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Input Allocation Behaviour on Tariff Changes: The Case of Indonesia's Manufacturing Industries

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Abstract: *Can firms reallocate their imported inputs to domestic sources when faced with import tariffs? To answer this question, we analyse the input allocation behaviour of Indonesian medium and large-sized manufacturing firms in responding to the movement of import tariffs from 2000 to 2013 by utilising plant-level input data of Indonesian manufacturing. We find that an increase in tariffs only creates a weak substitution effect. Our findings indicate that firms reallocate their inputs towards domestic sources, although this is accompanied by a decrease in the firms' value added. This implies that domestic inputs are worse substitutes for imported inputs and that firms' capacity to switch over to domestic products is limited, suggesting that firms will immediately switch back to importing when the tariff is removed. We find no evidence that firms make any adjustment towards more domestic-oriented input composition over time; and heterogeneity exists within the result, as industries with a strong basis in the domestic market are more capable of adjusting.*

Keywords: tariff, imported input, import substitution, Indonesian manufacturing

***JEL Classification*:** F61, F14, L60

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1. Introduction

The behaviour of firms' input usage in responding to trade liberalisation has not been widely explored. This is in contrast to evidence supporting the argument that imported inputs bring productivity gains through learning and improvement in quality. This study assesses the impact of tariff reduction on imported inputs and on firms' input allocation behaviour, especially with respect to substitutability between imported and domestic inputs. The study attempts to answer the following questions: do changes in import tariffs on inputs make firms substitute their inputs from local to foreign sources? and to what extent of the firms' switching capability?

In examining input usage behaviour, the study estimates the effect of input tariffs on the imported input ratio, imported value, and total input value. It also analyses the effect of the tariff on outputs, proxied by value added. This study conducts exploratory estimations to identify the impact of tariffs on input usage indicators. It identifies the capability of firms to switch to domestically produced inputs using value added as the proxy for performance. If firms can switch their input sources perfectly, firms' performance should not change. The analysis conducted by this study is possible because of the rich database on Indonesian manufacturing, which records detailed input usage for firms on both domestic and imported inputs.

This study goes deeper by conducting multiple estimations over time and across industries and examining the coefficient variations between them. Our intention in analysing the coefficient variations over time is to check whether firms adjust their input sources to domestic sources after being exposed to some level of import tariffs over time. The analysis of the sectoral variation checks whether the impact is different across industries within manufacturing. This is motivated by a recent study on the subject (Narjoko, Anas, and Herdiyanto, 2018), which indicated that several firms invest in the intermediate input sector in Indonesia to reduce import costs.

The overall study is motivated by the deeper trade liberalisation that has happened in Indonesia since 1998 following the Asian financial crisis. Tariffs on imported inputs have been decreasing over time (falling to 5% on average in 2013), but the imported input value (in real terms) also showed a surprising decreasing trend from 2000 to 2013 (Figure 1). At the same time, the domestic input value (in real

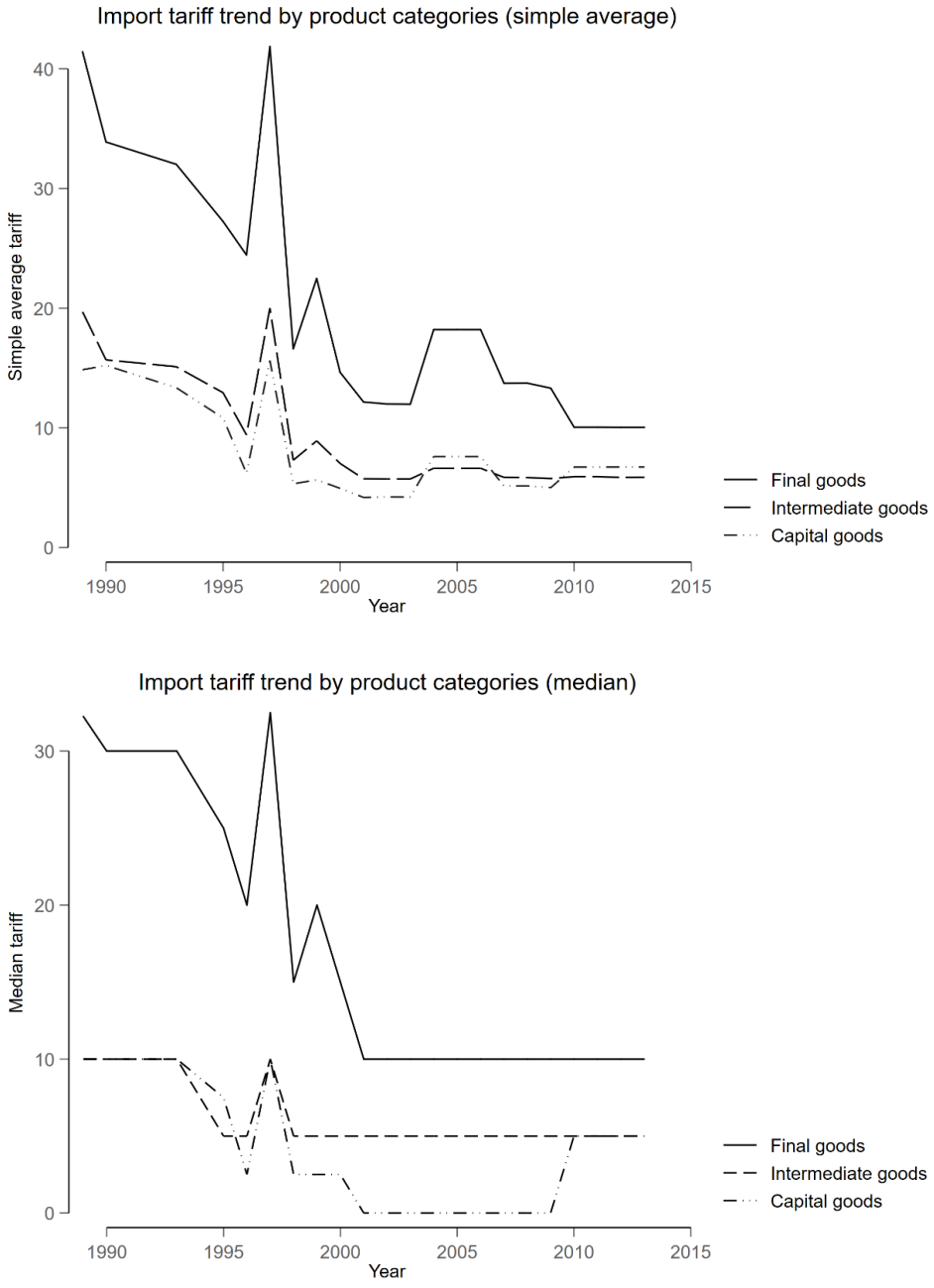
terms) has been increasing. This phenomenon raises a question about the effectiveness of tariff reduction in increasing the usage of imported inputs, considering the hypothesis that a decrease in tariffs should be accompanied by an increase in imported input value. Figure 1 shows an indication of some degree of substitutability between imported and domestic inputs, through the opposite trend between imported and domestically produced inputs.

Figure 1: Real Input Value Trend, 2000–2013

Source: Statistics of Indonesia's Large and Medium Manufacturing Survey, authors' calculation.

Despite the implementation of various policy reforms after the crisis, manufacturing in Indonesia has not grown much in terms of productivity, pointing to a lack of competitiveness in the sector. The growing threat of protectionism depresses competitiveness even further. This phenomenon is popularly known as 'creeping protectionism', as described in Basri and Hill (2008) and Pangestu, Rahardja, and Ing (2015), for example. Notwithstanding, Indonesia has managed to keep import tariffs reasonably low (Figure 2).

Figure 2: Trend of Import Tariffs by Type of Goods



Source: World Integrated Trade Solution (WITS), World Bank, authors' calculation.

While an extensive amount of literature on imported inputs and productivity exists, literature regarding input usage behaviour per se is still limited. Regarding the relationship between imported inputs and productivity, multiple studies have shown the positive effects of trade liberalisation, including intermediate inputs, on productivity. On the theoretical side, studies such as Grossman and Helpman (1993)

and Romer (1987) have elaborated on the importance of intermediate inputs and specialisation in firms' productivity. Empirical studies have also found a positive relation between imported intermediate inputs and productivity in India (Goldberg et al., 2010); China (Feng, Li, and Swenson, 2012; Liu and Qiu, 2016; and Huang, Salike, and Zhong, 2017); Hungary (Halpern, Koren, and Szeidl, 2015); and France (Bas and Strauss-Kahn, 2014). In the case of Indonesia, Amiti and Konings (2007) reinforced the role of trade liberalisation, especially in the reduction of intermediate input tariffs, in increasing firms' productivity.

Vandenbussche and Viegelahn (2018) is one of the most recent studies on firms' input reallocation behaviour. Using India's database, coupled with anti-dumping policies in India, they found that Indian firms respond to protectionist policy by substituting protected imported inputs with other unprotected inputs, both imported and domestic. They also found that firms adjust their production by reducing outputs made with protected inputs. Another study on imported input behaviour with regard to protectionist policy, especially import tariffs, is Gopinath and Neiman (2014). Using Argentinian firms' data, they found that the increase in imported tariffs has no effect on the extensive margin, i.e. importers were still importing their inputs and did not switch to domestic inputs. However, in terms of changes within firms (intensive margin), they found significant heterogeneity in the analysis, which implies that firms' characteristics affect the input mix significantly.

In one of the most recent findings in Indonesia, Narjoko, Anas, and Herdiyanto (2018) suggested a non-linearity between protectionist policy on imported intermediate inputs and productivity. When considering firms' heterogeneity, several firms were revealed to be investing in the intermediate inputs sector in response to protectionist policy, mainly reflected in the high ratio of foreign ownership in intermediate inputs manufactures. These firms have the following characteristics: (i) the investing firms tend to be large; (ii) most investing firms are in capital-intensive sectors such as the electronics, machinery, and automotive industries; and (iii) the investing firms have been established for longer periods than average. In this case, firms are responding according to policymakers' expectations, as they choose to reallocate their foreign intermediate inputs to domestic intermediate inputs, while creating a positive impact on industries in the form of

investment. However, while trade liberalisation and productivity have been thoroughly assessed, firms' decisions on how to allocate their inputs have not been widely explored.

Based on this, we hypothesise that the intermediate input usage behaviour in firm-level analysis is an interesting phenomenon to explore since it is highly dynamic and largely unexplored. Firms' tendency to reallocate or complement their inputs can also be heterogenous and responsive to firms' characteristics and trade policies. Therefore, we examine this phenomenon by exploring the effect of imported input tariffs on input values and the foreign input ratio. We also observe the relationship between import tariffs and firms' performance to find further evidence on the behaviour of firms. We aim to find the heterogeneity entangled in the analysis. We utilise the firm-level data of Indonesia's large and medium-sized manufacturing industries from 2000 to 2013, accompanied by product-level data on input usage, as our main source of data.

In addition to contributing to the lack of literature related to input usage, our study has a potential policy implication related to the current trend in import substitution and creeping protectionism. Import tariffs are often seen as one of the major tools for the import substitution strategy, where the increase in import tariffs is expected to shift firms' imported input usage towards domestic inputs. In addition, firms' switching decisions to use domestic products as their inputs are often postulated as a measure of a successful import substitution strategy. As our study directly assesses this effect, it provides a method to assess the import substitution strategy in Indonesia.

2. Data

The main source of data is from Indonesia's large and medium-sized manufacturing industries (also known as *Statistik Industri Manufaktur Besar Sedang* (SI)) published by Statistics Indonesia. This database provides plant-level survey data covering all large and medium-sized manufacturing industries in Indonesia. The survey is conducted annually and each plant observation is tracked every year. The SI has unique plant level identifiers. This study uses SI annual data for 2000–2013. It

also uses Broad Economic Categories (BEC)[1] to identify intermediate inputs or other types of inputs. The weakness of the BEC is that it is too broad to classify an industry, therefore this study incorporates BEC codes into the 4-digit International Standard Industrial Classification of All Economic Activities (ISIC) Rev. 3. Thus, we can classify the ISIC Rev. 3 using the categories of goods (final, intermediate, and capital goods).

This study employs input data used by every large and medium-sized manufacturing plant, which is a subset of the SI data, for the same period as in the main database (2000–2013). The input database consists of detailed input components (9-digit Indonesian product classification), including raw material and intermediate inputs. The data are available annually and comprise domestic and foreign sources of inputs, as well as the quantity and value used for each input product. For the tariff data, the main source is the United Nations Conference on Trade and Development (UNCTAD) Trade Analysis Information System (TRAINS). This database uses the 6-digit Harmonised System (HS) level code for tariff rates, therefore adjustment was carried out to match the industry and product classification used in the SI and input database. With this aggregation, loss of detail and specifications is inevitable, but we observe that the number of inputs represented in the 4-digit ISIC code does not differ much from the original 9-digit classification system.

Since the annual data of the input database contain many inconsistencies, this study spent considerable efforts organising, cleaning, and making it ready for our analysis. The data cleaning steps are detailed in Appendix A1.

[1] BEC classification does not seem to have a reference in its classification of goods. Therefore, we also observe a classification alternative using the goods classification systems of the United Nations Conference on Trade and Development (UNCTAD), based on the 6-digit level of the Harmonised System (HS) to identify final, intermediate, raw, and capital goods. However, we decided to use the BEC classification since it covers more goods and identifies intermediate goods better than the UNCTAD classification. Thus, we consider the BEC classification to be more reliable.

3. Descriptive Statistics of Input Usage and Import Tariff Changes

Table 1: Imported Input Value by Output Sector

(Rp million)

Industry description	2000	2004	2008	2013	% change 2000–2004	% change 2004–2008	% changes 2008–2013
Basic metals	4,548,315	4,685,958	4,960,974	1,741,828	3%	6%	-65%
Chemical products	9,875,415	8,038,518	12,109,396	10,454,831	-19%	51%	-14%
Coal and oil products	137,751	31,280	24,602	1,318	-77%	-21%	-95%
Communication equipment	6,909,788	2,211,466	1,265,599	623,721	-68%	-43%	-51%
Fabricated metal	4,109,812	2,280,563	1,532,061	2,462,524	-45%	-33%	61%
Food and beverages	8,514,863	9,641,163	5,602,585	9,879,997	13%	-42%	76%
Furniture	531,519	452,947	722,202	1,713,569	-15%	59%	137%
Garments	1,294,538	1,665,520	1,357,533	884,146	29%	-18%	-35%
Leather and footwear	2,855,559	1,763,907	1,174,687	1,530,509	-38%	-33%	30%
Machinery and equipment	366,044	728,136	1,001,163	746,800	99%	37%	-25%
Motor vehicles	1,524,468	2,718,224	3,020,268	4,751,134	78%	11%	57%
Non-metal mineral	1,066,252	1,165,668	600,376	347,658	9%	-48%	-42%
Office equipment	1,029	760			-26%		
Other transport equipment	5,948,750	1,108,555	457,216	343,598	-81%	-59%	-25%
Other electric machineries	1,429,297	2,370,010	1,786,572	1,263,415	66%	-25%	-29%
Paper products	9,170,209	3,029,106	3,746,280	1,269,236	-67%	24%	-66%
Precision tools	426,016	117,571	61,747	137,910	-72%	-47%	123%
Printing and reproduction	1,055,616	157,527	168,584	105,585	-85%	7%	-37%
Rubber products	5,137,530	3,045,969	2,192,799	1,685,066	-41%	-28%	-23%
Textile	8,289,799	7,868,012	4,794,752	4,533,621	-5%	-39%	-5%
Tobacco	770,232	650,521	1,242,638	209,853	-16%	91%	-83%
Wood/bamboo products	684,981	739,297	315,943	80,998	8%	-57%	-74%

Source: Statistics of Indonesia's Large and Medium Manufacturing Survey, authors' calculation.

Imported inputs utilised by industry seem to have declined over 2000–2013, since almost all sectors are shown to have used less imported inputs (Table 1). These sectors experienced negative growth in the usage of imported inputs, except the motor vehicle industry, which showed persistent growth from 2000 to 2013. In contrast, the precision tools industry experienced a sudden jump in the use of imported inputs during this period. Meanwhile, the basic metal industry experienced a declining trend in the recent period (2008–2013) after having positive growth in the earlier period (2003–2008).

No pattern emerges in the usage of domestic inputs. As presented in Table 2, some sectors experienced declining usage of domestic inputs while others experienced high usage growth. For example, the usage of domestic inputs in the furniture industry increased to 32% during 2004–2008 but fell rapidly to –73% in 2008–2013. The only three sectors with high growth in domestic input usage in 2008–2013 were chemical products, coal and oil products, and the food and beverage industry.

Table 2: Domestic Input Value by Output Sector

(Rp million)

Industry Description	2000	2004	2008	2013	% change 2000–2004	% change 2004–2008	% change 2008–2013
Basic metals	8,457,132	6,672,689	11,420,596	4,248,501	-21%	71%	-63%
Chemical products	7,834,695	12,411,086	9,432,899	24,562,744	58%	-24%	160%
Coal and oil products	336,891	47,584	49,232	223,003	-86%	3%	353%
Communication equipment	2,719,943	3,270,720	456,543	779,758	20%	-86%	71%
Fabricated metal	2,528,088	3,794,120	2,317,759	3,014,056	50%	-39%	30%
Food and beverages	32,097,890	48,711,135	34,199,375	125,316,379	52%	-30%	266%
Furniture	3,639,130	2,965,849	3,913,779	1,071,069	-19%	32%	-73%
Garments	1,734,650	2,075,277	2,005,071	1,161,138	20%	-3%	-42%
Leather and footwear	2,922,876	1,817,014	2,303,666	1,992,628	-38%	27%	-14%
Machinery and equipment	261,559	1,031,315	1,610,251	1,549,512	294%	56%	-4%
Motor vehicles	467,294	8,045,986	4,446,233	3,342,504	1,622%	-45%	-25%
Non-metal minerals	1,429,555	2,464,375	2,824,791	1,345,047	72%	15%	-52%
Office equipment	1,244	10			-99%		

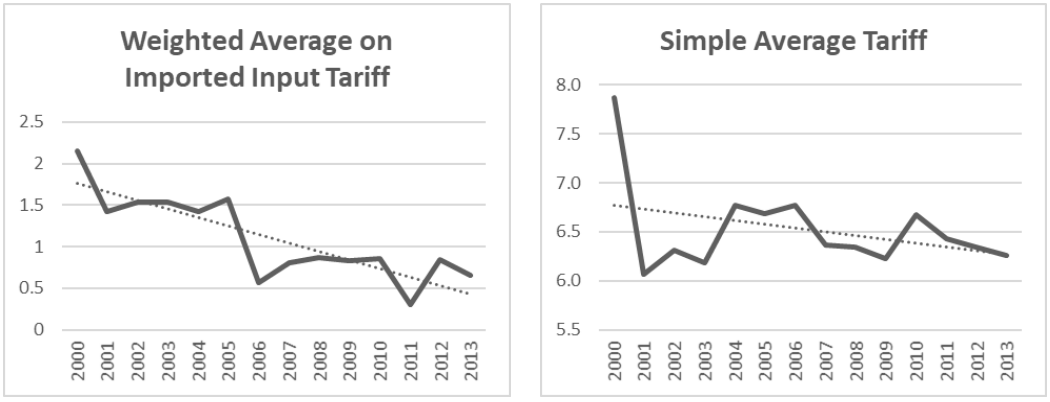
Other transport equipment	4,695,159	1,973,479	2,062,588	1,406,393	-58%	5%	-32%
Other electric machinery	862,721	7,973,722	3,443,422	1,235,714	824%	-57%	-64%
Paper products	7,277,243	7,011,229	13,133,920	6,937,968	-4%	87%	-47%
Precision tools	21,681	17,618	65,034	84,912	-19%	269%	31%
Printing and reproduction	3,460,636	3,047,788	2,086,786	979,898	-12%	-32%	-53%
Rubber products	7,049,729	9,557,991	8,251,588	5,119,990	36%	-14%	-38%
Textile	18,870,409	14,393,081	10,633,876	11,872,691	-24%	-26%	12%
Tobacco	8,308,713	5,105,517	19,172,292	10,713,722	-39%	276%	-44%
Wood/bamboo products	15,459,421	12,061,874	3,623,083	1,407,671	-22%	-70%	-61%

Source: Authors' calculation.

There is no clear inference as to whether the relationship between the two types of inputs substitutes or complements each other just by observing their general trend. Some sectors, such as motor vehicles, have a clearer relationship – as their imported input usage increases, they use less domestic inputs. However, in sectors such as the food and beverage industry, the trend of usage of both domestic and imported inputs is moving in a complementary direction. Sectors such as textiles also experience both decreasing usage of domestic and imported inputs.

Figure 3 shows the trend in tariffs imposed on imported inputs. Since 2000, we can see an overall declining trend in the amount of tariff measures. An increase occurred in tariff measures for some years, such as 2003–2006, but subsequent trends decline continuously.

Figure 3: Aggregate Input Tariffs Imposed on Industries



Source: WTO Trains database, authors' calculation.

Table 3: Import Tariff Trend by Sector – Intermediate Goods

ISIC Rev. 3	Description	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	Agriculture	4.2	4.0	4.0	4.0	4.0	4.0	4.3	4.2	4.3	4.4	4.4	4.3	4.3
2	Forestry	2.2	2.1	2.1	1.2	1.2	1.2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
5	Fisheries	7.5	7.5	7.5	6.5	6.5	6.5	5.6	5.6	5.6	6.1	6.1	6.1	6.1
10	Coal mining	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
11	Oil and gas	3.0	3.0	3.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
12	Uranium and thorium mining	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
13	Mining of metal ores	3.8	3.8	3.8	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
14	Other mining	3.8	3.8	3.8	3.9	3.9	3.9	3.7	3.7	3.5	3.7	3.7	3.7	3.7
15	Food and beverages	5.1	4.7	4.5	6.3	6.3	6.3	6.4	6.4	6.5	5.0	5.0	4.7	4.7
17	Textiles	8.6	8.6	8.6	8.7	8.7	8.7	8.9	8.9	8.9	8.9	8.9	8.9	8.9
18	Garments	6.3	6.3	6.3	6.4	6.4	6.4	6.7	6.7	6.7	5.0	5.0	5.0	5.0
19	Leather and footwear	0.9	1.2	1.2	1.3	1.3	1.3	1.4	1.3	1.3	1.3	1.3	1.3	1.3
20	Wood/ bamboo products	2.4	2.3	2.3	4.1	4.1	4.1	3.0	3.0	3.0	2.2	2.2	2.2	2.2
21	Paper products	3.9	4.2	4.2	4.4	4.4	4.4	4.5	4.4	4.4	4.4	4.4	4.4	4.4
22	Publishing/ printing	4.5	4.5	4.5	3.2	3.2	3.2	3.8	3.8	3.8	3.8	3.8	3.8	3.8
23	Coke, petroleum, nuclear fuel	3.6	4.5	4.5	4.7	4.7	4.7	2.4	2.4	2.1	2.2	2.2	2.2	2.2
24	Chemical products	4.6	4.6	4.6	5.1	5.1	5.1	4.6	4.6	4.5	5.2	5.2	5.0	5.0
25	Rubber products	11.5	11.6	11.5	13.2	13.2	13.2	12.3	12.3	11.8	10.2	10.2	10.2	10.2
26	Non-metallic minerals	6.0	6.0	6.0	5.8	5.8	5.8	6.8	6.8	6.4	6.6	6.6	6.6	6.6
27	Basic metals	7.5	7.4	7.5	9.7	9.7	9.7	6.6	6.6	6.5	6.4	6.4	6.4	6.4
28	Fabricated metals	9.3	9.3	9.3	10.4	10.4	10.4	9.8	9.8	9.4	9.5	9.5	9.5	9.5
29	Machinery and equipment	1.7	1.9	1.8	2.1	2.1	2.1	2.3	2.3	2.3	4.9	4.9	4.9	4.9
30	Office equipment	1.0	0.8	0.8	1.1	1.1	1.1	1.3	1.3	1.3	2.2	2.2	2.2	2.2

ISIC Rev. 3	Description	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
31	Electrical machinery	7.2	7.2	7.2	7.1	7.1	7.1	6.1	6.1	5.8	5.9	5.9	5.9	5.9
32	Communication equipment	0.8	0.8	0.8	1.4	1.4	1.4	1.0	1.0	1.0	1.8	1.8	1.8	1.8
33	Precision tools	3.7	3.7	3.7	3.9	3.9	3.9	3.9	3.9	3.9	4.7	4.7	4.7	4.7
34	Motor vehicles	12.7	12.7	12.7	10.9	10.9	10.9	8.0	7.6	8.0	6.7	6.7	6.3	6.7
35	Other transport equipment	3.7	3.7	3.7	6.1	6.1	6.1	5.0	5.1	5.1	5.5	5.5	5.5	5.5
36	Furniture	8.3	8.3	8.3	8.5	8.5	8.5	8.4	8.4	8.4	7.1	7.1	7.1	7.1
40	Electricity	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
74	Other services	7.5	7.5	7.5	7.2	7.2	7.2	6.9	6.9	6.9	3.8	3.8	3.8	3.8
92	Recreation, culture, and sport	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Source: WTO Trains database, authors' calculation.

Table 4 shows that several sectors of final goods are charged with relatively high import tariffs, especially on motor vehicle, garment, textile, leather and footwear, non-metallic metal, and rubber products (all are above 10%). This is interesting to note since several large tariffs are imposed in manufacturing sectors with high value added and export value in Indonesia, such as motor vehicle and chemical products. While uncertain, this reinforces an argument that there is still an effort to retain a classical trade protection strategy within the import of final goods, arguably to keep the domestic products competitive.

Table 4: Import Tariff Trend by Sector – Final Goods

ISIC Rev. 3	Description	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	Agriculture	5.1	5.1	5.1	5.2	5.2	5.2	5.8	5.8	5.8	5.5	5.5	5.5	5.5
2	Forestry	20.0	20.0	20.0	20.0	20.0	20.0	15.0	15.0	15.0	5.0	5.0	5.0	5.0
5	Fisheries	5.3	5.3	5.3	5.5	5.5	5.5	5.3	5.3	5.3	4.8	4.8	4.8	4.8
15	Food and beverages	14.3	13.4	13.4	19.0	19.0	19.0	17.9	17.9	17.9	6.8	6.8	6.8	6.8
16	Tobacco	13.0	13.0	13.0	14.4	14.4	14.4	14.4	14.4	14.4	23.1	23.1	23.1	23.1
17	Textiles	11.7	11.8	11.8	12.7	12.7	12.7	12.7	12.7	12.7	12.8	12.8	12.7	12.7
18	Garments	13.6	13.6	13.6	13.9	13.9	13.9	14.2	14.2	14.2	14.2	14.2	14.2	14.2
19	Leather and footwear	11.8	11.8	11.8	11.7	11.7	11.7	15.3	15.3	15.3	14.7	14.7	14.8	14.8
20	Wood/ bamboo products	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	5.0	5.0	5.0	5.0
21	Paper products	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
22	Publishing/ printing	4.5	4.5	4.5	5.4	5.4	5.4	4.5	4.5	4.5	3.4	3.4	3.4	3.4
24	Chemical products	7.2	7.1	7.2	6.8	6.8	6.8	6.1	6.1	5.9	5.3	5.3	5.3	5.3
25	Rubber products	10.9	10.9	10.9	13.4	13.4	13.4	12.5	12.5	12.3	10.0	10.0	10.0	10.0
26	Non-metallic minerals	5.0	5.0	5.0	5.0	5.0	5.0	13.3	13.3	13.3	13.3	13.3	13.3	13.3
28	Fabricated metals	12.6	12.6	12.6	13.4	13.4	13.4	12.0	12.0	11.1	11.1	11.1	11.1	11.1
29	Machinery and equipment	10.2	10.2	10.2	10.1	10.1	10.1	9.8	9.8	9.6	8.8	8.8	8.8	8.8
31	Electrical machinery	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
32	Communication equipment	13.3	13.3	13.3	14.1	14.1	14.1	14.4	14.4	14.4	9.7	9.7	9.7	9.7
33	Precision tools	6.9	6.9	6.9	7.2	7.2	7.2	7.3	7.3	7.3	7.2	7.2	7.2	7.2
34	Motor vehicles	43.7	43.7	43.7	44.5	44.5	44.5	39.5	39.8	34.1	29.4	29.4	29.4	29.4
35	Other transport equipment	22.3	22.3	22.3	32.5	32.5	32.5	23.6	23.6	18.8	14.0	14.0	14.0	14.0
36	Furniture	11.7	11.7	11.7	12.1	12.1	12.1	11.7	11.7	11.5	10.2	10.2	10.2	10.2
92	Recreation, culture, and sport	8.9	8.9	8.9	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	4.2	4.2

Source: WTO Trains database, authors' calculation.

Table 5: Import Tariff Trend by Sector – Capital Goods

ISIC Rev. 3	Description	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
23	Coke, petroleum, nuclear fuel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	5.0	5.0
28	Fabricated metal	9.3	9.3	9.3	9.6	9.6	9.6	9.3	9.3	8.7	8.8	8.8	8.8	8.8
29	Machinery and equipment	2.1	2.2	2.2	2.7	2.7	2.7	2.6	2.6	2.6	5.7	5.7	5.7	5.7
30	Office equipment	1.9	1.9	1.8	1.8	1.8	1.8	1.5	1.5	1.5	2.2	2.2	2.2	2.2
31	Electrical machinery	5.9	5.9	5.9	6.3	6.3	6.3	6.0	6.0	6.0	6.9	6.9	6.9	6.9
32	Communication equipment	6.4	6.4	6.3	8.4	8.4	8.4	6.3	6.3	6.2	5.2	5.2	5.2	5.2
33	Precision tools	3.8	3.8	3.8	3.9	3.9	3.9	3.9	3.9	3.9	4.9	4.9	4.9	4.9
34	Motor vehicles	18.5	18.5	18.5	25.6	25.6	25.6	24.0	24.2	22.9	21.3	21.3	21.3	21.3
35	Other transport equipment	0.8	0.8	0.8	1.0	1.0	1.0	1.3	1.3	1.3	4.0	4.0	4.0	4.0
36	Furniture	10.7	11.3	11.3	10.5	10.5	10.5	8.8	8.8	8.8	8.8	8.8	8.8	8.8

Source: WTO Trains database, authors' calculation.

Tables 3 and 5 display tariff trends in intermediate input and capital goods, respectively. The tariff on capital goods is relatively low, with an anomaly in the motor vehicle industry – mainly because of the high tariff on transportation vehicles used in industry (e.g. trucks and other vehicles). Although the imported input tariffs for intermediate and capital goods are lower across the sectors than the tariffs for final goods, some industries are subject to higher tariffs. The pattern of the tariff level in these industries has not been stable over the period, e.g. for motor vehicles, the tariff was about 20%, increasing from 2001 to 2013; for electrical machinery, it was 6.9% in 2013, increasing from 5.9% in 2001; and for fabricated metal, it was 8.8% in 2013.

4. Estimation Strategy

The estimation method adopted by this study is similar to the one adopted by Vandenbussche and Viegelahn (2018) on the effect of anti-dumping policy on input reallocation. However, this study is unable to employ the difference-in-difference estimation as in Vandenbussche and Viegelahn (2018) because we are not able to uncover a major and significant anti-dumping policy in Indonesia. Alternatively, we conducted several linear regressions on imported input usage indicators, controlling for variables that reflect the characteristics of firms and industries. As such, we want to check the production of firms and its effect on total input value to ensure that the substitution effect happens without distracting the usual production pattern.

We consider four usage indicators: (i) the share of imported intermediate input, (ii) the imported input value, (iii) the total input value, and (iv) the real value added. The share of imported intermediate input is defined as the ratio of foreign input j over total input j used in firm i at time t:

$$\text{FRatio}_{jit} = \frac{\text{X}_{jit,F}}{\text{X}_{jit,D} + \text{X}_{jit,F}}$$

$FRatio$ is a proxy of the degree of substitutability since the ratio will respond to the price change because of the tariff. X_{jit} represents the value of inputs from industry j that are used in industry i. D indicates domestic goods and F indicates imported goods.

The statistical model below is used to determine the effect of input tariffs on the substitutability of foreign to domestic inputs:

$$\mathrm{Y}_{jit} = \alpha_i + \beta_2 \text{Input Tariff}_{jt-1} + \beta_3 \boldsymbol{Z_{it}} + \vartheta_k + \theta_t + \epsilon_{jit}$$

Where Y_{jit} consists of the log form of the total input value, imported input value, real value added, and the share of foreign input ratio (FRatio_{jit}), all of which are in their real value. These four variables are the endogenous variables reflecting the firm's input usage behaviour. Input Tariff_{jt} is the import tariff applied to intermediate inputs j at time t with two periods of lags. We put the lagged term on the intermediate input tariff since a policy response might have delayed the impact. Meanwhile, Z_{it} is a matrix of control variables that reflect firms' characteristics. We use exporter status (1 if firms export their products), foreign ownership dummy (1 if firms have foreign ownership above 10%), and the number of workers as a proxy of firm size. We also include the industry fixed effect ϑ_k, which we categorise in two-digit sector ISIC industry k, and the year fixed effect θ_t to control for time trends. We estimate the data using panel fixed effect regression, with the standard error clustered at the individual firm level.

A strong indication of the substitution of foreign with domestic inputs is shown by the negative effect of input tariffs on the imported input ratio (FRatio_{jit}) and the imported input value, accompanied by a small or increasing effect on the total input value or the real value added.

To complement the analysis, we also observe whether firms make an adjustment in facing input tariffs. Specifically, we assess the movement of coefficient magnitudes of import tariffs towards the endogenous variables across the years of observation. Arguably, firms adjust over time and gradually change their input orientation to more domestic-oriented inputs when subjected to import tariffs. If this argument is true, then the magnitude of import tariffs would be gradually larger in decreasing the share and usage of imported inputs without substantially hurting value added and total input usage. In particular, the magnitude of import tariffs on value added and total input usage would gradually decrease and become less significant. For this exercise, the same equation is estimated cross-sectionally for each year of observation.

Nonetheless, previous studies are not always clear on the substitutability of domestic and foreign inputs. Some complementarities could exist, whereby an increase in input tariffs would negatively affect both import and domestic inputs; hence, the effect of the change in input tariffs on the domestic input ratio would not be significant.

As stated, one limitation of this study is that it is unable to rule out price effect as a consequence of increasing import tariffs. Import tariffs could affect both imported and domestically produced input prices because of competition. Therefore, our estimation could include some bias.

5. Econometric Analysis

Table 6 displays the regression results of import tariffs on the share of imported inputs. There is a strong negative relationship between lagged import tariffs and the share of imported inputs – an increase in import tariffs decreases the share of imported inputs. This inference holds with the addition of control variables in the second until fourth specifications. Our control variables also work well in controlling the size and variety of firms. In this case, exporting firms and foreign-owned firms tend to have a larger share of imported inputs. The larger firm size, represented by the number of workers, also contributes to a higher share.

Table 6: Regression Result on the Share of Imported Inputs – All Sectors

	(1) Share of Imported Input	(2) Share of Imported Input	(3) Share of Imported Input	(4) Share of Imported Input
Import tariff t-1	-0.0672***	-0.0529***	-0.0659***	-0.0462***
	(0.0107)	(0.0106)	(0.0106)	(0.0105)
Exporter = 1		0.993***	1.278***	0.931***
		(0.229)	(0.234)	(0.231)
Foreign owned = 1		12.14***	10.93***	10.97***
		(0.634)	(0.614)	(0.608)
ln workers		3.027***	2.793***	2.733***
		(0.109)	(0.107)	(0.106)
Constant	7.269***	-6.284***	-8.151***	-7.216***
	(0.140)	(0.422)	(0.428)	(0.440)
Industry FE	No	No	Yes	Yes
Year FE	No	No	No	Yes
N	456,148	364,101	364,100	364,100

( ) = standard error, FE = fixed effect, N = number of observations.
Notes:
1. Standard errors in parentheses.
2. * p<.1, ** p<.05, *** p<.01.
Source: Authors' calculation.

The model adopted by this study thus robustly explains the movement of the usage variables. Using several specifications with variations in control variables, our main variable of interest – the lagged import tariff – consistently predicts the movement of the endogenous variables with precise estimates. In addition, our control variables have consistently managed to pin down the variations between firms or industries, and periodic trends.

Estimation over the log form of real imported input value also shows similar results. From Table 7, it can be seen that the effect of lagged import tariffs is negatively impacted by imported input value. The effect is also robust and consistent across all specifications. The coefficient magnitude is particularly consistent and precise in explaining the variation in imported input values.

Table 7: Regression Result on Imported Input Value – All Sectors

	(1) ln Imported Inp. Value	(2) ln Imported Inp. Value	(3) ln Imported Inp. Value	(4) ln Imported Inp. Value
Import tariff t-1	-0.00359***	-0.00505***	-0.00549***	-0.00547***
	(0.000975)	(0.000997)	(0.000980)	(0.000974)
Exporter = 1		-0.0861***	-0.0602**	0.0384
		(0.0228)	(0.0235)	(0.0242)
Foreign owned = 1		0.770***	0.683***	0.710***
		(0.0516)	(0.0513)	(0.0504)
ln workers		0.299***	0.279***	0.263***
		(0.00997)	(0.00999)	(0.00985)
Constant	0.541***	-0.716***	-0.813***	-0.557***
	(0.0107)	(0.0378)	(0.0392)	(0.0399)
Industry FE	No	No	Yes	Yes
Year FE	No	No	No	Yes
N	1071175	805569	805569	805569

( ) = standard error, FE = fixed effect, N = number of observations.
1. Standard errors in parentheses.
2. * p<.1, ** p<.05, *** p<.01.
Source: Authors' calculation.

As shown in Tables 8 and 9, the estimation of import tariffs is also consistent and robust against total input value and value added. Even when subjected by control variables and year and industry fixed effects, the import tariff consistently predicts total input value and value added. The model also shown robustness against several specifications.

Table 8: Regression Result on Total Input Value – All Sectors

	(1) ln Total Inp. Value	(2) ln Total Inp. Value	(3) ln Total Inp. Value	(4) ln Total Inp. Value
Import tariff t-1	0.00681***	-0.0192***	-0.0162***	-0.0343***
	(0.00229)	(0.00265)	(0.00265)	(0.00282)
Exporter = 1		-0.844***	-0.763***	-0.0351
		(0.0391)	(0.0400)	(0.0403)
Foreign owned = 1		-0.409***	-0.321***	-0.190***
		(0.0724)	(0.0730)	(0.0696)
ln workers		0.211***	0.237***	0.184***
		(0.0166)	(0.0167)	(0.0158)
Constant	5.017***	4.876***	5.432***	6.340***
	(0.0227)	(0.0687)	(0.0722)	(0.0747)
Industry FE	No	No	Yes	Yes
Year FE	No	No	No	Yes
N	1,071,175	805,569	805,569	805,569

( ) = standard error, FE = fixed effect, N = number of observations.
1. Standard errors in parentheses.
2. * p<.1, ** p<.05, *** p<.01.
Source: Authors' calculation.

Nevertheless, regression on total input value has shown a very small and negative effect on total input value. The first specification showed a robust estimation of the lagged import tariff, which precisely estimated a small positive effect on the total input value. However, following controls for other specifications, the effect became negative though still precisely estimated. In addition, Table 9 shows the negative effect of import tariffs on real value added. This result is consistent with similar literature (Amiti and Konings, 2007; Halpern, Koren, and Szeidl, 2015; Blaum, Lelarge, and Peters, 2018), which also showed that the increase in import tariffs negatively affected the productivity and output of firms.

Table 9: Regression Result on Value Added – All Sectors

	(1) ln Value Added	(2) ln Value Added	(3) ln Value Added	(4) ln Value Added
Import tariff t-1	-0.0110***	-0.00472***	-0.00296***	-0.000927**
	(0.000888)	(0.000554)	(0.000514)	(0.000467)
Exporter = 1		0.138***	0.159***	0.0850***
		(0.0134)	(0.0133)	(0.0136)
Foreign owned = 1		0.418***	0.367***	0.356***
		(0.0254)	(0.0240)	(0.0239)
ln workers		1.091***	1.095***	1.104***
		(0.00852)	(0.00806)	(0.00801)
Constant	13.70***	9.017***	8.952***	8.787***
	(0.0142)	(0.0352)	(0.0345)	(0.0354)
Industry FE	No	No	Yes	Yes
Year FE	No	No	No	Yes
N	1,071,169	805,563	805,563	805,563

( ) = standard error, FE = fixed effect, N = number of observations.
1. Standard errors in parentheses
2. * p<.1, ** p<.05, *** p<.01.
Source: Authors' calculation.

The estimation results indicate weak substitution from imported to domestic inputs. Overall, we find that even though firms switch from using imported inputs to domestic inputs when subjected to an increase in import tariffs, we are still unable to separate whether the substitution within firms is accompanied by decreasing outputs or if firms can substitute their source within the same products. Next, we explore whether firms are gradually becoming more adaptable in switching their input products by examining the adjustment using the yearly trends in estimated coefficients presented below.

Identifying Firms' Adjustment from Imported to Domestic Inputs

As stated in the estimation strategy, we rerun the estimation for each year of observation and plot the coefficient magnitude in a time series manner. In all four series of estimations using different endogenous variables, we identify that the coefficients are robust over time and precisely estimated, except for estimations from 2010 to 2013. We observe that all estimations in this period are imprecisely estimated, possibly because of sudden hikes and volatility in input data.

Overall, the evidence of firms' switching capacity is found to have been very weak. Figure 4 represents the input tariff coefficient on the imported input ratio and imported input value. It shows that the effect of import tariffs on the imported input

ratio is negatively constant over time, with an anomaly after 2010 where the estimation becomes imprecise. However, we can also see that the effect on imported input value is stable over time, with consistently negative magnitude towards the import value. While this finding supports the evidence of substitution, it also implies that firms do not gradually adjust to permanently using domestic inputs, as the effect on import changes is relatively similar over time. Therefore, even though firms can substitute their inputs with domestic sources, firms' capacity to switch is limited.

Although our study is unable to elaborate on the constraint, it is suggested that firms may have a degree of complementarity between domestic and imported inputs or the supply of domestic inputs with the same quality may be limited. This makes firms keep using imported inputs if they wish to maintain their high level of performance. In any case, we can conclude that import tariffs are unable to structurally change firms' input allocation behaviour.

Figure 4a: Imported Input Tariff *t-1* Coefficient to Imported Input Ratio over Time

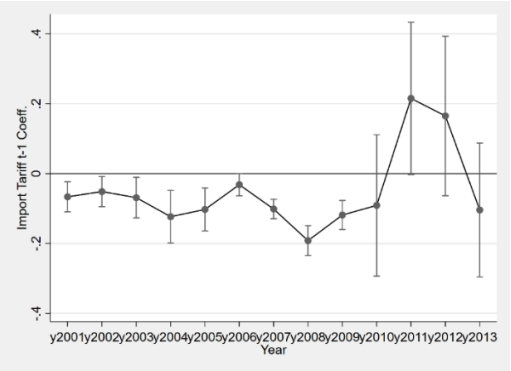
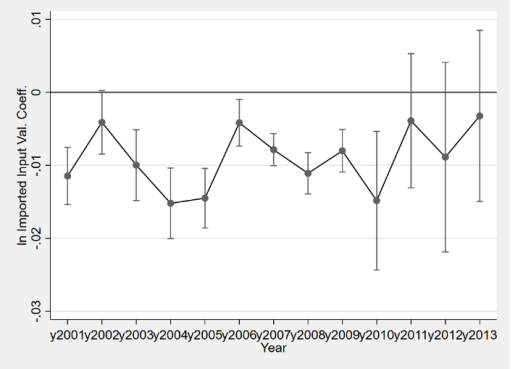


Figure 4b: Imported Input Tariff *t-1* Coefficient to Imported Input Ratio to Imported Input Value over Time



Source: Authors' calculation.

If firms are unable to adjust towards more domestic-oriented use of inputs, what about the effect of import tariffs on firms' performance? Figure 5 shows the

coefficient magnitude of import tariffs to total input and value added. The effect of input tariffs is shown to be consistently negative in affecting total input value. However, the magnitude seems to be decreasing over time, with a positive effect in 2013. Meanwhile, the impact on value added was nearly zero in 2000 but suddenly dropped in 2009 and has stayed negative since then.

In relation to previous results, Figure 5 implies that as firms consistently decrease their total input value in response to import tariffs, the reduction diminishes over time. While we cannot rule out the possibility of price effect, it can be said that firms gradually increase their total input value through domestic inputs, since we know that the effect to imported input value is consistent over time from Figure 4. However, it seems that the effect to value added does not behave in a similar way to the effect to total input value. The import tariff negatively affects value added in general and the negative impact keeps increasing over time. Thus, we find that the increase in domestic input usage is unable to improve firms' performance.

Figure 5a: Imported Input Tariff *t-1* Coefficient to ln Total Input Value

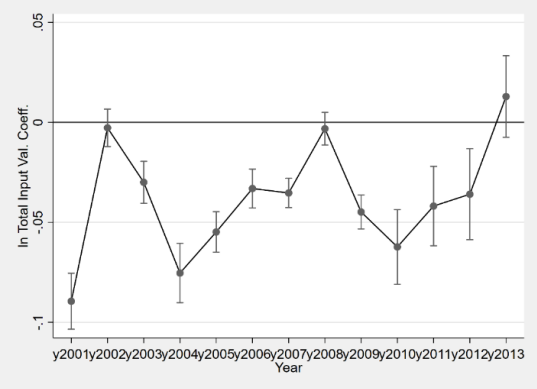
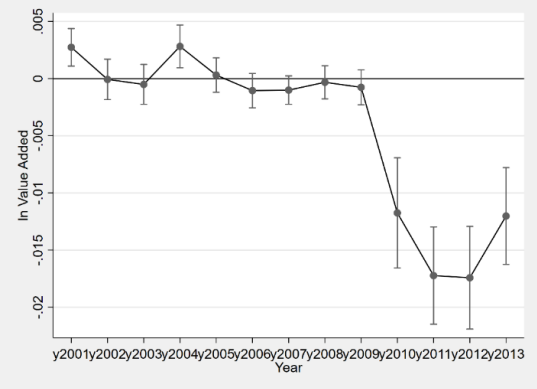


Figure 5b: Imported Input Tariff *t-1* Coefficient to ln Value Added over Time



Source: Authors' calculation.

Our findings show a weak substitution effect between imported and domestic inputs in response to changes in import tariffs. However, the performance of firms is negatively impacted by the import tariff increases, limiting the substitution capability. Further, we find that firms do not make adjustments in their response to import tariffs, as the effect is generally consistent over time. Rather, the evidence indicates that they adjust (reduce) their production capacity along with the changes in input composition. The effect on the total input value is shown to decrease gradually, but this is accompanied by a larger negative effect on value added.

Our result is consistent with the related literature. Confirming the findings of Amiti and Konings (2007), we find a negative effect of import tariffs on firms' performance within Indonesian manufacturing firms – even though this study was conducted after trade liberalisation in Indonesia, which had already cut many import tariffs following the regulatory reform. In addition, our study indicates that imported inputs carry on improvement in productivity more than domestic inputs (Halpern, Koren, and Szeidl, 2015; Bas and Strauss-Kahn, 2014; Goldberg et al., 2010). This indication comes from our finding regarding the negative effect of value added, even though the domestic and total input value is increasing.

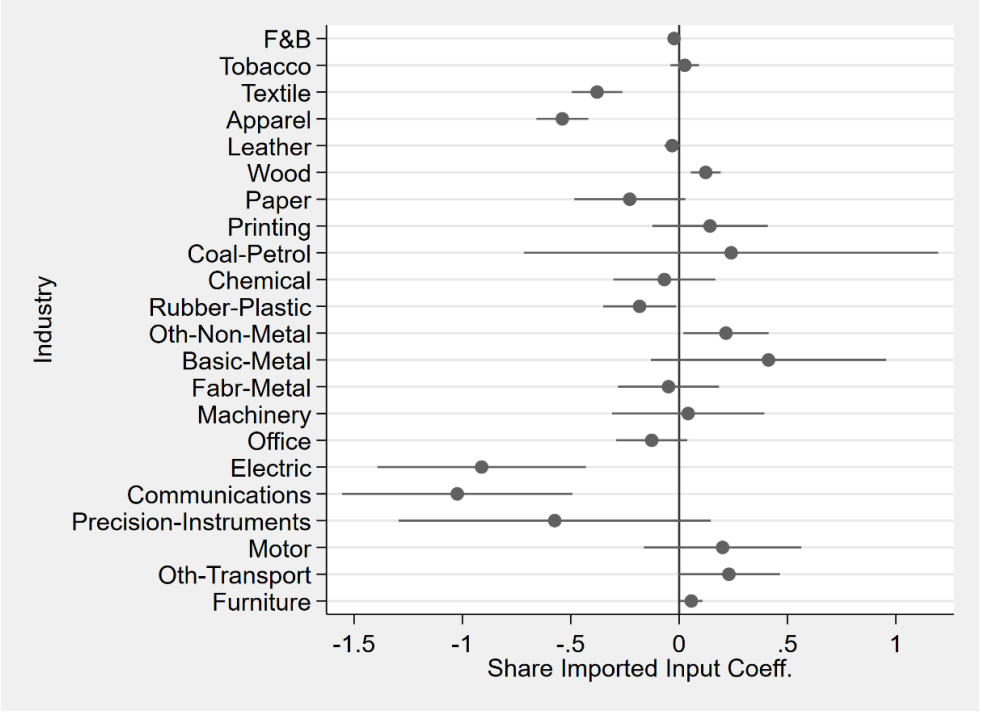
Although our study does not intend to explain the mechanism behind the adjustment in domestic and foreign input composition and firms' performance as a response to import tariffs, we suggest several explanations regarding the mechanism based on our findings. First, domestic inputs cannot become good alternatives to imported inputs when firms are forced to switch their inputs as a response to import tariffs to reduce production costs. As domestic inputs cannot provide the same outputs for production, this eventually leads to the decrease in firms' performance. One of the reasons for the inability of domestic inputs to substitute foreign inputs is that domestic inputs are lower quality and negatively affect firms' performance. Another reason is that domestic inputs with comparable quality are more expensive, which can explain the effect on the total input value. Therefore, it is inefficient to switch to domestic inputs as it would make the firms less competitive. Second, complementarity can exist between domestic and imported inputs, even within the same product categories. Since our analysis is based on the 4-digit ISIC sector level, it is possible to have complementarities between inputs in the same categories. All

the stated reasons indicate that firms' input composition is rigid and substitution capacity is limited. Therefore, import tariffs cannot structurally change input usage behaviour.

Heterogeneity by Industries

We re-estimate using our model for each group of industries based on the 2-digit ISIC Rev. 3. While the robustness of the results is mixed, we find several interesting facts, especially within sectors that have a strong basis in the domestic market. Figures 6, 7, and 8 illustrate the coefficients of tariffs to the share of imported inputs, value added, and imported inputs by sector, respectively.

Figure 6: Import Tariff Coefficient Towards the Share of Imported Inputs, by Sector

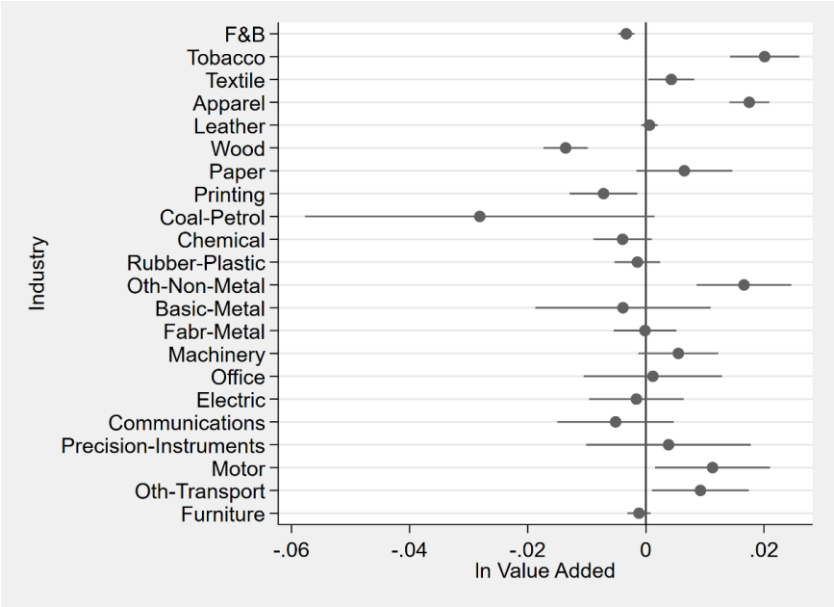


Source: Authors' calculation.

We find that heterogeneity exists within industries. For example, the textile and apparel industries have a better degree of substitution within their inputs. As import tariffs increase, both sectors manage to switch their imported inputs to domestic inputs more easily than other industries. They also manage to increase their domestic inputs significantly and maintain or improve their performance, as can be seen by the positive effect in value added (Figure 7). Meanwhile, the food and beverage sector

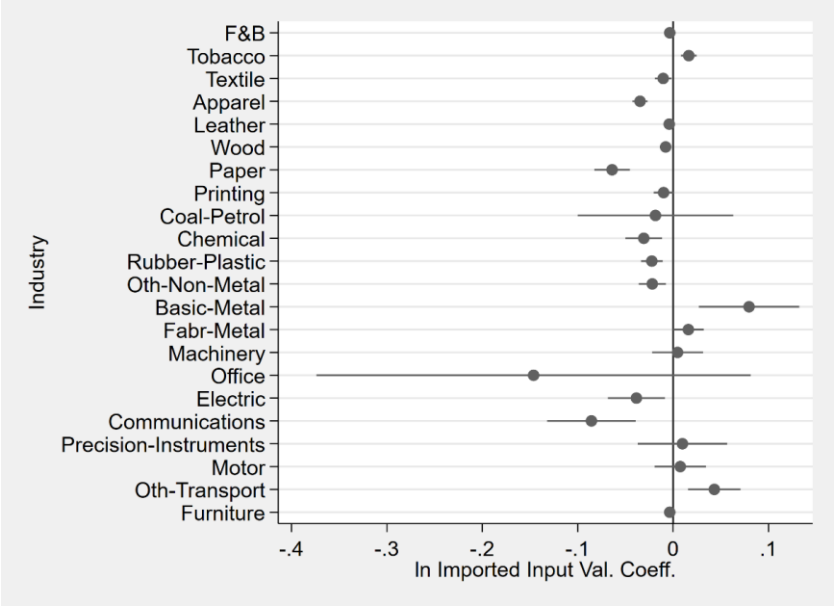
has low substitutability between its inputs since import tariffs are unable to reduce the share of imported inputs. In addition, firms in the sector still lowered their imported input usage (Figure 8). However, the food and beverage sector tends to reduce its production capacity and performance as a result of import tariffs. Moreover, our results indicate that the food and beverage sector has strong complementarities between domestic and imported inputs.

Figure 7: Import Tariff Coefficient Towards Value Added, by Sector



Source: Authors' calculation.

Figure 8: Import Tariff Coefficient Towards Imported Input Value, by Sector



Source: Authors' calculation.

6. Conclusion

This study elucidates the impact of tariffs on input usage behaviour, particularly in Indonesian manufacturing firms after trade liberalisation. It examines the effect of import tariffs on the share of imported inputs, imported input value, total input value, and value added, controlling with several variables and fixed effects. The study finds evidence of weak substitutability between imported and domestic inputs.

This study contributes to the scarce literature on the effects of tariffs on imported input usage. Related literature has shown strong evidence of the effects of tariff reductions caused by trade liberalisation on increasing productivity. The most common reason is that imported inputs bring an embedded productivity within their products in the form of quality and cheaper prices. Consequently, importing firms tend to have higher productivity than domestic-oriented firms. However, few studies have examined firms' responses to tariff changes in terms of input usage, as there might be limited flexibility to substitute imported inputs with domestically produced inputs.

Findings from the estimations suggest that firms switch to domestically produced inputs in response to tariff increases. However, the substitutability is accompanied by reducing output within firms, limiting the substitution capability. The study also finds no adjustment over time in adopting domestic inputs. Instead, it identified that long-term exposure to import tariffs will likely hurt firms' performance in terms of value added because firms are suggested to adjust their production efficiency rather than their input usage. Nonetheless, we argue that this result is consistent with findings from several previous studies. First, domestic inputs are not necessarily the best alternative since they often provide lower product quality and price relative to imported inputs, which affects firms' performance. Second, the production structure of the firms might allow some complementarities between imported and domestic inputs, even within the same product categories. Therefore, import tariff changes will not structurally change their input composition.

It is important to note several limitations to this study. First, it is unable to rule out price effect within the estimation. It is highly probable that the import tariff changes will affect both domestic and imported input prices. However, because of

data limitations, it is impossible to gather price data at this stage. Moreover, the data quality on the input usage quantity is low, limiting further analysis. Second, this study is not devised to provide a mechanism that considers search costs when firms want to switch to using more domestic inputs. Third, we are also unable to assess the readiness of upstream industries in supplying the same quality as imported inputs, limiting us to conclude that the substitution rigidity is caused by the lack of domestic inputs – in quality, price, and quantity. Therefore, further study is needed to assess the impact of import tariffs on supplying firms. Nonetheless, faithful to the purpose of this study, our analysis provides strong evidence of firms' input substitution behaviour.

Policy Implications

This study is important because governments in many developing countries are advocating an import substitution agenda. To promote the policy, governments tend to use import tariffs as one of the main tools to force industries to switch to domestic products. However, our findings suggest that import tariffs do not have any effect on structurally shifting firms towards using more domestic inputs. Instead, the evidence shows that substitutability with domestic inputs is likely to be a temporary response to increased (or higher) tariffs. The findings do not suggest that an increase in tariffs could lead firms to permanently change their patterns to use more domestically produced inputs.

This study further suggests that applying tariffs to intermediate inputs stimulates a counterproductive response. Firms appear to have reduced their performance and efficiency, as indicated by the negative effect of tariffs on value added. Therefore, instead of making firms more productive, import tariffs reduce firms' productivity and performance.

Overall, as an alternative to taxing imported inputs in an effort to develop domestic industries, it might be better for governments to improve local upstream industries to provide better quality domestic inputs. Instead of forcing firms to switch producers, the government should promote the production of domestic inputs to create more efficient and higher quality products. This would encourage firms to adjust their production patterns to incorporate more domestic inputs as they would be more efficient.

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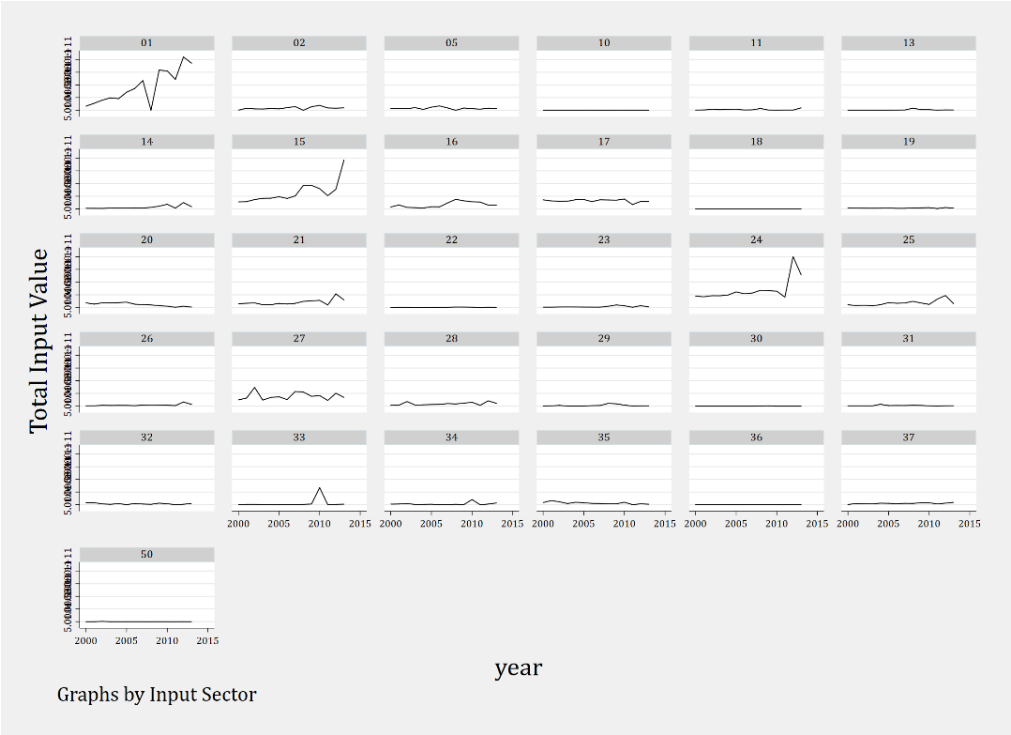
Appendix

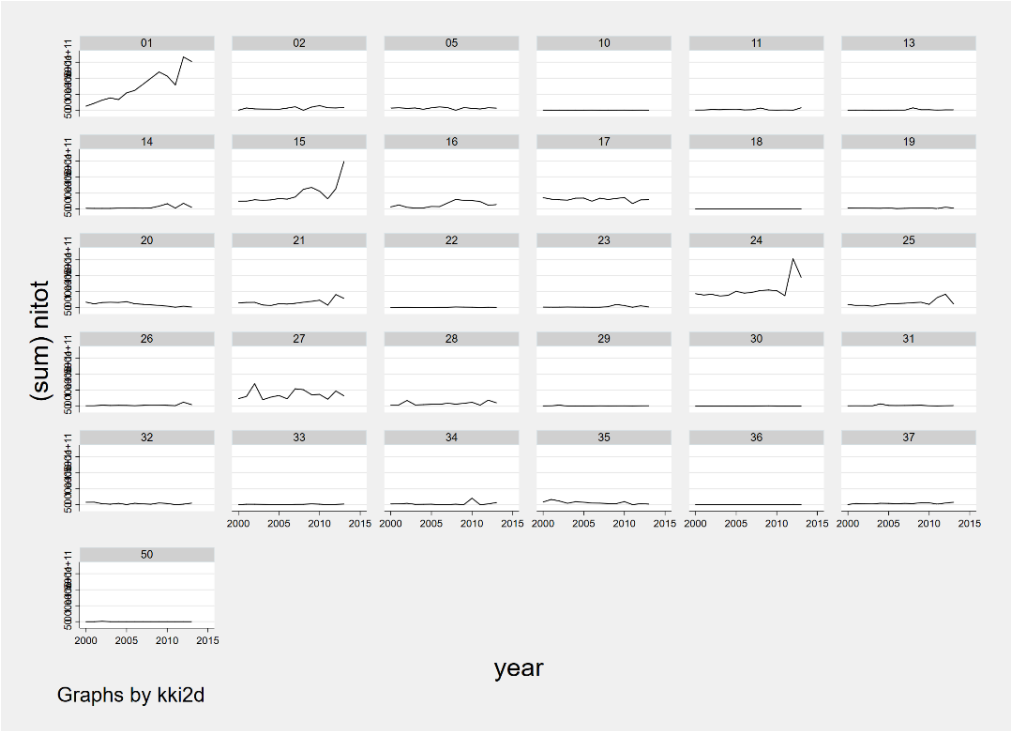
A1. Data Cleaning

This appendix explains the steps and adjustments involved in the data cleaning process. First, we removed all the negative values of both domestic and imported input data, since a negative value in input usage is impossible. Second, we checked several inconsistencies from the input database, in which the total value of firm input usage in the input database might be different from the main Indonesian large and medium-sized manufacturing industries database (also known as *Statistik Industri Manufaktur Besar Sedang* (SI)) published by Statistics Indonesia. We assume this issue is mainly an imputing issue in the input database since the main SI database provides a more consistent trend. Thus, we dropped all incidence of different total input values. Third, we also control for unusual values over quantity distribution. For example, we found that several inputs have an extremely small quantity with a high value, while other records show a significantly lower value over the quantity (price) ratio. We discarded the observations that have an unusual quantity over value distribution in our estimation. Finally, we managed the missing International Standard Industrial Classification of All Economic Activities (ISIC) codes and incomplete input of the ISIC codes. We call this incomplete, since it is not imputed in the 9-digit Indonesian Commodity Classification (KKI) code, but only in partial digits (mostly 4- or 5-digit). To capture the data in the proper ISIC code, we matched the input description with the existing description manually. However, we are unable to identify all the input descriptions, so several unidentified inputs were dropped.

Figure A1 shows the total input value difference between the raw and cleaned data.

Figure A1: Total Input Value from Database
Above: Raw Data, Below: Cleaned Data





Source: Authors' calculation.

There is one major difference in sector 01 – agricultural, fisheries, husbandry, and forestry products – where we account 0 total input value in 2008. The problem arises from imputing problems, where every input description is not filled in with the codes. Thus, we dropped sector 01 in 2008 from our observation.

To calculate the import tariff using the 4-digit ISIC Rev. 3 code, we summed the total tariff and effective trade lines from each Harmonised System (HS) contained in the 4-digit ISIC. We then continue to divide the total tariff by the number of effective trade lines to create the simple average for each sector, according to the 4-digit ISIC classification.

While important, we are unable to collect both domestic and imported input price data because credible data are not available. The only calculation possible is to divide the input value over the input quantity from the firms' input level data. However, the data on input quantity are extremely inconsistent, which is exacerbated by the missing quantity measurement. Therefore, one of the major limitations of this study is our inability to control for price effect.

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