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Firms' responses to foreign demand shock: The case of Indonesia and the GFC

Sulistiyo K. Ardiyono[*] and Arianto A. Patunru

Abstract

Export-oriented manufacturing generally create jobs. But a few recent studies on Indonesian manufacturing based on input-output tables reported a declining power of this sector in creating jobs. Using firm-level data to examine manufacturing employment during the global financial crisis (GFC), we find that a 10% increase in the degree of export orientation rises the manufacturing employment by about 1% on average, depending on the firm's capital intensity. The low sensitivity to foreign demand shock and the economy's low exposure to the global market explain the mild effect of the Global Financial Crises (GFC) on the Indonesian economy. An examination of the inter-related adjustments of labour, capital, and intermediate input confirms that the changes in employment are not independent of the adjustments of other factor inputs such as capital and material inputs. The results are robust when external and internal instruments are used in instrumental variable (IV) and GMM estimations, respectively.

Keywords: GFC, manufacturing sector, employment, foreign demand shock

JEL codes: F16, J23, D22, L60

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1. Introduction

As shocks and crises frequently happen, it is important for policy makers to understand how they affect business sector's performance and employments. Since the 1990s and before the Covid-19, Indonesia has experienced two major crises: the Asian Financial Crises 1997/1998 (AFC) and the Global Financial Crises (GFC) with different magnitudes, transmissions, and impacts. Between the two crises, AFC has impacted the Indonesian economy much worse. The economy shrunk by more than 13% in 1998, the exchange rate depreciated by more than 200%, and the poverty rate soared to 39% in 1998 from 11% in 1996.[1] Radelet et al. (1998) argue that the impact of AFC in Southeast Asian countries was massive because the shock in the financial industry was amplified by corruption and inefficiencies of the industry. Meanwhile, Hill (1999) explains that the crisis became worse because of the political turbulence and low trust in government. Both arguments conclude that the problems that started from Baht depreciation in Thailand transmitted and amplified in Indonesia's real economy through corruption and inefficiency in the financial system and in the government.

While AFC is very destructive, the impact of GFC on the Indonesian economy was relatively mild despite the big shock in its origin. The crisis grew from financial market turbulence in the developed countries. It was transmitted to the rest of the world through financial, investment, commodity prices, and trade channels (Mishkin, 2010 in Harrison & Sepulveda, 2011). Among these channels, the financial industry is the most impacted in Indonesia. The composite index dropped by 50%, the government bond yield rose to its highest level in October 2008, 22%, while the interbank lending and borrowing volume fell by around 50% (Basri & Siregar, 2011). The same study also shows that the Rupiah depreciated by approximately 28% as the foreign investors withdrew from the domestic market. One key factor differentiating AFC and GFC is that the banking industry was still solid during the latter crisis despite the drop in the interbank confidence, partly because of proper responses from the monetary authority (Basri & Rahardja, 2010; Patunru & Zetha, 2010; Basri & Hill, 2011).

In contrast to the significant impact of GFC in the financial sector, the effect on the real economy is modest. In 2009, Indonesia's economic growth slowed down from 6% in 2008 to 4.6% in 2009 before turning to 6.2% in 2010. The studies mentioned above (Basri & Siregar, 2009; Basri & Raharja, 2010; Patunru & Zetha, 2010; Basri & Hill, 2011; Basri, 2015) argue that the modest impact of GFC on the real economy is because the Indonesian external sector

[1] The figures for economic growth and exchange rate are obtained from the World Development Indicator while the poverty rate is from Hill (1999).

was less exposed to foreign demand compared to other countries in the region. Also, the Indonesian government has learnt from the AFC and so instituted some necessary reforms after the crisis. Still, these studies note that although the monetary and fiscal policy played a role, the low exposure to foreign shock was more prominent.

Interestingly, none of these studies discusses the impact of the crisis on manufacturing employment. In 2008/2009, the manufacturing sector was the most significant contributor to GDP with a share of 27%. However, its role in job creation has declined. Using an Input-Output analyses, James and Fujita (2000) and Aswicahyono and Manning (2011) found evidence of the diminishing role of manufacturing export in creating jobs. They argue that low employment elasticities of export are due to the compositional change from labour-intensive to capital intensive industries. However, they do not estimate how many jobs will be affected due to the change in export. As the manufacturing sector is still the most significant economic contributor to the Indonesian economy in absorbing many workers, it is critical to understand its sensitivity to different shocks.[2]

This study tries to answer some questions about the manufacturing firms' decisions in hiring and firing in response to foreign demand shocks. The main questions are, when a foreign demand shock strikes, how much adjustment a firm need to make in terms of employment; and whether such adjustment differs between production and non-production workers. The next questions are how the interrelated demand function pattern works in the Indonesian manufacturing firms, and how the response differs between labour-intensive and capital-intensive firms.

This study contributes to the literature in two ways. First, it provides an estimate of the impact of foreign demand on manufacturing sector employment in Indonesia.[3] The matched data between the manufacturing industry firms and their export destinations allow us to construct a robust exogenous instrument for export. We find that for every 10% increase in foreign demand, the manufacturing employment increases by around 1%. As the study period is from 2008 to 2012, it is able to explain why GFC had a mild impact on the Indonesian economy through the real sector. Second, we provide evidence that employment elasticity of export depends on capital intensity and is not independent of other factors' adjustments. This conditional elasticity will help estimate the impact of the foreign shock on different industries

[2] By 2020, the manufacturing sector is still the biggest contributor to Indonesian GDP with around 20% share. It employs approximately 18 million workers, the third biggest employment after agriculture and trade sectors.

[3] We use the term 'foreign demand' rather than 'export' in this context as we will be looking at exogenous demand shock from foreign markets, instead of at export decisions that are often endogeneous to firms' characteristics.

based on their capital intensity and is still relevant as the firms use more capital over time. Furthermore, the impact estimation on labour should consider the flexibility of firms in adjusting other factor inputs such as material and financing, as this study concludes.

The findings are robust as the exogenity of the export shock is warranted by the external- and internal instruments, and hence the causality can be established. We apply an instrumental variable (IV) approach by instrumenting the firms' export with the changes in the trading partner countries' demand that we construct based on the matched dataset. In this strategy, we use the actual value of monetary variables to control the price factors and include the firm-, industry group-, and year fixed effects to handle the technological change.[4] We also conduct a robustness test by restricting the sample whose fixed assets do not vary significantly over time and using the firms that consistently export in the whole period of observations.[5] Finally, the results are also robust when the internal instrument is used in the generalised method of moments (GMM) estimation.

The remainder of this paper is organised as follows. Section 2 provides the literature review on the firm's response to demand shocks. Section 3 explains the theoretical framework and the empirical strategy we use, followed by data description in section 4. Section 5 discusses the results, and Section 6 concludes with some caveats.

2. Literature Review

When facing a demand shock, firms adjust their factor inputs such as labour and capital interdependently and gradually to optimise their net worth. An early study by Eisner and Strotz (1963) shows that the adjustment of factor inputs occurs slowly to minimise the cost. Lucas (1969) extends the analysis by introducing the concept of gradual interrelated factor inputs adjustment, basically laying the foundation that adjustment in one factor is not independent of that in other factors. As Nadhiri and Rosen (1969) illustrated, the adjustment includes factor inputs' quantity changes and utilisation rates. They show that firms instantaneously adjust capital utilisation rate and labour utilisation rate as reflected in the total working hours followed by adjustment in the number of employees. Capital stock, on the other hand, does not change in the short run.

[4] The industry is classified based on firms two digit ISIC group.

[5] We limit the samples for firms whose fixed asset in every years observed do not exceed their one standard variation from their mean. By implementing this, observations with an increase / decrease in fixed asset by 1 standard deviation from the mean are excluded.

Prices of capital and labour, transaction costs of hiring and firing, and the acquisition- and disposal costs of fixed assets affect the adjustments' sequence and duration. Nickel (1986) shows that the adjustments of skilled- and non-skilled labour are different due to their extra adjustment cost. Another study by Rosen and Nadiri (1974) show that worked hours and utilisation rate act as the firm's buffer in the adjustment process. The utilisation rate is the first to adjust, followed by the number of production and non-production workers, and then the capital stock. Another study that examines the adjustment in working hours and different types of employment is Saphiro (1986), with a similar finding. Roshen and Nadiri (1974) show that adjustment of production workers take place in four quarters while between industries, the adjustment in the durable sector is more rapid than that of the non-durable sector. Sims (1974) shows that the adjustment in person-hours of production workers is essentially complete in six months and employment adjustment takes place in five quarters. In a later study, Bloom (2009) shows that employment declines four months after a shock.

The adjustment magnitude varies across studies as firms sampled, periods examined, and macroeconomic environment underlying the adjustment costs differ. Using the US firm annual data from 1947 to 1976, Epstein and Denny (1983) find that for every 10% increase in output, employment increases by about 6% to 7%. Using US manufacturing monthly data from March 1951 to December 1971, Sims (1974) shows that the immediate impact of every 10% sales increase on working hours is around 4.9% while on employment (number of workers) is 4%. Although the numbers are quite similar, the adjustment duration is shorter for working hours. Around 90% of cumulative impact takes place in 6 months while similar adjustment of employment takes place in 9 months and continues to adjust for two years. Differently, Saphiro (1986) concludes based on US firms' quarterly data (1955-1980) that hours worked has a much higher elasticity on wage bill (53%), followed by the number of production workers (45%) and then non-production workers (27%). He suggests that labour input should be treated as hours and workers separately in studying the interrelated demand function.

Further studies argue that firms respond to demand shock by considering the cost of present adjustment and the expected gain and losses in the future. Dixit (1997) shows that a firm will make no adjustment amidst a shock if it perceives that the expected gain of inaction would exceed the adjustment cost. So, firms will invest (disinvest) in capital stocks or hire (fire) workers only if the decision is perceived to bring benefits in the future. The costs of capital, capital services, and hiring and firing play essential role in driving the firm decision. Bloom (2009) adds the analysis by incorporating the uncertainties into the firms' decision. He shows that firms will be more likely to wait and see when uncertainties increase, which will slow down the economy during the time they do not expand or stop hiring. He also illustrates that when the tensions dissipate, the adjustment made tends to overshoot when a positive shock happens in the medium term.

Although the perception of uncertainties varies among firms, there is a pattern within similar industry groups. Fabiani et al. (2015) argue that firms' most important response to demand shock is cutting costs and this pattern is consistent in manufacturing, trade, or market services industries and across different severity of shocks. They find that if demand shock is weak, firms will reduce non-labour costs, and if they perceive the demand shock as significant and long-lasting, they will cut the labour cost by reducing the working hours and the number of employment. The second primary response to shock, according to this study, is reducing output in the case of manufacturing firms or reducing profit margin in the case of non-manufacturing firms. In sum, using flexible wage to cope with shock is less likely to be opted for by the firms.

Ramstetter and Takii (2006) conclude that foreign-affiliated firms in developing countries such as Indonesia have higher flexibility to sell their product between domestic and foreign markets and a higher propensity to export. Based on this finding, the response between these firms to a foreign demand shock can be different. Alfaro and Chen (2012) suggest that foreign-affiliated firms perform better in sales during global financial crises than the local ones with similar characteristics because of their stronger market linkages and financial support. However, the difference is insignificant during the non-crises period. On the other side, the productivity differential between these two firms is not always evident. It depends on the productivity measurement and the classification of foreign affiliates, as Takii (2006) discussed.[6] So, the heterogeneous impact of foreign shocks to local and foreign-affiliated firms might be ambiguous.

Policies such as employment protection that regulate hiring and firing affect employment adjustment cost. Thus, firms in a rigid labour market environment will make less employment adjustment. Bentolila and Saint-Paul (1989) show that hiring and firing costs affect firms' labour demand as steady-state labour demand increases (decreases) when the cost is low (high). This theory has found empirical evidence in extensive literature based on studies from developed or developing countries. From OECD countries data, Banker et al. (2013) find evidence that stricter employment protection increases adjustment costs, while Holden and Wulfsberg (2008) find that countries with severe EPL and high union density show significant downward nominal wage rigidity. Montenegro and Pages (2007), who use Chilean data, show

[6] Wholly-foreign plants are generally more productive than minority-foreign plants and domestic firms.

that job regulation provides security for male, old, and skilled workers at the expense of female, young, and unskilled labour. Ardiyono and Patunru (2021) find that a flexible hiring and firing regulation will attract FDI especially in the developing countries, while the impact is decreasing in the developed ones.

Meanwhile, comparing the employment in rural areas with relaxed, moderate, and strict labour regulation, Adhvaryu et al. (2013) find that firms in the Indian's states where labour regulation are flexible, make more adjustments to total workers. The difference in adjustment among firms in pro-employer states and pro-employee states is around 7%. A similar finding can be found in Cabalero et al. (2013), who use multi-country study. They find that the speed of employment adjustment is slower in countries with high legal protection against dismissal, especially when such protection is likely to be enforced.

When the interrelated demand function includes the cost of hiring and firing in accordance to the labour market regulation, firms will adjust other factors such as utilisation rate and the level of capital intensity if the employment adjustment is considered costly. Uniquely, Moller (2010) shows that German firms deal with inflexible labour regulation by optimising the flexible working hours scheme and hoarding the high-skilled labour. Before the crisis, the demand for high skilled labour was not fully met, so when the GFC hit, German firms retained their workers in anticipation of future demands. In the case of Columbia, Eslava (2010) concludes that the market deregulation in the early 1990s contributes to job reduction in Colombia. However, job reduction coincides with lower decline in capital accumulation, which implies that the firms turn to be more capital intensive in the strict regulatory regime and reduce employment more when the cost of firing is cheaper.

Factor adjustments are also highly affected by financial constraint that will in turn propagate the impact of shock on the aggregate production and consumption. Campello et al. (2010) documents that firms with limited access to financing during the global financial crises will more likely reduce their employment, capital spending, and investments. Furthermore, it is likely that they will sell their asset to cover the cost. Chodorow-Reich (2014) finds that financial access difficulties contribute to more than one-third of the unemployment decline in the non-financial firms in the US, contributing to one-fifth to one-third of aggregate unemployment. The impact is significant for the small and medium businesses in line with the hypothesis that asymmetric information of the small-medium business financial condition affects the lending during the crises.

On the contrary, Michaels et al. (2019) show that leverages' impact on earnings is negatively strong while its effects on employment are weak. They argue that the impact of leverage on average labour earnings is strong because a higher probability of default from a high debt level could serve as a bargaining power for the employer to negotiate the wage. Meanwhile, the impact on employment is insignificant because the labour adjustment friction suppresses the negative effect of leverage. The result becomes negatively significant when the adjustment cost is frictionless.

Demand shock potentially leads to job destruction and disinvestment that can prolong a recession, as seen in Den Haan (2010). To prevent this, governments make interventions to prevent or minimise the effect on the economy or reduce the uncertainties in the economy. However, the intervention might not always be effective. Cho (2019) finds that the US Recovery Act increases employment by around 3.5%, impacting between 3 to 12 months. He argues that the program is effective as firms perceive it to be long-lasting, as Hammermesh (1993) also documented. However, Bloom (2009) argues that firms will become more insensitive to factor prices such as interest rate and wages when uncertainties are high. Therefore, government intervention such as cutting the benchmark rate or wages adjustment will be ineffective in the short run. Instead, it will affect the firm behaviour when the uncertainties get lower.

3. Theoretical framework & empirical strategy

3.1. Theoretical framework

We use Bond and Reneen (2007) as the main framework for this study. They consider a firm's production function with constant elasticity of substitution (CES) as follows:

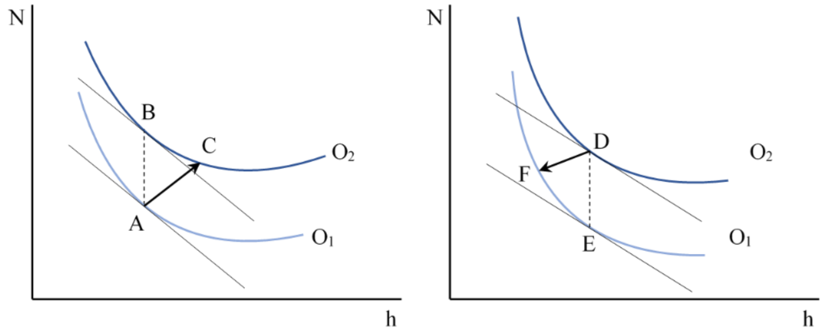
$$Y_t = F(K, L) = (a_K K_t^{\rho} + a_L L_t^{\rho})^{\frac{1}{\rho}} \tag{1}$$

where Y_t is output at time *t*, K is capital, L is labour, and ρ is the elasticity of substitution between capital and labour. Assuming some degree of monopolistic competition and a downward sloping demand curve, their labour demand function is:

$$ln\, L_t = \sigma \ln a_L \left(1 - \frac{1}{\eta^D}\right) + ln\, Y_t - \sigma\, ln \left(\frac{w}{p}\right)_t \tag{2}$$

where η^D is the price elasticity of product demand and *w/p* is the real wage. Note that this model is static in that it does not incorporate the adjustment cost that shapes the path and inter-related adjustment between labour, capital, and utilisation rate. As the factor input adjustment does not complete instantaneously, a dynamic model is needed to better capture the adjustment path.[7]

An adjustment in a factor input is not independent of the adjustments in other factor inputs. As an illustration, when the utilisation rate of labour and capital are included, the employment adjustment might be preceded by the adjustment in working hours as described by Hart (2017), based on Rosen and Nadiri (1974) below.



Notes: N=number employed; h=average hours worked; O=output
Sources: reproduced based on Hart (2017)

Figure 1. Firms' response to demand shock with two-factor input

When a firm with isoquant O_1 faces a positive demand shock, it diverts the optimal path from AC to AB due to the cost of adjustment. Suppose a firm has an unutilised capacity and costly hiring procedure; it will increase the capital utilisation and working hours before increasing employment and capital. The opposite is true when the firm faces a negative demand shock.

3.2. Empirical strategy

The data set we use does not have information of working hours, so we cannot observe the adjustment path from changes in working hours to changes in the number of workers employed. So, we assume that the firm has already considered the cost incurred from adjusting. This is consistent with Sims (1974) and Bloom (2009) in that the working hour's adjustment will take place in less than one year while the employment adjustment will take place in one to two years time.

In this study, we model the firms' responses as a function of foreign demand shock reflected in the firm's export, other factors, time-invariant and time-variant unobservables, that is,

$$FR_{it} = \alpha_1 exp_{it} + \boldsymbol{z}_{it1}\boldsymbol{\delta}_1 + c_i + u_{it1} \quad (3)$$

$$FR_{it} = \boldsymbol{x}_{it1}\boldsymbol{\beta}_1 + c_i + u_{it1} \quad (4)$$

7 Equation 3.26 in Bond & Reneen (2007) provide a reduced form of the dynamic model for capital which is analogous to the dynamic employment model in their equation 7.3.

where FR_{it} is the firm's response, $exp_{it}$is export, $\boldsymbol{z}_{it1}$ is a matrix of exogenous variables, $\boldsymbol{x}_{it1}$ is a matrix of export and other time-varying variables, $c_i$is time-invariant firm characteristic, and u_{it1} is time-varying unobservables.

Our primary interest in the firm response is the employment change reflected in the number of total workers, production workers, and non-production workers (see Table 1 for the definition). However, as labour adjustment is dependent on other factor inputs, we also analyse the impact of export on the utilisation rate, fixed asset, material input, stocks and their contribution to labour adjustments.[8]

With the assumption that $\boldsymbol{x}_{it1}$ is exogenous and by applying fixed-effect effect estimator, we can remove c_i from equation (3). However, equation (2) shows that we have to control for technological change, price effect, and domestic sales, which is part of the production, to get robust estimates. Otherwise $\boldsymbol{\beta}_1$is biased due to omitted variables. Unfortunately, our data do not have information about price and technological change.

We argue that our empirical strategy is capable of eliminating these biases. First, the firm and industry group fixed effect will eliminate the time-invariant technological level that is firm and industry-specific. The inclusion of year dummies and their interaction with the industry group dummies is expected to eliminate the time-variant shock in prices and technology, which are industry-specific. One of our robustness tests uses the firms' data in which the fixed asset does not vary by more than one standard deviation from their mean with an assumption that the fixed assets such as machines and other hardware determine the firms' technological level.

Further, to eliminate the remaining bias from the omitted variable and reverse causality, we apply the instrumental variable (IV) and the generalised method of moments (GMM) utilising external- and internal instruments, respectively, in each approach. The instruments assure the exogeneity of the export or foreign demand shock, so the estimates should be unbiased.

When applying the IV strategy using an external instrument, we mainly present the result from the control function (CF) approach, which is similar to those from the two-stage least square (2SLS).[9] In this setting, we instrument the firm export using the import decline in the destination country and follow the steps described in equations (5) to (7).[10] The first stage

[8] We use half-finished product stocks because of the data availability and the empirical results consistency. See Table 1 for the description.

[9] We follow Wooldridge (2012, 2015) in applying the CF procedure. In addition to the CF, we also run 2SLS-IV estimation (Schaffer, 2010). The results from both methods are very similar.

[10] We discuss the instrument further in section 3.3.

regression in equation (5) estimates the residual (v_i) that represents the time-varying omitted variable.

$$ln\ exp_{i,t} = \alpha\ ln\ FD_{i,t} + \phi_1\ ind\_group_{i,t} + \phi_2\ ind\_group_{i,t} * year + \mu_i + \eta_t + v_{i,t} \quad (5)$$

where FD_{it} is foreign demands of firm *i*'s product at time *t*, which we define in section 3.3; ind_group_t is the industry dummies based on two-digit ISIC classification; $ind\_group_t * year$ is the interaction between industry group and year dummies; μ_i is the firm fixed effect; η_t is the trend effect; and $v_{i,t}$ is the first stage regression residual.

The fixed effect (FE) estimation will eliminate μ_i in equation (5) and other time-invariant dummy variables, and we can get the residual estimate:

$$\widehat{v_{i,t}} = ln\ exp_{i,t} - \alpha\ ln\ FD_{i,t} \quad (6)$$

Then we plug the residual into the second stage regression

$$ln\ FR_{i,t} = \beta_1 ln\ exp_{i,t} + \rho_1 \widehat{v_{i,t}} + \phi\ ind\_group_{i,t} + \phi\ ind\_group_{i,t} * year + \mu_i + \eta_t + \varepsilon_{i,t} \quad (7)$$

where $\widehat{v_{i,t}}$ is the estimated residual from the first stage FE regression; and $\varepsilon_{i,t}$ is the error term from the second-stage regression. If firms' export is endogenous in equation (7) given the instrument we use, we expect $\rho_1 \neq 0$, and hence our estimations are unbiased from the omitted variable error. However, if $\rho_1 = 0$, we do not have enough evidence that the firm's export is endogeneous. In this case, we apply the GMM to examine if the export is better to be treated as predetermined.[11]

Denoting $\Delta lnFR_{i,t} = lnFR_{i,t} - lnFR_{i,t-1}$, the difference GMM estimation takes the form of:

$$\Delta lnFR_{i,t} = \delta\ \Delta lnFR_{i,t-l} + \beta_1 \Delta ln\ exp_{i,t} + \beta_2 \Delta ln\ x_{i,t} + \Delta\varepsilon_{i,t} \quad (8)$$

We use the fixed asset to represent capital when the dependent variables are employment, utilisation rate, material input, or stocks.[12] Meanwhile, we include the industry classification dummies (resource-based, low, medium, and high technology industries) when estimating the impact of export on fixed assets.

As shown in the previous studies, factor adjustments are interrelated. Therefore, we investigate the impact of export and other factor input adjustment on employment using equation (9).

$$\Delta lnFR_{i,t} = \delta\ \Delta lnFR_{i,t-l} + \beta_1 \Delta ln\ exp_{i,t} + \Delta ln\ \boldsymbol{X}_{i,t}\boldsymbol{\beta_2} + \Delta\varepsilon_{i,t} \quad (9)$$

[11] We follow Kripfganz (2020) to run the GMM estimation and Schaffer and Windmeijer (2020) for overidentification and underidentification test.

[12] The fixed assets here refer to land, building, machinery, and other fixed assets.

where $\boldsymbol{X}_{i,t}$ is a matrix of other factor input $x_{i,t}^{(m)}$ of M distinct variables that include the utilisation rate, fixed assets, material input, and stocks, while $\varepsilon_{i,t}$is error.

Further, to show that the response is heterogeneous across capital levels, we add the interaction of export and fixed asset:

$$\Delta lnFR_{i,t} = \delta\, \Delta lnFR_{i,t-l} + \beta_1 \Delta ln\, exp_{i,t} + \Delta ln\, \boldsymbol{X}_{i,t}\boldsymbol{\beta_2} + \beta_3(\Delta ln\, exp_{i,t} * \Delta ln\, FA_{i,t}) + \Delta\varepsilon_{i,t} \quad (10)$$

where $FA_{i,t}$is firms' fixed assets. Concerning the random disturbance in equation (8)-(10), $\Delta\varepsilon_{i,t}$, the moment conditions of the regressors, either lagged dependent variable ($FR_{i,t-l}$) and the explanatory variables ($exp_{i,t}, x_{i,t}^{(m)}$, $FA_{i,t}$), can be classified as endogenous, predetermined, or exogenous for these conditions below:

$E\left(FR_{i,t}\Delta\varepsilon_{i,t}\right) = 0$ for $s \leq t\text{-}2$,

$E\left(x_{i,s}^{(m)}\Delta\varepsilon_{i,t}\right) = 0$ for $s \leq t\text{-}2$ if $x_{i,t}^{(m)}$ is endogenous with respect to $\varepsilon_{i,t}$

$E\left(x_{i,s}^{(m)}\Delta\varepsilon_{i,t}\right) = 0$ for $s \leq t\text{-}1$ if $x_{i,t}^{(m)}$ is predetermined with respect to $\varepsilon_{i,t}$

$E\left(x_{i,s}^{(m)}\Delta\varepsilon_{i,t}\right) = 0$ for $\forall_s$ if $x_{i,t}^{(m)}$ is exogenous with respect to $\varepsilon_{i,t}$

Additionally, by using the dynamic model in equations (8-10), we can analyse the speed of adjustment in factor input as represented by δ, whose number indicates the adjustment length of the factor input. Therefore, we can also calculate the long-run impact or elasticities of export on the specified factor input as denoted as LR elasticities using equation (11).

$$LR\ elasticites\ of\ export = \frac{\beta_1}{1-\delta} \quad (11)$$

3.3. The instrument used in the IV approach

For the IV estimation, we instrument export ($exp_{i,t}$) by the foreign demand (FD_{it}) following Berman (2015) and Erbahar (2020):

$$FD_{i,t} = \sum_{c,p} \omega_{icp}.\, import_{cp,t} \quad (12)$$

The term $FD_{i,t}$ refers to the import of the destination countries that firm *i* serves. Thus, $FD_{i,t}$ is the foreign demand shock to firm *i* at time *t*, ω_{icp} is the average weight of a country-product *cp* in firm *i*'s total export in 2008-2012; $import_{cp,t}$ is country *c*'s import of product p in the year *t* from the world exclude Indonesia.[13] The decline of the demand of product h from the

[13] We construct the instrument by matching the firm performance dataset from the SI-IBS with the firm-level export dataset.

foreign countries will be transmitted into firm i's export but not vice versa. Therefore, the foreign demand ($FD_{i,t}$) is exogenous to the firm's performance.

As we show in the result section, the foreign demand ($FD_{i,t}$) is a strong instrument for the firm's export ($exp_{i,t}$). We also argue that the exclusion restriction is satisfied as the demand change in a foreign country will be transmitted into firms' performance only through the trade channel (firms' export). There is a possibility that the trading partner's increase in imports will be transmitted through the investment channel. However, the transmission will take time as the cross-border investments require an agreement and regulatory compliance, while installing the new capital is time-consuming.

However, we do not rule out this possibility, so we try to eliminate the impact of foreign demand changes through the investment channel. One of our strategies is by restricting the samples to firms whose capital levels do not change by more than one standard deviation from the mean for a robustness test. The range is necessary to accommodate the capital change due to measurement, depreciation, and repair. On the other hand, we control the level of capital by adding fixed assets in the GMM estimation. Our strategy shows that the result is robust from the capital level adjustments.

4. Data

The study uses the matched data of firms' performance obtained from the Statistik Industri Besar dan Sedang (SI-IBS) and their export by destination.[14,15] The period used here is 2008-2012 based on the availability of data that fits the post GFC period. The samples are restricted to firms that export their product for at least one year during the period observed. We use the import data from World Integrated Trade System (WITS) to calculate the country-product-year import in the foreign demand shock estimation.

Table 1. Data measurement and sources

Variable	Measurement in the equation	Sources
1. Employment (ln) a. Total workers b. Production workers	All measurements are in the log form, while the definition refers to BPS.[16] • Production workers are directly involved in the production process, including the production	SI-IBS (BPS)

[14] It refers to the information collected from the population of medium and big manufacturing firms whose number of workers are at least 20. Both datasets are from the Indonesian national statistics agency or Badan Pusat Statistik (BPS).
[15] The matched data is only used for IV approach to construct the instrument for export.
[16] It refers to the definition provided by BPS, available online at https://www.bps.go.id/subject/9/industri-besar-dan-sedang.html

Variable	Measurement in the equation	Sources
c. Non-production workers	supervisor, machine operator, and inventories administrator. • Non-production workers are the supporting employees who are not directly involved in the production line, such as non-production managers, human resources staff and supervisors, security staff, drivers, and secretaries. • Total workers = production + non-production workers	
2. Utilisation rate (ln of the percentage ratio)	The ratio of production to the installed capacity	SI-IBS (BPS)
3. Fixed assets (ln, real value)	The firm's fixed asset value includes land, building, machinery and equipment, vehicle, and other fixed assets.	SI-IBS (BPS)
4. Material input (ln, real value)	The value of raw and intermediate input used for production	SI-IBS (BPS)
5. Half-finished product stocks (ln, real value)	The average level of half-finished product stocks is calculated by averaging the stocks at the beginning and the end of the year = $\frac{1}{2}.(\text{stocks in January} + \text{stocks in December})$. BPS defines half-finished product stocks as the material input plus the value of works that have been done.	SI-IBS (BPS)
6. Export (ln, real value)	The value of firm export. We use the customs' export data for IV estimation and the export data from SI-IBS for GMM estimation. The export data from SI-IBS is calculated from the percentage of products sold for export.[17]	SI-IBS (BPS) & Firms export dataset (BPS)

[17] There are discrepancies between the export data from customs and that from SI-IBS as the latter is estimated from the percentage of production sold to foreign market. However, the mean and the distribution of the data (in their log value) are very similar (see Appendix 10).

Variable	Measurement in the equation	Sources
7. Domestic sales (ln, real value)	Share of products sold in the domestic market (total production – the value of products sold in the foreign market).	SI-IBS (BPS)
8. Product-country-year import (ln, real value)	The destination countries' import of product *p* the firm *i* export, in year *t*. The product is classified in ISIC code to match the classification used in SI-IBS.	World Integrated Trade System

We use the natural logarithm of all variables in the estimation. Before being translated into its natural log form, the monetary value of the variables obtained from SI-IBS and the customs dataset are adjusted by the price level using the wholesale price index (WPI) in the manufacturing industry. The foreign demand initially in USD is converted into Indonesian Rupiah using the annual exchange rate data obtained from the World Bank Development Indicator. The summary statistics of the variables can be seen in Table 2.

Table 2. Summary Statistics

	Observation	Mean	Std. deviation	Min*	Max
No. of total workers	13,965	447	1,093	20	32,977
No. of production worker	13,965	379	978	2	29,854
No. of non-production worker	12,970	67	185	0	5,944
Utilisation rate (%)	11,387	77	16	1	100
Export (customs – Rp billion)	11,752	110	580	0	27,100
Export (SI-IBS data – Rp billion)	7,503	141	1,430	0	84,000
Domestic sales (Rp billion)	7,738	157	975	0	29,400
Material input (Rp billion)	13,360	123	1,140	0	81,000
Fixed assets (Rp billion)	8,922	213	4,480	0	252,000
Half-finished stocks (Rp billion)	7,557	22	290	0	13,300

Notes: * For values in Rupiah (Rp), when the figure is zero, it means the number is less than Rp 1 billion

There are more than 13 thousand observations from around 2,500 exporting firms over 2008-2012 in the matched dataset. However, not all of the firms have complete data in each variable used in this study. The number of observations declines to around 3,000 observations associated with approximately 1,100 firms as we put all factor inputs into a single equation. We run the regression using both the complete samples and the reduced samples depending on the data availability.

5. Results

This section discusses the impact of export on firms' employment and other factor input. To begin with, we present the estimation result of the export impact on total workers, production workers and non-production workers. Further, we analyse the impact of export on other factors such as utilisation rate, fixed assets, material input, and half-finished product stocks and their inter-relation in affecting employment. The baseline model uses control function (CF) procedures and appropriately treats the endogeneity of export. To get confidence in the CF estimates and deal with the endogeneity when other factor inputs are put together in the equation, we use the generalised method of moment (GMM) to deal with the problems. The two approaches show that our estimations are robust and that the factor input adjustments are inter-related.

5.1. The impact of foreign demand shocks on employment

Table 3 presents the impact of export on employment measured as the number of total workers, production workers, and non-production workers. Models (1) to (3) do not include the interaction of industry group dummies and year dummies, while Models (4) to (6) do. The inclusion of the interaction barely changes the result.

The CF approach seems plausible in estimating the impact of export on the total number of workers and production workers. The residuals (v_i) calculated from the first stage regression are significant at 5%, and 1% levels for the corresponding estimation as shown in Models (1), (2), (4), and (5) validates the endogenous assumptions. The instruments used in these equations are strong, with the coefficients significant at 1% level, and high t-statistics and adjusted R-squared in the first regression. So, there is enough evidence to conclude that export positively affects the number of total workers and production workers.

Table 3. Impact of foreign demand shocks on employment (CF)

Model	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Total workers	Production workers	Non-production workers	Total workers	Production workers	Non-production workers
Export (ln - real value)	0.09***	0.11***	0.05	0.08***	0.10***	0.05
	(3.61)	(3.96)	(1.51)	(3.26)	(3.61)	(1.38)
Residual (v_i)	-0.06**	-0.07***	-0.04	-0.05**	-0.07**	-0.03
	(-2.27)	(-2.64)	(-0.94)	(-1.98)	(-2.34)	(-0.81)
Observations	11,337	11,337	10,475	11,337	11,337	10,475
R-squared	0.92	0.92	0.86	0.92	0.92	0.86
Number of firms	2,597	2,597	2,466	2,597	2,597	2,466
Adjusted R-squared	0.90	0.89	0.82	0.90	0.89	0.82
Degrees of freedom (model)	25	25	25	111	111	111
Firm FE	Y	Y	Y	Y	Y	Y
Industry group (2 digit ISIC) FE	Y	Y	Y	Y	Y	Y
Industry group (2 digit ISIC) * Year FE	N	N	N	Y	Y	Y
First stage regression						
- Foreign demand (ln - real value)	0.24***	0.24***	0.24***	0.24***	0.24***	0.24***
- Instrument t-stat	9.31	9.31	9.31	9.31	9.31	9.31
- First stage adj. R-squared	0.89	0.89	0.89	0.89	0.89	0.89

*Notes: Robust t-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1*

The models without the interactions of industry group and year dummies are preferred because the interaction does not give additional predictive power. At the same time, it increases the models' degrees of freedom, causing a slight difference in the estimates.[18] So, based on Model (1) and Model (2), every 10% increase in export will increase the number of total workers by around 0.9% and of the production workers by approximately 1.1%.[19]

Meanwhile, Table 3 shows that the endogenous assumption of export in Model (3) and (6) are not plausible. The residual (v_i) is not significant at the 10% level, although the *t*-statistics is marginally below the critical value. The estimations using panel 2SLS-IV in Appendix 1 show that the *p*-value of the endogeneity test is 0.30. It means there is not enough evidence that export is endogenous in estimating the export impact on the non-production workers given the instruments we use.

When we assume that export is exogenous and estimate the impact of export on non-production workers using fixed effect (FE), we get a significant coefficient at the 5% confidence level. However, the magnitude is small, 0.02 (see Appendix 2 column 1). Furthermore, the significance is unstable when the dynamic models are applied in the estimations using FE (column 7) and OLS model (column 13). It suggests that proper dynamic models are necessary for the estimation as the dynamic model using OLS and FE are suffered from Nickel bias. The

[18] Therefore, it reduces the total degrees of freedom and usable observations. Although, the difference in the degrees of freedom do not affect the estimates so much as the number of observations are large.

[19] The result in Table 3 is based on the control function (CF) procedure discussed by Wooldridge (2012, 2015) as it is convenient to work with dummy variables. In Appendix 1, we show the similar result based on the 2SLS-IV run using xtivreg2 (Schaffer, 2010).

lagged of non-production workers is downward biased or too small (0.11) in FE model column (5) and is upward biased (0.87) in OLS model column (9).

To better capture the adjustment path, we use GMM, treat export as endogenous and predetermined, and present the result in Table 4. By treating the export as endogenous and controlling for the fixed asset level, the impacts of export on the number of total workers, production workers, and non-production workers of the GMM model are similar to those from the CF models. The export coefficients in Model (1) and Model (2) are significant and the same as the corresponding coefficients shown in Table 3. Even they are barely different when export is treated as predetermined, as shown in Model (4) and (5). However, the smaller t-statistics and higher Akaike Information Criteria (AIC) in Model (1) and (2) suggest that the endogenous assumption of export in the total workers and production workers estimations are more appropriate.

Table 4. Impact of foreign demand shocks on employment (GMM)

Model	Endogenous			Predetermined		
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Total workers	Production workers	Non-production workers	Total workers	Production workers	Non-production workers
L1.[dependent variable]	0.57***	0.50***	0.48***	0.56***	0.47***	0.38***
	(9.30)	(8.89)	(9.19)	(3.46)	(3.33)	(4.78)
Export (ln - real value)	0.09***	0.11***	0.03	0.10**	0.11*	0.03*
	(4.28)	(4.73)	(0.99)	(2.09)	(1.90)	(1.87)
Fixed assets (ln - real value)	0.26***	0.28***	0.35***	0.25***	0.28***	0.32***
	(3.85)	(3.55)	(3.43)	(3.18)	(3.05)	(3.36)
Observations	6,050	6,050	5,517	6,050	6,050	5,517
Number of firms	2,073	2,073	1,930	2,073	2,073	1,930
No. of instruments	15	15	15	14	14	15
Hansen p-value	0.98	0.97	0.99	0.95	0.93	0.96
AR1 p-value	0.00	0.00	0.00	0.00	0.00	0.00
AR2 p-value	0.65	0.36	0.10	0.71	0.40	0.15
Underidentified p-value	0.00	0.00	0.00	0.00	0.00	0.00
AIC	-13.91	-13.59	-14.53	-11.76	-11.60	-13.40
GMM model	Sys	Sys	Sys	Diff	Diff	Sys
All difference-in-Hansen p-value > 0.2	Y	Y	Y	Y	Y	Y
- Level & predet. instrument p-value > 0.3	Y	Y	Y	Y	Y	Y
Long term elasticities	0.20***	0.22***	0.06	0.24	0.21	0.05*
	(4.33)	(4.70)	(0.97)	(1.40)	(1.45)	(1.93)

*Notes: Robust t-statistics in parentheses; Sys=system GMM (Blundell & Bond), Diff=difference GMM (Arrelano & Bond); *** p<0.01, ** p<0.05, * p<0.1*

Meanwhile, the different assumption of export changes the significance level of the export impact on non-production workers, as illustrated by Model (3) and Model (6). The magnitude in each Model is the same, 0.03, but insignificant under the endogenous assumptions and significant at the 10% level under the predetermined assumption. Although the information criteria suggest that the endogenous assumption is preferable, the AR2 in Model (6) is more convincing.[20] It indicates that the predetermined model is preferred for estimating the impact on non-production workers.

Based on the dynamic model above, now we can see the speed of adjustment of the dependent variables and estimate the long-run impact or elasticities. Both the endogenous and predetermined assumptions give similar adjustment speeds for total workers and production workers. The coefficients for lagged total workers and lagged production workers are around 0.47-0.57 indicates that the adjustment is moderate. Therefore, the long-run elasticities of export on total workers and production workers based on the preferred models under the endogenous assumption are around 0.20. The figure for the non-production workers is much smaller, 0.05, and marginally significant.

5.2. Interrelated factor demand

5.2.1. The impact of foreign demand on other factor inputs

Studies in firms' factor input adjustment conclude that the adjustment in one factor of production is not independent of other factors. To see such behaviour in the Indonesian manufacturing firms, we estimate the impact of export on other factors such as utilisation rate, fixed asset, material input, and stocks. Further, we include all these factors in a single equation to see their impact on the total number of workers.

Table 5. The impact of exports on other factor input (CF)

Model	(1)	(2)	(3)	(4)
Dependent variable	Utilisation rate	Fixed asset	Material input	Half-finished stock
Export (ln - real value)	0.00	0.07	0.09	0.19**
	(0.24)	(1.12)	(1.64)	(2.18)
Residual (v_i)	0.00	-0.05	-0.04	-0.15*
	(0.06)	(-0.73)	(-0.64)	(-1.67)
Constant	4.21***	14.75***	14.85***	11.18***
	(15.57)	(13.58)	(14.13)	(7.72)
Observations	9,190	7,139	10,843	6,066
R-squared	0.63	0.85	0.84	0.89
Number of firms	2,274	1,830	2,517	1,518
Adjusted R-squared	0.51	0.79	0.79	0.85
Degrees of freedom	25	25	24	23
Firm FE	Y	Y	Y	Y
Industry group (2 digit ISIC) FE	Y	Y	Y	Y
Industry group (2 digit ISIC) * Year FE	N	N	N	N
First stage regression				
- Foreign demand (ln - real value)	0.24***	0.24***	0.24***	0.24***
- Instrument t-stat	9.31	9.31	9.31	9.31
- First stage adj. R-squared	0.89	0.89	0.89	0.89

Robust t-statistics in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

[20] Kiviet (2020) suggest the AR2 p-value is ≥ 0.05-0.15.

From Table 5, we can see that the impacts of export on utilisation rate, fixed assets, and material input are not significant based on the CF approach. However, the residual (v_i) in column (1) to (3) are not significant, suggesting that the endogeneity treatment in these models are not satisfactory. The same conclusion is obtained when the 2SLS IV model is used. As shown in Appendix 1, the *p*-values of the endogeneity test in the estimations of the utilisation rate, fixed asset, and material input are 0.95, 0.39, and 0.49.

On the other hand, the estimation of the impact on the half-finished product stocks seems plausible. Column (4) shows that the export coefficient is significant at the 5% level. The significance of the residual at the 10% level suggests that the export endogeneity is appropriately treated in this model. The instrument is also strong with *t*-statistics 9.31 or significant at a 1% level. Appendix 1 shows that the Kleibergen F-statistics from the first stage regression is 100.82 or much higher than the rule of thumb level of 10. It suggests that the half-finished stocks play a significant role in firms adjustment to foreign demand shocks. Every 10% increase in export will increase the inventory by around 1.9%.

As external instruments in Model (1) to (3) are not satisfactory, we utilise the internal instruments in the GMM approach. Table 6 shows that the impacts of export on other factor input are significant with relatively stable magnitudes. The effect of export on the utilisation rate is barely different under the endogenous assumption in column (1) and the predetermined assumption in column (5), which are 0.07 and 0.05, significant at 10% and 5% levels, respectively. While both models have similar AIC and long-run elasticities, the endogenus and predetermined export assumption do not significantly affect the estimates.

Table 6. The impact of exports on other factor input (GMM)

Model	Endogenous				Predetermined			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	Utilisation rate	Fixed asset	Material input	Half-finished stock	Utilisation rate	Fixed asset	Material input	Half-finished stock
L1.[dependent variable]	0.50***	0.53***	0.33***	0.08	0.49***	0.51***	0.32***	0.16***
	(5.86)	(0.00)	(8.08)	(1.15)	(4.50)	(0.00)	(4.24)	(2.84)
Export (ln - real value)	0.07*	0.36**	0.24***	0.17**	0.05**	0.41***	0.29***	0.14***
	(1.82)	(0.01)	(5.39)	(2.40)	(1.99)	(0.00)	(2.64)	(2.95)
Fixed assets (ln - real value)	-0.01		0.38**	0.19**	0.02		0.36**	0.20***
	(-0.28)		(2.51)	(2.13)	(1.10)		(2.20)	(3.24)
Observations	4,762	5,443	5,777	3,183	4,762	5,443	5,777	3,183
Number of firms	1,833	1,934	2,009	1,171	1,833	1,934	2,009	1,171
No. of instruments	15	15	15	15	15	16	14	19
Hansen p-value	0.54	0.92	0.89	0.79	0.48	0.91	0.87	0.51
AR1 p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AR2 p-value	0.77	0.85	0.20	0.10	0.94	0.79	0.27	0.16
Overidentified p-value	0.27	0.91	0.89	0.78	0.25	0.91	0.87	0.50
Underidentified p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Joint-test p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIC	-9.00	-8.58	-12.39	-11.34	-8.48	-9.92	-10.84	-12.75
GMM model	Sys	Sys	Sys	Sys	Diff	Sys	Diff	Sys
All difference-in-Hansen p-value > 0.2	Y	Y	Y	Y	Y	Y	Y	Y
- Level & predet. instrument p-value > 0.3	Y	Y	Y	Y	Y	Y	Y	Y
Long term elasticities	0.14*	0.75***	0.36***	0.19**	0.11*	0.84***	0.42**	0.17***
	(1.82)	(2.61)	(5.41)	(2.25)	(1.90)	(3.00)	(2.26)	(2.80)

*Notes: Robust t-statistics in parentheses; Sys=system GMM (Blundell & Bond), Diff=difference GMM (Arrelano & Bond); *** p<0.01, ** p<0.05, * p<0.1*

The impact of export on fixed assets is significant at the 5% level in the endogenous model (Table 6 column (2)), while it is significant at the 1% level under the predetermined assumption. The lack of endogeneity evidence from the CF approach and the lower AIC suggest that export is better treated as predetermined in estimating the impact of export on fixed assets. However, in both models, the export coefficients are just slightly different. Therefore, Table 6 column (6) provides evidence that every 10% increase in export will increase fixed assets by around 4%.

Based on the AIC, the endogenous assumption in column (3) is preferred for material input estimation, although the magnitude from the predetermined model in column (7) is barely different. These models suggest that every 10% foreign demand increase will increase the exporters' material input by more than 2%.

Meanwhile, the predetermined assumptions seem more plausible in estimating the export impact on the half-finished product stocks as it has a lower AIC. However, both models are under-identified, with their export coefficients being just slightly different, 0.17 based on the endogenous model and 0.14 based on the predetermined one. The advantage of the latter model is its higher AR2 *p*-value.[21] Hence, there is enough evidence to conclude that every 10% foreign demand increase will raise the firms' half-finished product stocks by around 1.4%. Both models

[21] Kiviet (2020) suggests 0.05-0.15 as the threshold for AR2 p-value.

suggest the long-run elasticities of export on the half-finished product stocks is about 0.17-0.19.

5.2.2. The impact of export and other factor adjustments on employment

As factor input adjustments are interrelated, we put all factor inputs into a single equation to see how exports and other factors contribute to the employment adjustment. In this setting, endogeneity is a severe issue that is too complicated to handle using the IV approach, and therefore we use the GMM for the estimation.

In Table 7, we show that the impact of export on employment is still consistent when other factor inputs are being controlled. The endogenous models in columns (1) to (4) do not satisfy the requirement in using level based on criteria suggested by Kiviet (2020), while Model (4) has an additional issue as it is not under-identified based on the test proposed by Windmeijer (2021)[22]. So, the endogenous assumption is not plausible in the estimations when all other factor inputs are being controlled. The predetermined models also do not satisfy the criteria suggested by Kiviet (2020) unless Model (8) and marginally Model (5). In both models, the export coefficients are between 0.07 and 0.08, although the former from Model (8) is preferred.

After controlling other factor input, the lagged dependent variable coefficient become lower, suggesting a slower adjustment in the number of total workers. It implies that the firms' flexibility in adjusting their factor input such as material input, capital, and stocks affect their response to shocks. If all factor inputs are being restricted, the long-term elasticities of export on the number of total workers become 0.11 or around a half of the corresponding estimates shown in Table 4 column (1), which is 0.20. It suggests that the impact of export on employment will be higher if firms can freely adjust other factor inputs.

Table 7. The impact of export and factor inputs on the number of workers

[22] Kiviet (2020) suggests the incremental Hansen p-value the level instruments using in system GMM is more than 0.3

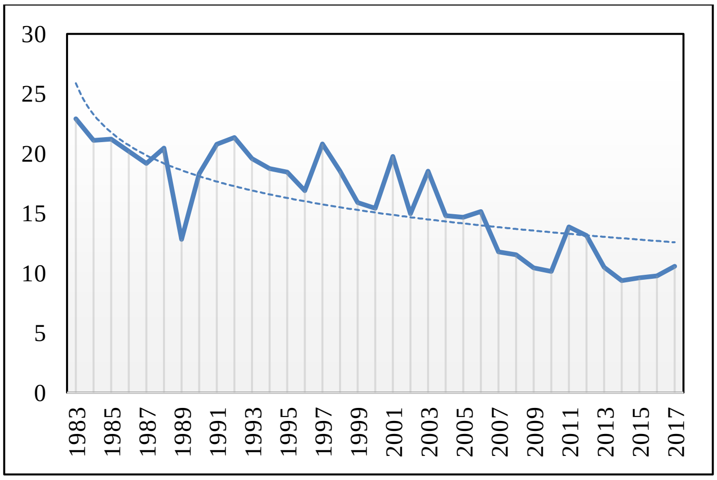
Dependent variable	Number of total workers							
Model	Endogeneous				Predetermined			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L1.Total workers (ln)	0.46***	0.57***	0.39***	0.43***	0.50***	0.43***	0.34***	0.35***
	(7.72)	(6.44)	(4.30)	(4.13)	(10.03)	(3.31)	(2.99)	(3.05)
Export (ln)	0.04	0.14***	0.07**	0.08*	0.08**	0.10***	0.07***	0.07***
	(1.47)	(4.13)	(2.18)	(1.89)	(2.25)	(3.84)	(3.90)	(2.79)
Utilisation rate (ln)	0.27	0.11		0.15	0.11	-0.02		0.07
	(0.76)	(0.60)		(0.72)	(0.92)	(-0.27)		(0.44)
Fixed assets (ln)	0.03	0.01	0.01	0.01	0.08***	0.08**	0.06**	0.07**
	(0.75)	(0.36)	(0.45)	(0.35)	(3.69)	(2.06)	(2.13)	(1.97)
Material input (ln)	0.18***		0.21***	0.18**	0.12***		0.11***	0.11***
	(2.84)		(3.69)	(2.41)	(6.68)		(6.16)	(4.93)
Half-finished stocks (ln)		-0.03	-0.01	-0.03		0.11**	0.08**	0.09**
		(-1.05)	(-0.51)	(-1.11)		(2.31)	(2.42)	(2.25)
Observations	5,034	3,044	3,481	3,016	5,034	3,044	3,481	3,016
Number of firms	1,878	1,199	1,271	1,189	1,878	1,199	1,271	1,189
No. of instruments	22	24	24	25	24	27	27	27
Hansen p-value	0.73	0.44	0.33	0.87	0.89	0.79	0.32	0.98
AR1 p-value	0	0	0	0	0	0	0	0
AR2 p-value	0.20	0.89	0.72	0.68	0.23	0.68	0.50	0.76
Overidentified p-value	0.72	0.60	0.46	0.90	0.90	0.63	0.21	0.98
Underidentified p-value	0.03	0.00	0.00	0.13	0.00	0.00	0.00	0.00
AIC	-16.51	-14.84	-13.18	-20.77	-21.29	-22.93	-15.71	-27.06
GMM model	Sys	Sys	Sys	Sys	Sys	Sys	Sys	Sys
All diff-in-Hansen p-value > 0.2	N	N	N	N	Y	N	N	Y
- Level & predet instrument p-val > 0.3	N	N	N	N	N	N	N	Y
Long-term elasticities	0.08	0.33***	0.12**	0.13*	0.17**	0.18***	0.11***	0.11***
	(1.40)	(5.55)	(2.22)	(1.81)	(2.38)	(4.84)	(4.67)	(3.43)

*Notes: Robust t-statistics in parentheses; Sys=system GMM (Blundell & Bond), Diff=difference GMM (Arrelano & Bond); *** p<0.01, ** p<0.05, * p<0.1*

5.3. The heterogeneous impact of export at different levels of capital intensity

Compared to other studies, the impact of foreign demand shocks on Indonesian manufacturing firms is somewhat low. Sims (1974), Saphiro (1986), and Epstein and Denny (1983) find that the impact of output on the manufacturing sector employment in the US is around 0.40 to 0.70. The coefficients are not directly comparable as our studies focus on the effects of export rather than the total output. However, with an assumption that the sensitivity of domestic demand on employment is at the same level, the coefficient from the Indonesian manufacturing firm is still relatively low.

Decreasing labour intensity of the Indonesian manufacturing firm over time may explain the low impact of foreign demand shocks on employment in the country. As shown in Figure 3, the share of labour cost to the Indonesian manufacturing firms' value-added has continuously decreased. To see the impact of the capital intensity on the firm's employment adjustment, we add the interaction of export and fixed assets into the estimation. The regression result can be found in Appendix 3.

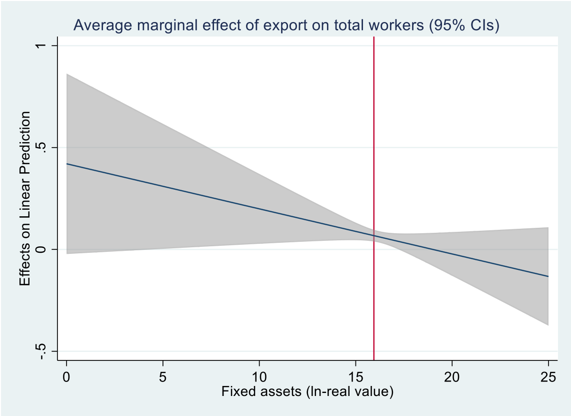


Sources: Estimated from the Manufacturing Industrial Indicator (BPS, 1983-2017)

Figure 3. Labour cost to value added (%)

Based on the models in Appendix 3, the export and fixed assets interaction's coefficients are negative with different significant levels among models. Model (4) is preferred because it satisfies all criteria suggested by Windmeijer (2021) and Kiviet (2020). Based on the selected model, the impact of export at the average level of capital is 0.09. The coefficient is higher for firms with a lower level of capital, suggesting that the employment in a small firm, which is also less capital intensive, is more sensitive.[23] As the capital level increases, the sensitivity of firms' employment to foreign demand shock reduces. Figure 4 shows that the heterogeneous impact of export across different levels of capital. Both models in panel a (Model 3) and panel b (Model 4) control fixed assets and utilisation rates. The difference is that Model (3) also controls the material input, while Model (4) controls the average stocks of half-finished products. Both models suggest that the sensitivity of employment on foreign demand shock become smaller as firms' capital becomes higher. While if the material input is held constant, the impact of export on employment also becomes insignificant for smaller firms.

[23] We obtain the same conclusion if we interact export with capital per worker instead of fixed assets as shown in Appendix 4. However, the models using the capital per worker are less satisfactory as there are the incremental Hansen p-value less than 0.20.



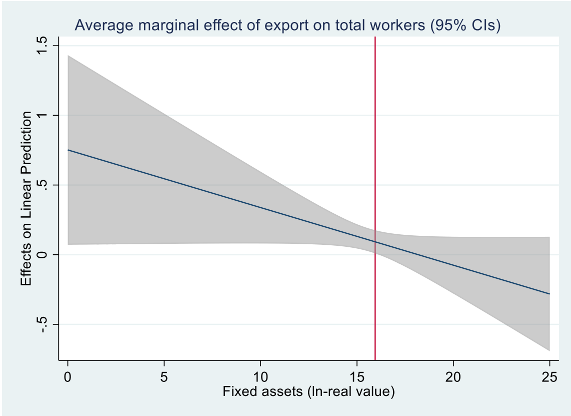


Figure 4. The heterogeneous impact of export at different levels of capital (fixed asset)

a. Based on Model (3) **b. Based on Model (4)**

Regarding the heterogeneous impact across the levels of capital, we argue that small firms in the samples are more responsive to foreign demand shock as their share of export to total production is higher, and they are more labour-intensive, as illustrated in Table 8. There is no supporting argument that the heterogeneous impact is attributed to the utilisation rate.

Table 8. Firms' characteristics based on decile of fixed asset

Decile of fixed asset	1	2	3	4	5	6	7	8	9	10
Share export to total production	0.6	0.6	0.5	0.5	0.5	0.6	0.5	0.5	0.5	0.4
Capital per worker (Rp mil/workers)	4.2	16.7	27.2	43.3	57.9	70.4	101.8	158.0	255.8	5105.5
Capacity utilisation rate (%)	77.9	77.8	77.0	76.2	76.7	77.1	76.1	75.6	77.4	78.1

Source: Estimated from Manufacturing Industrial Statistics (Statistik Industri Bear & Sedang, BPS, 2008-2012)

Regarding the heterogeneous response between domestic and foreign-affiliated firms, we argue that the employment in foreign firms is less sensitive to the foreign shocks because of their high level of capital intensity.[24] Table 9 shows that the level of capital intensity, measured by the number of fixed assets per labour, is significantly different between domestic and foreign-affiliated firms. On average, the difference is almost fourfold between the two groups.

Table 9. Mean difference of capital intensity between group of firms (in Rp mil/ per worker)

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Domestic	9,233	146.04	30.63	2943.45	85.99	206.09
Foreign	4,484	861.22	250.10	16747.59	370.89	1351.54
Combined	13,717	379.83	84.36	9880.18	214.47	545.18
Difference		-715.18	179.74		-1067.50	-362.85

Notes: t-statistics of the difference is 3.9789; dof=13,715

[24] We define a firm as foreign-affiliated if there is ownership at any percentage of the total ownership.

Further, we test the contribution of the foreign ownership by including the dummy of the foreign firm into the main equation and interacting it with export and capital intensity. As shown in Appendix 11, given the export and fixed asset constant, foreign-affiliated firms has fewer workers than domestic firms implying that foreign-affiliated firms are more efficient in using labour (Model 1).

However, foreign ownership has no additional explanatory power on employment when interacting with export and fixed assets. In Model 2, the interaction between export and foreign dummy (FD) is insignificant, while in Model 3, ownership's interaction with fixed assets is insignificant. In all models, exports are significant at least at 10% level. When the interaction of export and fixed assets is considered in Model 4, foreign ownership is no longer significant.

In line with Table 9, Models (2-4) suggest that the heterogenous response between domestic and foreign firms is because of the different levels of the capital intensity measured by the fixed asset in our estimation. It implies that foreign ownership brings more capital into the domestic economy, hire less labour, and their employment is less sensitive to shock.

5.4. Robustness test

There is enough evidence to conclude that our estimations are robust. **First**, all the CF and 2SLS models produce similar estimates, with the export impact on the total workers being around 0.09 for the total workers and 0.11 for the production workers. The GMM estimations that control for the fixed assets also produce the exact estimates. **Second**, when other factor inputs are held constant in the GMM estimation, the export coefficients are around 0.07-0.08 or just slightly decreased. In addition, when export interacts with the capital (Appendix 3) or capital intensity (4), the impact of export on the total workers at the average level of capital and capital intensity is 0.09.

Further, to see if the results are sensitive to the data utilised, we run the regressions using the winsorised data and the restricted samples of firms who export consistently in 5 years (consistent exporters) and firms whose fixed assets do not vary significantly. The winsorised data is used to ensure that the result is not affected by the outliers. In contrast, the consistent exporters' subsample is used to see whether the different behaviour exists between the consistent and the intermittent exporters. On the other hand, the samples of firms whose fixed assets do not vary by one standard deviation are used to control the technological level in the IV approach.

In Appendix 3 to 7, we present the 2SLS IV results, which are similar to those from the CF and the GMM models. The latter approach is used because the endogeneity is not always evident from the IV based result. If there is enough evidence of the endogeneity from the 2SLS and CF approach, we also present the GMM result based on the endogenous assumption. Meanwhile, if the endogeneity evidence is not satisfied in the 2SLS/CF approach, we show the predetermined GMM result.

Appendix 5 to 9 show that the result is not sensitive to the outliers and different data subsets. Based on the 2SLS and the GMM models, the export impacts on total workers ranged between 0.06 to 0.11, with a median of 0.09. The similar estimates for the production workers are ranged from 0.06-0.13 with a median of 0.11 for the production workers estimation. From the same appendices, most models show the marginally significant impact of export on non-production, with the estimates ranging between 0.04-0.05.

While the IV models in Appendices 5-7 show the insignificant impact of export on the utilisation rate, the GMM model in Appendix 8 and 9 provide evidence that export's sensitivity on the utilisation rate is 0.05. Similarly, the impact on the fixed assets is robust and consistent at the level of 0.34-0.35 based on the GMM model in Appendix 8 and 9. On the other hand, the impact of export on the material input is not consistent enough, ranging from 0.25 to 0.56 based on Appendix 8 and 9. However, both estimations are not satisfactory due to the presence of weak instruments.[25] Meanwhile, the impact of export on the half-finished product stocks is relatively stable, 0.17 in Appendix 8 and 0.13 in Appendix 9, although the latter estimation is not entirely satisfactory.

6. Discussion and conclusion

This study confirms that the impact of foreign demand shocks on the manufacturing firm employment is significant but relatively weak. Unlike the other studies that usually use Input-Output analyses to link the export to job but fail to provide estimates of the employment elasticity of foreign shock, we combine the firms' performance dataset with their export destination dataset to construct an instrument for their export. Using these exogenous foreign demand shocks and the IV estimation, we provide a robust and consistent estimate that every 10% increase in export will increase the manufacturing firms total workers by around 1%. The result is robust when internal instruments are applied in the IV and GMM estimation. Furthermore, the dynamic model (GMM) estimates that a 10% increase in export can potentially increase employment by around 2% if firms can freely adjust their other factor input.

[25] The difference in Hansen p-value of some instruments are below 0.2.

We argue that the small impact of export on employment in the short run is due to the high capital intensity of the Indonesian exporting manufacturers during 2008-2012. We show that the firms have become less labour-intensive over time, and the impact of foreign demand shock is heterogeneous across different capital levels. In other words, firms with higher capital intensity make more minor employment adjustments.

The magnitudes of adjustments in the capital, material input, and stocks are higher, suggesting that although the direct impact of foreign demand on employment is small, its backward implications should not be ignored. This study shows that the impact of foreign demand on the material input and the stocks are significant, and the increase in these factor input will increase the number of workers. Although the effects of export on fixed assets and the utilisation rate are both significant, we can only provide evidence of the substantial role of the former in employment adjustment when all factor inputs are being controlled in the same equation.

The evidence explains why the effect of global financial crises on the Indonesian economy is mild through the manufacturing trade channel. However, the small magnitude also implies that the cost of employment adjustment in the Indonesian manufacturing firm is high. As suggested by other studies, the labour regulation in Indonesia might contribute to the employment adjustment cost. However, the analysis is beyond the scope of our studies.

These conclusions lead to some policy implications. **First**, employment in the labour-intensive industry is more sensitive to foreign demand shock that potentially creates more job when the world demand increase. But consequently, the employment rate in this industry is more volatile to foreign demand shocks. A policy to promote job creation through labour-intensive industries should be complemented by better social protection or other sectors development to absorb the unhired labour during a downturn. **Second**, the access of capital and intermediate input should be improved as they play a significant role in boosting employment in the manufacturing sector.

We acknowledge that our study has limitations due to our data and model. The annual data prohibit us from seeing the sequence of the firm's response to foreign demand shock from adjusting the utilisation rate to altering the number of workers. The impact on working hours is unrevealed as the data is not available. However, regarding the limitation of the response, we show that even using the annual data, the utilisation rate is one of the firm responses coping with the foreign shocks. In addition, our study only covers the impact of the first moment of the foreign demand shock and do not cover the uncertainties or the second-moment effect of the shock.

Reference list

1. Adhvaryu, A., Chari, A. V., & Sharma, S. (2013). Firing costs and flexibility: evidence from firms' employment responses to shocks in India. *Review of Economics and Statistics*, *95*(3), 725-740.
2. Alfaro, L., & Chen, M. X. (2012). Surviving the global financial crisis: Foreign ownership and establishment performance. *American Economic Journal: Economic Policy*, *4*(3), 30-55.
3. Ardiyono, S. K., & Patunru, A. A. (2021). The impact of employment protection on FDI at different stages of economic development. *Working Paper in Trade and Development No.18/2021*, Crawford School of Public Policy, Australian National University
4. Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The review of economic studies*, *58*(2), 277-297.
5. Aswicahyono, H., & Manning, C. (2011). Exports and job creation in Indonesia before and after the Asian financial crisis. *Arndt-Corden Department of Economics Crawford School of Economics and Government ANU College of Asia and the Pacific*.
6. Baldwin, R., & Tomiura, E. (2020). Thinking ahead about the trade impact of COVID-19. *Economics in the Time of COVID-19*, *59*.
7. Banker, R. D., Byzalov, D., & Chen, L. T. (2013). Employment protection legislation, adjustment costs and cross-country differences in cost behavior. *Journal of Accounting and Economics*, *55*(1), 111-127.
8. Basri, M. C. (2015). 2. A Tale Of The Two Crises. In *Two Crises, Different Outcomes* (pp. 41-63). Cornell University Press.
9. Basri, M. C., & Hill, H. (2011). Indonesian growth dynamics. *Asian Economic Policy Review*, *6*(1), 90-107.
10. Basri, M. C., & Rahardja, S. (2010). The Indonesian economy amidst the global crisis: good policy and good luck. *ASEAN Economic Bulletin*, 77-97.
11. Basri, M. C., & Siregar, R. Y. (2009). Navigating policy responses at the national level in the midst of the global financial crisis: The experience of Indonesia. *Asian Economic Papers*, *8*(3), 1-35.
12. Bloom, N. (2009). The impact of uncertainty shocks. *econometrica*, *77*(3), 623-685.
13. Bond, S., & Van Reenen, J. (2007). Microeconometric models of investment and employment. *Handbook of econometrics*, *6*, 4417-4498.
14. Bentolila, S., & Saint-Paul, G. (1994). A model of labour demand with linear adjustment costs. *Labour Economics*, *1*(3-4), 303-326.
15. Brinca, P., Duarte, J. B., & Faria-e-Castro, M. (2020). Is the COVID-19 pandemic a supply or a demand shock?. *Available at SSRN 3612307*.
16. Caballero, R. J., Cowan, K. N., Engel, E. M., & Micco, A. (2013). Effective labour regulation and microeconomic flexibility. *Journal of Development Economics*, *101*, 92-104.

17. Campello, M., Graham, J. R., & Harvey, C. R. (2010). The real effects of financial constraints: Evidence from a financial crisis. *Journal of Financial Economics*, *97*(3), 470-487.

18. Cho, D. (2018). The labour market effects of demand shocks: Firm-level evidence from the recovery act. Mimeo. Available at https://scholar.princeton.edu/sites/default/files/davidcho/files/jmp-david-cho.pdf

19. Cooper, R., Haltiwanger, J., & Willis, J. L. (2015). Dynamics of labour demand: Evidence from plant-level observations and aggregate implications. *Research in Economics*, *69*(1), 37-50.

20. Correia, S. (2019). REGHDFE: Stata module to perform linear or instrumental-variable regression absorbing any number of high-dimensional fixed effects.

21. Den Haan, W. J., Ramey, G., & Watson, J. (2000). Job destruction and propagation of shocks. *American economic review*, *90*(3), 482-498.

22. Dixit, A. (1997). Investment and employment dynamics in the short run and the long run. *Oxford Economic Papers*, *49*(1), 1-20.

23. Eisner, R., Strotz, R. H. (1963)," Determinants of Business Investments", Research study Two in Impacts of Monetary Policies (Englewood Cliffs, NJ: Prentice-Hall, 1963).

24. Epstein, L. G., & Denny, M. G. (1983). The multivariate flexible accelerator model: its empirical restrictions and an application to US manufacturing. *Econometrica: Journal of the Econometric Society*, 647-674.

25. Eslava, M., Haltiwanger, J., Kugler, A., & Kugler, M. (2010). Factor adjustments after deregulation: panel evidence from Colombian plants. *The Review of Economics and Statistics*, *92*(2), 378-391.

26. Fabiani, S., Lamo, A., Messina, J., & Rõõm, T. (2015). European firm adjustment during times of economic crisis. *IZA Journal of Labour Policy*, *4*(1), 1-28.

27. Hamermesh, D. S. (1989). Labour demand and the structure of adjustment costs. *The American Economic Review*, 674-689.

28. Hamermesh, D. (1993). Labour demand. Princeton university press. *Princeton, NJ*.

29. Hamermesh, D. S., & Pfann, G. A. (1996). Adjustment costs in factor demand. *Journal of Economic Literature*, *34*(3), 1264-1292.

30. Harrison, A. E., & Sepúlveda, C. (2011). Learning from developing country experience: growth and economic thought before and after the 2008-09 crisis. *World Bank Policy Research Working Paper*, (5752).

31. Hart, R. A. (2017). Hours vs employment in response to demand shocks. *IZA World of Labour*, (393).

32. Holden, S., & Wulfsberg, F. (2008). Downward nominal wage rigidity in the OECD. *The BE Journal of Macroeconomics*, *8*(1).

33. Fujita, N., & James, W. E. (1997). Employment creation and manufactured exports in Indonesia, 1980–90. *Bulletin of Indonesian Economic Studies*, *33*(1), 103-115.
34. James, W. E., & Fujita, N. (2000). *Employment and manufacturing exports in Indonesia: An input-output analysis*. International Centre for the Study of East Asian Development.
35. Kiviet, J. F. (2020). Microeconometric dynamic panel data methods: Model specification and selection issues. *Econometrics and Statistics*, *13*, 16-45.
36. Kripfganz, S. (2020). XTDPDGMM: Stata module to perform generalised method of moments estimation of linear dynamic panel data models.
37. Kripfganz, S. (2019, September). Generalised method of moments estimation of linear dynamic panel data models. In *London Stata Conference* (No. 17).
38. Lucas, R. (1967). Optimal Investment Policy and the Flexible Accelerator. *International Economic Review, 8* (1), 78-85.
39. Mishkin, F. S. (2011). Over the cliff: From the subprime to the global financial crisis. *Journal of Economic Perspectives*, *25*(1), 49-70.
40. Möller, J. (2010). The German labour market response in the world recession–de-mystifying a miracle. *Zeitschrift für Arbeitsmarktforschung*, *42*(4), 325-336.
41. Montenegro, C. E., & Pagés, C. (2007). *7. Who Benefits from Labour Market Regulations? Chile, 1960–1998* (pp. 401-434). University of Chicago Press.
42. Nadiri, M. I., & Rosen, S. (1969). Interrelated factor demand functions. *The American Economic Review*, 457-471.
43. Nickell, S. J. (1986). Dynamic models of labour demand. *Handbook of labour economics*, *1*, 473-522.
44. Patunru, A. A., & Zetha, E. (2010). Indonesia's Savior: Fiscal, Monetary, Trade, or Luck?. *Public Policy Review*, *6*(4), 721-740.
45. Radelet, S., Sachs, J. D., Cooper, R. N., & Bosworth, B. P. (1998). The East Asian financial crisis: diagnosis, remedies, prospects. *Brookings Papers on Economic Activity*, *1998*(1), 1-90.
46. Rosen, S., & Nadiri, M. I. (1974). A disequilibrium model of demand for factors of production. *The American Economic Review*, 264-270.
47. Rossana, R. J. (1990). Interrelated demands for buffer stocks and productive inputs: Estimates for two-digit manufacturing industries. *The Review of Economics and Statistics*, 19-29.
48. Schaffer, M.E., (2010). xtivreg2: Stata module to perform extended IV/2SLS, GMM and AC/HAC, LIML and k-class regression for panel data models. http://ideas.repec.org/c/boc/bocode/s456501.html
49. Schaffer, M.E., Windmeijer, F. (2020). underid: Postestimation tests of under- and over-identification after linear IV estimation, https://ideas.repec.org/p/bri/uobdis/18-696.html

50. Shapiro, M. D. (1986). The dynamic demand for capital and labour. *The Quarterly Journal of Economics*, *101*(3), 513-542.
51. Sims, C. A., Lovell, M. C., & Solow, R. M. (1974). Output and labour input in manufacturing. *Brookings Papers on Economic Activity*, *1974*(3), 695-735.
52. Sjöholm, F., & Takii, S. (2006). Multinational Companies and Exports in Indonesian Manufacturing. *Multinationals in Indonesia and Thailand: Wages, Productivity and Exports. Hampshire, UK: Palgrave-Macmillan*, 173-193.
53. Takii, S. (2006). Productivity differentials and spillovers in Indonesian manufacturing. *Multinational Corporations in Indonesia and Thailand: Wages, Productivity, and Exports, Hampshire, UK: Palgrave Macmillan*, 85-103.
54. Treadway, A. B. (1971). The rational multivariate flexible accelerator. *Econometrica: Journal of the Econometric Society*, 845-855.
55. Windmeijer, F. (2021). Testing underidentification in linear models, with applications to dynamic panel and asset pricing models. *Journal of Econometrics*.
56. Wooldridge, J. (2012). Panel data models with heterogeneity and endogeneity. Programme Evaluation for Policy Analysis, Institute Fiscal Studies.
57. Wooldridge, J. M. (2015). Control function methods in applied econometrics. *Journal of Human Resources*, *50*(2), 420-445.

Appendix 1. The estimation result using IV-2SLS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variables	Total workers	Production workers	Non-production workers	Utilisation rate	Fixed assets	Material input	Half-finished stock
Export (ln-real value)	0.09***	0.11***	0.05	0.01	0.07	0.09*	0.17**
	(0.02)	(0.03)	(0.03)	(0.02)	(0.06)	(0.06)	(0.07)
Observations	11,345	11,345	10,483	9,197	7,143	10,849	6,072
R-squared	-0.00	-0.01	0.00	0.00	0.01	0.05	0.04
Number of firms	2,598	2,598	2,467	2,275	1,831	2,518	1,519
Adjusted R-squared	-0.31	-0.31	-0.31	-0.33	-0.33	-0.24	-0.29
Kleibergen-Paap F-Stat	152.53	152.53	128.53	125.77	99.40	138.94	100.82
Endogeneity test p-value	0.01	0.00	0.30	0.95	0.39	0.49	0.05

Robust standard errors in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

Appendix 2. The estimation using OLS, FE, with and without lagged dependent variables

Model	Fixed-effect (FE)										Ordinary least square (OLS)					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Dependent variable	Non-production workers	Utilisation rate	Fixed assets	Material input	Total workers	Production workers	Non-production workers	Utilisation rate	Fixed assets	Material input	Total workers	Production workers	Non-production workers	Utilisation rate	Fixed assets	Material input
L1.[dependent variable]					0.22***	0.18***	0.11***	0.06	0.01	-0.05***	0.94***	0.93***	0.87***	0.64***	0.81***	0.76***
					(8.50)	(7.19)	(4.71)	(1.45)	(0.22)	(-2.76)	(170.18)	(153.28)	(113.69)	(20.02)	(50.87)	(77.74)
Export (ln-real value)	0.02**	0.01	0.03**	0.06***	0.02***	0.03***	0.02	0.01	0.04**	0.05***	0.01***	0.02***	0.02***	0.00***	0.05***	0.08***
	(2.39)	(1.52)	(2.05)	(4.58)	(3.63)	(4.15)	(1.55)	(1.29)	(2.20)	(3.36)	(6.41)	(7.45)	(7.36)	(2.94)	(7.49)	(13.50)
Constant	3.27***	4.20***	15.59***	15.19***	3.76***	3.72***	3.01***	3.94***	14.89***	17.10***	-0.15*	0.04	-0.12***	1.46***	1.11***	3.84***
	(13.94)	(62.51)	(44.09)	(20.13)	(20.52)	(20.72)	(11.84)	(20.75)	(20.21)	(43.06)	(-1.85)	(0.20)	(-3.80)	(8.84)	(2.70)	(4.20)
Observations	10,484	9,198	7,146	10,852	8,861	8,861	7,968	6,369	5,010	8,370	9,213	9,213	8,357	6,887	5,443	8,742
R-squared	0.86	0.64	0.85	0.84	0.93	0.93	0.88	0.69	0.88	0.85	0.88	0.87	0.76	0.41	0.72	0.70
Adjusted R-squared	0.82	0.51	0.79	0.79	0.90	0.90	0.82	0.55	0.82	0.79	0.87	0.87	0.76	0.41	0.72	0.70
Long-term elasticities					0.03***	0.03***	0.02	0.01	0.04**	0.05***	0.25***	0.26***	0.18***	0.01***	0.28***	0.32***
					(3.63)	(4.16)	(1.54)	(1.29)	(2.21)	(3.37)	(8.28)	(9.75)	(8.54)	(2.97)	(8.82)	(16.81)

*Robust t-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1*

Appendix 3. The interaction between export and the capital intensity

Dependent variable	Total workers			
Model	(1)	(2)	(3)	(4)
L1. Total workers	0.40***	0.65***	0.32***	0.29***
	(3.18)	(11.36)	(3.61)	(2.65)
Export (ln)	0.75***	1.05***	0.42*	0.75**
	(3.01)	(3.63)	(1.86)	(2.16)
Fixed assets (ln)	0.67***	0.96***	0.40*	0.75**
	(2.61)	(3.40)	(1.72)	(1.98)
Export * Fixed assets	-0.04**	-0.06***	-0.02	-0.04*
	(-2.45)	(-3.26)	(-1.59)	(-1.88)
Utilisation rate		-0.37	0.04	0.01
		(-1.09)	(0.66)	(0.10)
Material input (ln)			0.13***	
			(7.21)	
Half-finished stock (ln)				0.03
				(1.60)
Observations	6,050	5,178	5,034	3,044
Number of firms	2,073	1,924	1,878	1,199
No. Instruments	19	22	27	27
Hansen p-value	0.35	0.63	0.53	0.98
AR1 p-value	0.00	0.00	0.00	0.00
AR2 p-value	0.93	0.64	0.22	0.62
Overidentified p-value	0.31	0.77	0.29	0.99
Underidentified p-value	0.00	0.02	0.00	0.00
Joint-test p-value	0.00	0.02	0.00	0.00
Impact of export at the average capital	0.15***	0.13***	0.07***	0.09*
- p-value	0.00	0.00	0.00	0.05
AIC	-9.76	-15.21	-18.02	-27.04
Treating export as	Endo	Endo	Pre	Pre
GMM model	Sys	Sys	Sys	Sys
All diff-in-Hansen p-value > 0.2	Y	Y	N	Y
Level & predet instrument p-val > 0.3	N	N	N	Y
- Instrument 1	0.26	0.27	0.45	0.75
- Instrument 2	0.45	0.63	0.34	0.91
- Instrument 3	0.32	0.49	0.69	0.98
- Instrument 4	0.33	0.71	0.15	0.51
- Instrument 5	0.84	0.26	0.22	0.61
- Instrument 6	0.28	0.31	0.26	0.74
- Instrument 7	0.54	0.61	0.30	0.46
- Instrument 8	0.81	0.26	0.65	0.93
- Instrument 9		0.39		

*Notes: t-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1*

Endo=endogenous, pre=predetermined; Y=Yes, N=No

Appendix 4. The interaction between export and the capital intensity using capital per worker

Dependent variable	Total workers			
Model	(1)	(2)	(3)	(4)
L1. Total workers	0.48***	0.53***	0.40*	0.64***
	(3.08)	(3.04)	(1.81)	(8.98)
Export (ln)	0.59***	0.80***	0.68**	0.70**
	(4.10)	(3.34)	(2.07)	(2.33)
Fixed assets (ln)	0.70***	1.20***	0.99*	0.92**
	(3.56)	(3.17)	(1.78)	(2.12)
Export * Fixed assets	-0.04***	-0.07***	-0.06*	-0.05**
	(-3.40)	(-3.07)	(-1.83)	(-2.05)
Material input (ln)			0.02	-0.01
			(0.24)	(-0.15)
Observations	6,050	6,050	5,841	5,841
Number of psid	2,073	2,073	2,020	2,020
No. Instruments	19	19	20	23
Hansen p-value	0.26	0.61	0.38	0.31
AR1 p-value	0.00	0.00	0.01	0.00
AR2 p-value	0.79	0.46	0.39	0.39
Overidentified p-value	0.16	0.66	0.56	0.57
Underidentified p-value	0.00	0.00	0.03	0.04
Joint-test p-value	0.00	0.00	0.03	0.04
Impact of export at the average capital per worker	0.15***	0.09***	0.09	0.13***
- p-value	0.00	0.00	0.22	0.00
AIC	-8.54	-12.82	-10.17	-11.86
Treating export as	Endo	Pre	Endo	Endo
GMM model	Sys	Sys	Sys	Sys
All diff-in-Hansen p-value > 0.2	N	Y	N	N
Level & predet instrument p-val > 0.3	N	N	N	N
- Instrument 1	0.15	0.43	0.32	0.11
- Instrument 2	0.34	0.72	0.77	0.66
- Instrument 3	0.10	0.20	0.05	0.12
- Instrument 4	0.24	0.20	0.06	0.18
- Instrument 5	0.70	0.87	0.13	0.95
- Instrument 6	0.43	0.91	0.71	0.18
- Instrument 7	0.56	0.89	0.26	0.81
- Instrument 8	0.45	0.54		0.31
- Instrument 9				0.28

*Notes: t-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Endo=endogenous, pre=predetermined; Y=Yes, N=No*

Appendix 5. The result of 2SLS IV using winsorised data p(0.05)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variables	Total workers	Production workers	Non-production workers	Utilisation rate	Fixed assets	Material input	Half-finished stock
Export (ln-real value)	0.11***	0.13***	0.08**	0.01	0.05	0.11	0.18**
	(4.18)	(4.46)	(2.00)	(0.79)	(0.80)	(1.45)	(2.46)
Observations	11,345	11,345	10,483	9,197	7,143	11,345	6,072
Number of firms	2,598	2,598	2,467	2,275	1,831	2,598	1,519
Kleibergen-Paap F-Stat	184.99	184.99	155.42	159.46	121.49	184.99	107.69
Endogeneity test p-value	0.01	0.00	0.13	0.71	0.71	0.79	0.09

Robust t-statistics in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Appendix 6. The result of 2SLS using consistent exporters only

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	Total workers	Production workers	Non-production workers	Utilisation rate	Fixed assets	Material input	Half-finished stock
Export (ln-real value)	0.08***	0.10***	0.05	0.01	0.09	0.09	0.18**
	(3.37)	(3.72)	(1.26)	(0.33)	(1.43)	(1.44)	(2.26)
Observations	10,554	10,554	9,797	8,663	6,658	10,091	5,653
Number of firms	2,322	2,322	2,222	2,080	1,653	2,249	1,365
Kleibergen-Paap F-Stat	131.48	131.48	109.50	108.36	83.41	118.90	81.71
Endogeneity test p-value	0.03	0.01	0.44	0.99	0.36	0.63	0.06

Robust t-statistics in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Appendix 7. The 2SLS-IV using firms whose fixed assets do not change more/less than one standard deviation from their mean

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	Total workers	Production workers	Non-production workers	Utilisation rate	Fixed assets	Material input	Half-finished stock
Export (ln-real value)	0.06**	0.06**	0.06*	0.02	0.01	0.04	0.21**
	(2.13)	(2.10)	(1.67)	(1.14)	(0.36)	(0.61)	(2.57)
Observations	5,810	5,810	5,399	5,023	5,810	5,587	3,323
R-squared	0.01	0.01	-0.00	0.00	0.32	0.07	0.04
Number of psid	1,621	1,621	1,512	1,461	1,621	1,567	945
Adjusted R_Square	-0.39	-0.39	-0.40	-0.42	0.05	-0.31	-0.36
Kleibergen-Paap F-Stat	82.82	82.82	73.28	76.33	82.82	73.11	52.51
Endogeneity test p-value	0.21	0.23	0.17	0.47	0.86	0.74	0.01

Robust t-statistics in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Appendix 8. The GMM estimation using the winsorised data (full sample)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variables	Total workers	Production workers	Non-production workers	Utilisation rate	Fixed assets	Material input	Half-finished stocks
L1. [dependent variable]	0.58***	0.52***	0.40***	0.43***	0.54***	0.29***	0.07
	(9.94)	(9.67)	(5.14)	(8.82)	(6.95)	(2.85)	(0.99)
Export (ln)	0.09***	0.11***	0.04*	0.05***	0.35***	0.56***	0.17*
	(3.77)	(4.21)	(1.85)	(2.71)	(2.63)	(4.36)	(1.68)
Fixed assets (ln)	0.25***	0.26***	0.32***	0.02		0.07	0.20**
	(3.85)	(3.59)	(3.44)	(1.27)		(1.00)	(2.07)
Observations	6,050	6,050	5,517	4,762	5,120	6,050	3,183
Number of firms	2,073	2,073	1,930	1,833	1,741	2,073	1,171
No. Instruments	15	15	15	16	16	14	15
Hansen p-value	0.93	0.96	0.91	0.57	0.77	0.53	0.88
AR1 p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.01
AR2 p-value	0.95	0.71	0.06	0.46	0.64	0.18	0.12
Overidentified p-value	0.93	0.96	0.91	0.52	0.73	0.50	0.87
Underidentified p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Assumptions	Endo	Endo	Pre	Pre	Pre	Pre	Endo
Joint-test p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIC	-12.92	-13.48	-12.64	-10.31	-8.7	-7.93	-12.22
BIC	-58.02	-58.58	-57.16	-59.94	-41.48	-47.39	-52.74
HQIC	-29.78	-30.34	-29.34	-28.98	-21.06	-22.67	-27.81
All diff-in-Hansen p-value > 0.20	Y	Y	Y	Y	Y	N	Y
- Instrument 1	0.59	0.82	0.98	0.30	0.72	0.98	0.76
- Instrument 2	0.45	0.74	0.70	0.65	0.59	0.59	0.99
- Instrument 3	0.98	0.96	0.91	0.45	0.63	0.19	0.82
- Instrument 4	0.45	0.57	0.50	0.46	0.85	0.27	0.71
- Instrument 5	0.93	0.90	0.90	0.88	0.66	0.41	0.95
- Instrument 6	0.93	0.83					0.46

*Notes: t-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1*

Endo=endogenous; Pre=Predetermined; years & constant dummies not presented for simplicity

Appendix 9. The GMM estimation using the winsorised data (consistent exporters only)

Dependent variables	(1) Total workers	(2) Production workers	(3) Non-production workers	(4) Utilisation rate	(5) Fixed assets	(6) Material input	(7) Half-finished stocks
L1. [dependent variable]	0.57***	0.51***	0.49***	0.44***	0.55***	0.24***	0.16***
	(9.30)	(9.12)	(5.22)	(9.28)	(7.03)	(2.64)	(2.63)
Export (ln)	0.09***	0.11***	0.02	0.05**	0.34***	0.25***	0.13**
	(3.64)	(3.79)	(0.45)	(2.42)	(2.85)	(3.52)	(2.55)
Fixed assets (ln)	0.25***	0.28***	0.35***	-0.01	-3.65	0.40***	0.21***
	(4.12)	(4.11)	(3.59)	(-0.45)	(-1.51)	(2.59)	(3.07)
Observations	5,669	5,669	5,212	4,465	5,443	5,669	3,007
Number of firms	1,854	1,854	1,747	1,654	1,934	1,854	1,063
No. Instruments	15	15	14	16	16	14	19
Hansen p-value	0.88	0.94	0.87	0.68	0.76	0.5	0.48
AR1 p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AR2 p-value	0.96	0.72	0.05	0.48	0.62	0.13	0.15
Overidentified p-value	0.87	0.93	0.88	0.55	0.74	0.51	0.49
Underidentified p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Assumptions	Endo-Sys	Endo-Sys	Endo-Sys	Pre-Sys	Pre-Sys	Endo-Sys*	Pre-Sys
Joint-test p-value	0	0	0	0	0	0	0
AIC	-12.3	-13.1	-10.8	-11.38	-8.59	-7.69	-12.41
Difference in Hansen p-value							
- Instrument 1	0.36	0.70	0.82	0.22	0.75	0.29	0.42
- Instrument 2	0.41	0.61	0.84	0.89	0.49	0.80	0.51
- Instrument 3	0.99	0.95	0.66	0.42	0.84	0.16	0.35
- Instrument 4	0.21	0.27	0.98	0.81	0.94	0.44	0.71
- Instrument 5	0.97	0.76	0.53	0.36	0.89	0.36	0.27
- Instrument 6	0.77	0.79		0.72			

T-statistics in parentheses

**No-evidence of endogeneity based on CF/2SLS but predetermined GMM is not underifdentified*

Endo=endogenous; Pre=Predetermined; years & constant dummies not presented for simplicity

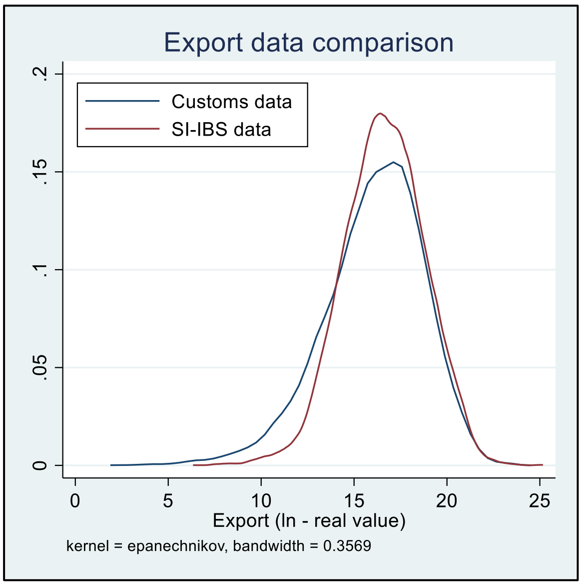
**** p<0.01, ** p<0.05, * p<0.1*

Appendix 10. The comparison of export data from customs and SI-IBS estimation

a. Mean (log, real value)

	Mean	Std. Err.	[95% Conf. Interval]	
Export (customs data)	16.59	0.03	16.53	16.64
Export (SI-IBS)	16.73	0.03	16.68	16.78

b. Distributions (kernel density)



Appendix 11. The heterogeneous response between domestic and foreign-affiliated firms

Dependent variable	Total workers (ln)			
Model	(1)	(2)	(3)	(4)
L1. Total workers (ln)	0.57***	0.63***	0.56***	0.40***
	(9.04)	(2.94)	(2.86)	(3.20)
Export (ln)	0.09***	0.07*	0.09***	0.75***
	(4.22)	(1.85)	(2.59)	(3.00)
Fixed assets (FA, ln)	0.27***	0.28***	0.35***	0.67***
	(3.80)	(3.86)	(3.62)	(2.60)
Foreign-affiliated dummy (FD)	-0.21***	-0.33	2.55	0.01
	(-3.38)	(-0.22)	(1.36)	(0.12)
FD * Export (ln)		0.01		
		(0.07)		
FD * FA (ln)			-0.17	
			(-1.46)	
Export (ln) * FA (ln)				-0.04**
				(-2.45)
Observations	6,050	6,050	6,050	6,050
Number of psid	2,073	2,073	2,073	2,073
No. Instruments	16	19	19	20
Hansen p-value	0.98	0.96	0.96	0.35
AR1 p-value	0.00	0.00	0.00	0.00
AR2 p-value	0.65	0.60	0.75	0.93
Underidentified p-value	0.00	0.01	0.00	0.00
Joint-test p-value (export & interactions)	0.00	0.10	0.02	0.00
AIC	-13.95	-16.41	-16.43	-9.76
GMM Model	Sys	Sys	Sys	Sys
Treating export as	Endo	Endo	Endo	Pre
Level & predet instrument p-value > 0.3	Y	Y	Y	Y

*Notes: - t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1*