location, industry, and interaction-effect				Yes
Year-fixed-effect	Yes	Yes	Yes	Yes
Plants	23,218	23,218	23,218	27,280
Observations	129,109	129,109	129,109	133,171
Under ID test			0.000***	
Weak ID test			97.665***	
Over ID test			0.579	
R^2	0.027	0.069	0.069	0.2855

Notes: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. 'UnderID' is the p-value of the Kleibergen-Paap rk LM statistic. 'Weak ID' is the value of the Kleibergen-Paap rk Wald F statistic. 'Hansen J' is the p-value of the Hansen J test statistic. The first three equations are estimated using the `xtivreg2` command in Stata (Schaffer, 2015).
Source: Author's calculations.

Figure 1. Number of Plant-level Exports



Source: Author's calculations.

Regarding the other control variables, the coefficient on the real exchange rate variable, $RERI$, is significantly negative. This indicates that an increase in the relative price in domestic markets compared to prices in foreign markets leads to a decrease in the number of products exported to foreign markets. The plant size measured in terms of output is also statistically significant. However, after accounting for these variables, the coefficients on productivity (TFP) are not statistically significant. More importantly, even after controlling for the productivity, the coefficient on $\#Im$ is significantly positive, suggesting that the technology or quality embodied in imported intermediate inputs is a more important factor that has a positive impact on the number of exported products compared to the improved productivity from importing intermediate inputs. The coefficient for output tariff reduction (OTR) is also not statistically significant.

While the regressions shown in columns (1)–(3) include plant-fixed dummies and year-fixed dummies, the regression shown in column (4) includes location-fixed (province level) dummies, industry-fixed dummies, and their interactions instead of plant-fixed effects. Therefore, the equation is estimated using pooled data with instrumental variables. The coefficient on $\#Im$ is not statistically significant, while the coefficient on Dim is significantly positive. Comparing the results of the panel data models shown in columns (1)–(3), the results indicate that the cross-sectional (between-) variation in export scope is greater than the within-plant variation. The positive coefficient on $RERI$ suggests that plants that manufacture products, which are comparatively high in price, export more kinds of products. In addition, the coefficient

on OTR^e is significantly positive, suggesting that plants that produce products, for which the tariff rates are reduced greatly, export more kinds of products.

4.2. Plant Characteristics: Experience in International Markets

This subsection examines the relationship between plant characteristics and the impact of import scope on export scope. The results explained in the previous subsection suggest that plants using more kinds of imported intermediate inputs tend to export more kinds of products. However, the determinants of export adding (or an increase in the number of exported products) may be different amongst plants with different characteristics. For example, the determinants for non-exporters to start exporting may be different from the determinants for incumbent exporters to start exporting other products that have not been exported. To examine the difference, sample plants are divided into two groups. One group includes plants that did not export during 1990–1999 and the other group includes plants that export their products in at least one year during the period.[10]

[10] For this classification, the export status variable at the plant-level (without product-level information) in the plant-level dataset is used.

Table 2. Impact of Importing and Plant Characteristics (one-way)

Column	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	$\#Ex$	$\#Ex$	$\#Ex$	$\#Ex$	$\#Ex$	$\#Ex$
Sample	***No export experience***	***Export experience***	***No import experience***	***Import experience***	***No foreign ownership***	***With foreign ownership***
Estimation	FEIV	FEIV	FEIV	FEIV	FEIV	FEIV
	b/[se]	b/[se]	b/[se]	b/[se]	b/[se]	b/[se]
$\#Im$	0.013	0.037	0.128	0.012	0.038	0.019
	[0.015]	[0.018]**	[0.041]***	[0.013]	[0.018]**	[0.018]
Dim	0.026	-0.003	-0.139	0.012	-0.022	0.087
	[0.033]	[0.054]	[0.078]*	[0.034]	[0.039]	[0.077]
$\#Prod$	0.100	0.319	0.176	0.167	0.156	0.330
	[0.008]***	[0.024]***	[0.010]***	[0.018]***	[0.009]***	[0.058]***
TFP	-0.010	-0.004	-0.012	0.005	-0.011	0.025
	[0.005]**	[0.014]	[0.005]**	[0.012]	[0.005]**	[0.023]
$RERI$	-0.067	-0.055	-0.085	-0.016	-0.078	-0.051
	[0.037]*	[0.078]	[0.040]**	[0.085]	[0.039]**	[0.126]
OTR^e	0.001	0.007	0.002	0.003	0.002	0.004
	[0.001]	[0.004]*	[0.002]	[0.003]	[0.001]	[0.007]
$Ln\ (Output)$	0.014	0.031	0.012	0.040	0.016	0.045
	[0.003]***	[0.010]***	[0.003]***	[0.009]***	[0.003]***	[0.021]**
Plant-fixed-effect	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed-effect	Yes	Yes	Yes	Yes	Yes	Yes
Plants	19,263	3,955	19,157	4,061	22,108	1,110
Observations	103,660	25,449	101,853	27,256	122,239	6,870
Under ID test	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
Weak ID test	53.462***	59.898***	82.043***	68.885***	75.513***	42.184***
Over ID test	0.598	0.313	0.949	0.282	0.643	0.817
R^2	0.038	0.139	0.066	0.068	0.061	0.148

Notes: See notes for Table 1.
Source: Author's calculations.

The regression results using the subsamples are shown in columns (1) and (2) in Table 2. The coefficient on $\#Im$ is significantly positive for the group of plants with past export experience. This indicates that originally export-oriented plants tend to increase the number of exports when they increase their number of imported intermediate inputs. On the other hand, the coefficient for the group of plants without past export experience, which were domestic-market oriented, is not statistically significant. For this group, the coefficient on TFP is significantly negative, indicating that relatively new exporters tend to reduce the number of exports when their productivity is increased, concentrating on their main products for the domestic market or their main exports for foreign markets. The coefficient on $RERI$ is also significantly negative, indicating that they tend to reduce the number of exports when the price of their product in the domestic market is increased compared to prices in foreign markets.

Similarly with the classification by export experience, the sample plants are classified into two groups based on past experience of importing during 1990–1999. The regression results for the subsamples are presented in columns (3) and (4). Unlike the case of export experience, plants without past import experience tend to increase their number of exports when the number of imported intermediate inputs is increased. Columns (5) and (6) shows the results when plants are classified based on whether the plant's foreign ownership share exceeded 9% in at least one year during 1990–1999. The results suggest that plants without past foreign ownership, or locally owned plants, tend to increase their number of exports.

To examine closely the relationship between the impact of imports on exports and plants' international experience, the sample plants are divided by a three-way classification: past export experience, past import experience, and foreign ownership. The results shown in Table 3 suggest that there are two groups of manufacturing plants that tend to increase their number of exports when they increase the number of imports. One is a group of mainly locally owned plants without either export or import experience. These plants are relatively new entrants in international export and import markets. The other group is mainly of export-oriented foreign-owned plants with both export and import experience.

Table 3. Impact of Importing and Plant Characteristics (Three-way)

Column	(1)	(2)	(3)	(4)
Dependent variable	$\#Ex$	$\#Ex$	$\#Ex$	$\#Ex$
Sample	***Export=No Import=No***	***Export=No Import=Yes***	***Export=Yes Import=No***	***Export=Yes Import=Yes***
Estimation	FEIV	FEIV	FEIV	FEIV
	b/[se]	b/[se]	b/[se]	b/[se]
No foreign ownership				
$\#Im$	0.089	-0.009	0.567	0.011
	[0.036]**	[0.008]	[0.352]	[0.037]
Dim	-0.096	0.051	-0.812	-0.002
	[0.069]	[0.023]**	[0.629]	[0.087]
Plants	17,179	1,815	1,764	1,350
Observations	89,584	12,424	10,969	9,262
With foreign ownership				
$\#Im$	-0.127	-0.050	-0.105	0.035
	[0.307]	[0.053]	[0.125]	[0.017]**
Dim	0.728	0.141	0.489	0.037
	[0.580]	[0.155]	[0.354]	[0.098]
Plants	74	195	140	701
Observations	443	1,209	857	4,361

Notes: See notes for Table 1.
Source: Author's calculations.

4.3. Product Attributes of Exports and Imports

In this subsection, the relationship between the impact of importing on exporting and product attributes is examined. First, products are classified into differentiated and homogeneous goods based on Rauch (1999). He argues that the search costs are higher in matching international buyers and sellers for differentiated goods compared to homogeneous goods, indicating that the determinants of plant export scope may be different by the type of products to be exported. Furthermore, if the source of differentiation in competitive advantage comes from the differentiated intermediate inputs, then the impact of imported intermediate inputs would be different by the type of products to be imported as intermediate inputs.

Table 4. Impact of Importing and Product Attributes

Column	(1)	(2)	(3)	(4)
Dependent variable	$\#Ex.dif$	$\#Ex.hr$	$\#Ex.ac$	$\#Ex.oc$
Estimation	FEIV	FEIV	FEIV	FEIV
	b/[se]	b/[se]	b/[se]	b/[se]
$\#Im$	-0.007	-0.048	0.036	0.001
	[0.012]	[0.014]***	[0.013]***	[0.023]
Dim	0.023	-0.023	-0.021	-0.005
	[0.023]	[0.017]	[0.021]	[0.025]
$\#Im.dif^{(1)}/\ ac^{(3)}$	0.078		-0.085	
	[0.036]**		[0.025]***	
$\#Im.hr^{(2)}/\ oc^{(4)}$		0.087		0.024
		[0.019]***		[0.028]
$\#Prod$	0.125	0.048	0.082	0.090
	[0.008]***	[0.004]***	[0.006]***	[0.005]***
TFP	-0.005	-0.002	-0.003	-0.003
	[0.004]	[0.003]	[0.003]	[0.004]
$RERI$	-0.062	-0.016	-0.039	-0.037
	[0.033]*	[0.018]	[0.025]	[0.026]
OTR^e	0.003	-0.001	0.003	-0.001
	[0.001]**	[0.001]	[0.001]***	[0.001]
$Ln\ (Output)$	0.008	0.010	0.004	0.013
	[0.002]***	[0.002]***	[0.002]**	[0.002]***
Plant-fixed-effect	Yes	Yes	Yes	Yes
Year-fixed-effect	Yes	Yes	Yes	Yes
Plants	23,218	23,218	23,218	23,218
Obs.	129,109	129,109	129,109	129,109
Under ID test	0.000***	0.000***	0.000***	0.000***
Weak ID test	136.773***	136.773***	144.926***	144.926***
Over ID test	0.240	0.007***	0.223	0.234
R^2	0.054	0.018	0.039	0.039

Notes: See notes for Table 1.
Source: Author's calculations.

Column (1) in Table 4 shows the regression results for the number of exported products categorised as differentiated goods ($\#Ex.dif$). The independent variable $\#Im.dif$ refers to the number of imported intermediate inputs categorised as differentiated goods. The coefficient on the variable is significantly positive, while the coefficient on $\#Im$ is not statistically significant. This result indicates that the number of differentiated exports is associated with the number of differentiated imports regardless of the number of other imported intermediate inputs (homogeneous and reference goods). The positive coefficient on OTR^e suggests that the number of differentiated exports increases when the output tariff is reduced. Column (2) shows the regression results or the number of exported products categorised as other than

differentiated goods ($\#Ex.hr$). The coefficient on $\#Im.hr$, the number of imported intermediate inputs categorised as other than differentiated goods, is significantly positive, and the coefficient on $\#Im$ is significantly positive. This result suggests that the importing of products other than differentiated goods leads to an increase in the number of exports categorised as other than differentiated goods, while the importing of differentiated goods leads to a decrease.

The next question to be asked here is whether importing from advanced countries leads to an expansion in export scope to advanced countries. This question is asked by Feng, Li, and Swenson (2016), who examine transaction-level data for Chinese firms and provide evidence that importing from the G7 countries facilitates exporting to the G7 countries.[11] Unfortunately, in the data for Indonesian manufacturing, the information on the destination of exports and the source of imports for each plant is not available. Instead, products are classified based on the shares of trading partners in national trade statistics as follows. First, the export and import values at the nine-digit level of the Indonesian Commodity Classification (*KKI*) are calculated from the Indonesian trade statistics by trading partner and commodity at the nine or ten-digit level of HS.[12] Second, the share of exports to advanced countries is calculated for each product using the export data for 2000–2002 (three-year average). Similarly, the share of imports from advanced countries is calculated. Third, if the share exceeds 50%, then the product is classified as a product mainly exported to or imported from advanced countries.

Columns (3) and (4) show the regression results for the number of products mainly exported to advanced countries ($\#Ex.ac$) and other countries ($\#Ex.oc$), respectively. Here, the advanced countries are defined as member countries of the OECD's Development Assistance Committee (DAC), excluding Japan and Korea.[13,]

[11] In their very rich dataset, not only the value and quantity of transactions are highly disaggregated at the eight-digit HS level but also the source or destination country is identified for each transaction by manufacturing firm during 2002–2006.

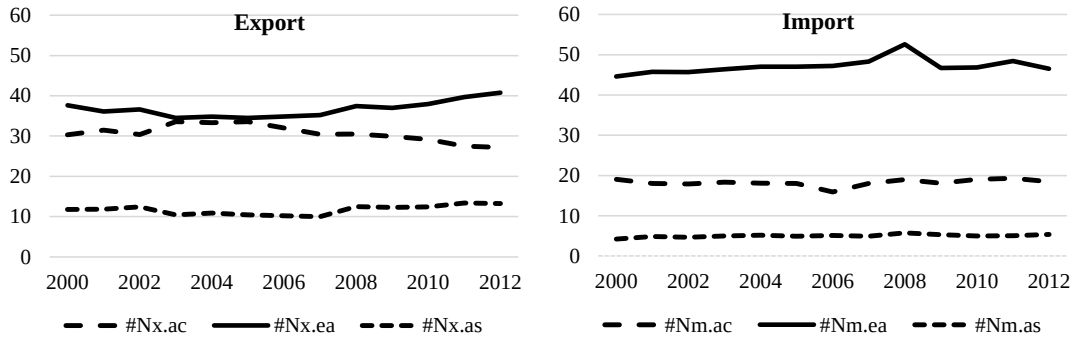
[12] If an HS number corresponds to more than one *KKI* number, the value is divided by the number of *KKI* and allocated to each *KKI* number equally.

[13] Development Assistance Committee (DAC) members include 29 countries as well as the European Union: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Republic of Korea, Luxembourg, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden,

[14] For the equation of $\#Ex.ac$, the coefficient on $\#Im$ is significantly positive and the coefficient on $\#Im.ac$ is significantly negative. This result suggests that manufacturing plants tend to export more kinds of products mainly to advanced countries when they use more kinds of intermediate inputs mainly imported from other countries; but they export fewer kinds of products when they use more kinds of intermediate inputs from advanced countries.

The result explained above is different from the case of China as examined by Feng, Li, and Swenson (2016), which suggests that exports to advanced countries are associated with imports from those countries. One of the possible reasons for the different result between China and Indonesia is the difference in the relative importance of the triangular trade pattern, in which Asian developing countries import key components from Asian advanced countries, like Japan and Korea, and export assembled products to other advanced countries. Furthermore, ASEAN countries, including Indonesia, have promoted regional integration and a mutual supply system for intermediate products has been developed in the region.

Figure 2. Shares in the Number of Exports and Imports by Product Type (%)



Source: Author's calculations.

Switzerland, the United Kingdom, and the United States.

[14] The inclusion of Japan and the Republic of Korea does not change the main results in Table 4.

Table 5. Product Type by Origin and Destination

Column	(1)	(2)	(3)
Estimation	FEIV	FEIV	FEIV
	b/[se]	b/[se]	b/[se]
Export to advanced countries ($\#Ex.ac$)			
$\#Im$	0.036	0.014	-0.022
	[0.013]***	[0.009]	[0.011]**
$\#Im.ac^{(1)}/as^{(2)}/ea^{(3)}$	-0.085	-0.034	0.072
	[0.025]***	[0.057]	[0.023]***
Export to ASEAN ($\#Ex.as$)			
$\#Im$	-0.002	-0.003	-0.003
	[0.004]	[0.003]	[0.005]
$\#Im.ac^{(1)}/as^{(2)}/ea^{(3)}$	0.005	0.051	0.005
	[0.010]	[0.025]**	[0.007]
Export to East Asian economies ($\#Ex.ea$)			
$\#Im$	0.009	0.005	0.012
	[0.008]	[0.006]	[0.009]
$\#Im.ac^{(1)}/as^{(2)}/ea^{(3)}$	0.001	0.057	-0.006
	[0.019]	[0.050]	[0.015]

Notes: See notes for Table 1.
Source: Author's calculations.

In order to take into account these aspects, products mainly exported to and imported from ASEAN countries and East Asian countries (including ASEAN countries) are defined similarly with the case of advanced countries. Figure 2 shows that about half of the products imported by manufacturing plants are products that are mainly imported from East Asian countries. It also suggests that the share of products mainly exported to advanced countries in the total number of exported products is gradually declining. The estimation results using these classifications are summarised in Table 5. As already explained above, in the equation for $\#Ex.ac$ (upper panel, column 1), the coefficient on $\#Im.ac$ is significantly negative. On the other hand, if we include $\#Im.ea$ instead of $\#Im.ac$ in the equation (upper panel, column 3), its coefficient is significantly positive, suggesting that the number of products mainly exported to advanced countries is associated with the number of intermediate inputs mainly imported from East Asian countries.[15] This indicates that plants exporting more products to advanced countries tend to import more kinds of intermediate inputs from East Asian countries.

[15] This result does not change if China is excluded from the definition of the East Asian countries group.

Another significantly positive coefficient is on $\#Im.as$ in the equation of $\#Ex.as$ (middle panel, column 2). This result suggests that the number of products mainly exported to ASEAN countries is associated with the number of intermediate inputs mainly imported from the ASEAN countries. This is consistent with the argument by Rauch (1999) that proximity is an import factor for bilateral trade (especially for differentiated goods).

5. Concluding Remarks

For middle-income countries, promoting manufacturing exports is an important policy challenge for sustainable economic growth because some countries are likely to lose the comparative advantages facing catch-up by latecomers. Therefore, it is important to promote export dynamics at not only the industry level but also the firm or plant level. This study has examined the relationship between the number of exports and imported intermediate inputs at the plant level in the Indonesian manufacturing sector to examine the importance of the use of imported intermediate inputs in producing products to be exported. The findings from the empirical analysis have several important implications for policies to facilitate the diversification or dynamics of plant-level exports.

First, policy measures promoting the use of more kinds of imported intermediate inputs can also promote manufacturing firms to export more kinds of products. There are some possible channels through which importing intermediate inputs leads to more kinds of exports. Amongst them, the empirical results in this study indicate that some exported products are required to be partially composed of imported intermediate inputs, and the quality/technology embodied in them can contribute to the expansion of export scope at the plant level.

Second, policy measures to promote the use of more kinds of imported intermediate inputs are more effective for local firms that have not much international experience. This is supported by the empirical results that suggest the number of exports is positively associated with the number of intermediate inputs for plants without foreign ownership or export or import experience during the previous decade

of the sample period for the regressions. Especially, supporting these plants to use imported intermediate inputs is important because the negative impacts of catch-up by other developing countries are likely to be greater for them.

Third, promoting the use of intermediate inputs from other ASEAN countries would be helpful to facilitate export dynamics at the plant level. The empirical results suggest that importing intermediate inputs from ASEAN countries leads to an expansion of product scope, mainly to ASEAN countries. Furthermore, the results also indicate that for differentiated products to be exported, the use of imported differentiated intermediate inputs is crucial. As argued by Rauch (1999), if proximity is an import factor for bilateral trade, especially for differentiated goods, promoting importing from and exporting to ASEAN countries is more effective. In this respect, deepening regional economic corporation and integration in the ASEAN region would facilitate the dynamics of firm exporting.

Fourth, unlike exports to ASEAN countries, exports to advanced countries are required to be composed of intermediate inputs imported from East Asian countries (including ASEAN countries). This result is considered to reflect the triangular trade pattern in which Asian developing countries import key intermediate inputs from other East Asian countries, like Japan, and Asian NICs and export products composed of the inputs. Promoting imports from East Asian countries can be an important policy measure to facilitate exporting to advanced countries. This would help Indonesian manufacturing firms to escape from the competitive pressure from other less developed countries in the region.

Finally, the empirical results in this analysis indicate that the technology or quality embedded in imported intermediate inputs is an important factor for the dynamics of export scope. In this respect, foreign-owned firms operating in Indonesia can play an important role because they are thought to be able to provide sophisticated intermediate inputs that are not available from local firms. Therefore, policy measures to promote inward foreign direct investment in upstream industries are also important for facilitating export dynamics.

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Appendix Table 1. Summary Statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
$\#Prod$	133,171	1.869604	1.477972	1	25
$\#Ex$	133,171	0.300321	0.928199	0	15
$\#Input$	133,171	3.640838	2.783334	1	83
$\#Im$	133,171	0.381622	1.244402	0	83
Dim	133,171	0.157707	0.364467	0	1
TFP	133,171	4.061411	1.076318	0.568389	15.371
$RERI$	133,171	1.340722	0.276249	0.910553	2.992595
OTR^e	133,171	3.395585	4.385976	-25	45.51279
$ln(Output)$	133,171	15.07251	2.198962	8.154788	25.15439

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