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Article

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Real exchange rate undervaluation and Indonesia's manufacturing exports

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Abstract: This study analyzes the impact of real exchange rate undervaluation on Indonesia's manufacturing exports in 22 manufacturing industries throughout 1990–2015. The study was undertaken by modifying a partial equilibrium model of monopolistic competition for exporting firms and using the augmented mean group (AMG) method. This study confirms that the real exchange rate, both misalignment and changes in levels (depreciation/appreciation), are insignificant in affecting Indonesia's manufacturing exports. In addition, this study finds that manufactured exports are significantly determined by the manufactured exports in the previous period, real interest rates, real wages, labor productivity, and firm growth. This finding indicates that the exchange rate manipulation policy is not an important factor in strengthening the competitiveness of Indonesia's manufacturing exports. We suggest policies that play more important roles in driving manufacturing exports are creating a competitive and conducive business climate, lowering domestic interest rates, and reforming the labor system.

Subjects: Monetary Economics; International Finance; International Trade; incl; trade agreements & tariffs

Keywords: real exchange rate; undervaluation; manufacturing exports; augmented mean group



Rasbin

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PUBLIC INTEREST STATEMENT

Until now, the impact of exchange rate undervaluation on exports is still the pros and cons. Therefore, the study of the relationship between the two variables, especially in developing countries such as Indonesia, is still an interesting topic to discuss and we focus on exports in the manufacturing sector. We find that exchange rate undervaluation does not significantly affect exports of the manufacturing sector. This implies that policy instruments to strengthen the export competitiveness of the manufacturing sector must be outside of exchange rate instruments such as banking sector support, competitive real wages for labor, increased labor productivity, and the growth of firms in the manufacturing industry.

GEL classifications: C33; F10; F31

1. Introduction

As one of the developing countries, Indonesia has achieved quite well in economic growth in the last few decades. Before the 1997/1998 economic crisis, or the period 1990–1997, the economy grew at an average of (GDP/gross domestic product) 6.9%. However, after the 1997/1998 economic crisis until the 2008 global economic crisis, or the period 1999–2008, the economy grew only at an average of 5.2%. Then the average economic growth rose to 5.4% post 2008 global economic crisis (World Development Indicator, World Bank). Following the economic growth, the composition of exports has also changed in the recent decades. In the period 1995–1998, Indonesia's exports were mainly driven by manufacturing exports which account for around 51% of total exports. However, this composition fell to 37% in the period 2008–2014 (Falianty, 2015).

Another macroeconomic indicator is the exchange rate. The average exchange rate of Indonesian rupiahs to US dollar was Rp2,196.40 in the period 1990–1997. Then, the Indonesian rupiah exchange rate depreciated sharply to Rp10,013.62 in 1998 (during the 1997/1998 economic crisis). The average exchange rate of Indonesian rupiah stood at Rp9,245.98 and Rp11,543.27 post 1997/1998 crisis (2000–2008) and after the 2008 global economic crisis, respectively (International Financial Statistics, International Monetary Fund). Is the exchange rate undervaluation ineffective in driving the export-led-growth strategy?

Many studies in Indonesia have discussed the relationship between exchange rates and exports. Generally, these studies adopt the exchange rate variables at its level or change (Ikhsan, 2009; Jongwanich, 2009;; Falianty, 2015). They focus on how the weakening of an exchange rate, whether depreciation or undervaluation, affects exports. To gain a more comprehensive view of different responses of exports to exchange rate movements, Falianty (2015) suggests decomposing exports into primary and manufacture exports. However, Di Nino et al. (2011) found that the elasticity of industrial goods export to the undervaluation of the exchange rate is greater than primary goods. Therefore, this study will focus on manufactured exports due to their large contribution in Indonesia's total exports. This study uses a partial equilibrium model of monopolistic competition for manufacturing industry to analyse the impact of exchange rate undervaluation on Indonesia's manufacturing exports.

Understanding the relationship between exchange rate undervaluation and manufactured exports in Indonesia is essential due to Indonesia's position as a non-price maker and its share of exports that is not exogenously determined. In correspondence to that, the value of Indonesia's manufactured exports is affected by product competitiveness, both in terms of price and non-price competition. Unlike the previous studies such as Dekle et al. (2010), the share of exports in this study is determined endogenously. Hence, this study involves two stages. *First*, the development of partial equilibrium model of monopolistic competition for manufacturing industry. *Second*, the measurement of exchange rate undervaluation impact on manufactured exports in Indonesia by treating the share of manufactured exports as an endogenous variable.

To estimate the relationship between the exchange rate undervaluation and manufacturing exports, this study uses the AMG (augmented mean group) method. The AMG method is an estimation method that considers the existence of unit root issues and cross-sectional dependence in panel-time series data. Ignoring the cross-sectional dependence assumption in panel data estimations may lead to biased, inconsistent, and invalid estimators (Guloglu & Bayar, 2016) and incorrect conclusions (Baltagi & Maasoumi, 2013). Besides, this method is also robust against the problem of second-order bias and structural breaks. To the best of our knowledge, this study is the first study in Indonesia that uses the AMG method to estimate the impact of exchange rate undervaluation on manufacturing exports.

Generally, previous research has studied the relationship between exchange rates and exports in Indonesia without using methods that consider the problem of cross-sectional dependence. Ikhsan (2009), Jongwanich (2009), and Falianty (2015) use cointegration and ECM (error correction mechanism) methods to estimate the impact of exchange rate depreciation on Indonesia's exports.

The remainder of this paper is organized as follows. The next section presents a brief overview of the literature on exchange rate misalignments and export. The monopolistic competition model is set out in Section 3 and the data and estimation strategy is discussed in Section 4. The results obtained are presented and discussed in the Section 5, and the final section provides conclusion.

2. Exchange rate misalignments and export

There are pros and cons of exchange rate undervaluation on exports. The Mercantilist group and the Washington Consensus have different views on this matter. According to the Mercantilist, exchange rate undervaluation can improve export performance and economic growth. In general, the empirical studies observed the relationship between exchange rate undervaluation and economic growth with the possibility of market failure. It was found that the issue of market failure is greater in the tradable sector than the non-tradable sector. However, the exchange rate undervaluation could carry economic costs due to market failure in the tradable sector to decline, thereby encouraging the expansion of the sector. Finally, this condition has a positive impact on economic growth (Auboin & Ruta, 2012).

Nevertheless, the positive impact of exchange rate undervaluation on economic growth only occurs in developing countries, not in developed countries. The correlation is stronger for countries with low income per capita. Furthermore, the positive correlation between exchange rate undervaluation and economic growth is stronger in developing countries than in developed countries (Di Nino et al., 2011).

One of the channels through which the exchange rate undervaluation contributes to economic growth is export or known as "export-led-growth" (Di Nino et al., 2011; Rodrik, 2008, 2008; Di Nino et al., 2011; Haddad & Pancaro, 2010).¹ However, the impact of real exchange rate undervaluation on exports is significant only in the short and medium-term but not in the long term (Haddad & Pancaro, 2010). Another case with Glüzmann et al. (2012) discovered that exchange rate undervaluation has no significant impact on exports and imports.

In contrast to the Mercantilist group, the "Washington Consensus" views the real exchange rate misalignments as a macroeconomic imbalance that can hinder economic growth. Misalignment of exchange rates could generate incorrect signals to economic agents thus leading to factor misallocation. However, the "Washington Consensus" supports the view of Rodrik (2008) and other economists that the exchange rate undervaluation is an effective instrument to boost export growth. However, the impact of exchange rate undervaluation on economic growth, in the long run, remains questionable (Berg & Miao, 2010). Therefore, a study on the impact of exchange rate undervaluation on economic growth and its implications on exports is an interesting topic to discuss, especially in developing countries such as Indonesia.

3. The model

3.1. Analysis of consumer preferences

An economy consists of n industries, and each of which produces product groups (indexed by i), $[1, n]$. Each product group i consists of a single differentiated product (indexed by ω) that is produced by firm in the industry, $\omega[1, n]$. The assumption is that each industry contains m firms. The definition of the product group in this paper refers to Allanson and Montagna (2005) and Anderson and De Palma (1992). The consumers, as end-users of product group i , are from the domestic and foreign countries with assumed identical preferences. Furthermore, the aggregate consumption on a series of product groups i in the form of CES (constant elasticity of substitution)

is the preference used to describe consumer utility. The consumption function is taken from Obstfeld and Rogoff (1996) and used by Dekle et al. (2010), as follows:

$$Y_t = \left[\int_{i=1}^n Y_{it}^{\frac{\theta-1}{\theta}} di \right]^{\frac{\theta}{\theta-1}} \quad (1)$$

where Y_t denotes aggregate consumption of product group i at date t .

In contrast to Obstfeld and Rogoff (1996) and Dekle et al. (2010), Y_{it} in this paper is the consumption of product group i at date t , and θ is a parameter that measures the elasticity of substitution among the product group i . The product group i has a higher and lower substitution ability when θ is above and below one, respectively.

The consumption of the product group i is expressed by the CES sub-utility function as follows:

$$Y_{it} = \left[\int_{\omega=1}^m [Y_{it}(\omega)]^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}} \quad (2)$$

where σ shows the elasticity of substitution among the products ω in group i while $Y_{it}(\omega)$ is the consumption of product ω at date t . The product ω has a higher and lower substitution ability when σ is above and below one, respectively.

In a monopolistic competition framework, the domestic aggregate price level P_t^d is given by

$$P_t^d = \left[\int_{i=1}^n (P_{it}^d)^{1-\theta} di \right]^{\frac{1}{1-\theta}} \quad (3)$$

while the domestic product group i price level P_{it}^d is

$$P_{it}^d = \left[\int_{\omega=1}^m (P_{it}^d(\omega))^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \quad (4)$$

where $P_{it}^d(\omega)$ denotes the price of domestic product ω .

By maximizing equation (1) subject to budget constraints, $I_t^d = P_t^d Y_t^d = \int_{i=1}^n P_{it}^d Y_{it}^d di$, where I_t^d denotes the nominal value of the total expenditures of the domestic consumer, the domestic consumer chooses his product group i consumption bundle, Y_{it}^d . This gives the domestic demand for product group i as

$$Y_{it}^d = \left(\frac{P_{it}^d}{P_t^d} \right)^{-\theta} Y_t^d \quad (5)$$

Similarly, foreign demand for product group i Y_{it}^f is:

$$Y_{it}^f = \left(\frac{P_{it}^f}{P_t^f} \right)^{-\theta} Y_t^f \quad (6)$$

The sum of domestic and foreign demand for product group i is called the total demand for product group i . We assume the law of one price, $P_t^d = e_t P_t^f$, $P_{it}^d = e_t P_{it}^f$, then the total demand for product group i is

$$Y_{it}^T = \left(\frac{P_{it}^d}{P_t^d}\right)^{-\theta} Y_t^T \text{ or } \left(\frac{P_{it}^f}{P_t^f}\right)^{-\theta} Y_t^T \tag{7}$$

where $Y_t^T = Y_t^d + Y_t^f$, is total aggregate consumption, and hence the total real income. Furthermore, Y_t^d and Y_t^f are domestic and foreign aggregate consumption, respectively.

Equation (7) illustrates the inverse demand functions for product groups i both in domestic and foreign, respectively.

$$P_{it}^d = P_t^d \left(\frac{Y_{it}^T}{Y_t^T}\right)^{\frac{-1}{\sigma}} \tag{8}$$

$$P_{it}^f = P_t^f \left(\frac{Y_{it}^T}{Y_t^T}\right)^{\frac{-1}{\sigma}} \tag{9}$$

The domestic consumption bundle for product ω , $Y_{it}^d(\omega)$, is obtained by maximizing the sub-utility function (equation 2) with respect to budget constraints $I_t^d = P_t^d Y_t^d = \int_{\omega=1}^m P_{it}^d(\omega) Y_{it}^d(\omega) d\omega$. The domestic demand for product ω is denoted as follows:

$$Y_{it}^d(\omega) = \left(\frac{P_{it}^d}{P_t^d}\right)^{-\theta} \left(\frac{P_{it}^d(\omega)}{P_{it}^d}\right)^{-\sigma} Y_t^d \tag{10}$$

Similar to equation (10), foreign demand for product ω ($Y_{it}^f(\omega)$), is as follows:

$$Y_{it}^f(\omega) = \left(\frac{P_{it}^f}{P_t^f}\right)^{-\theta} \left(\frac{P_{it}^f(\omega)}{P_{it}^f}\right)^{-\sigma} Y_t^f \tag{11}$$

The total demand for product ω , $Y_{it}^T(\omega)$, is a combination of domestic and foreign demand for products ω . We assume the law of one price, $P_{it}^d(\omega) = e_t P_{it}^f(\omega)$, then the total demand for products ω is

$$\begin{aligned} Y_{it}^T(\omega) &= \left(\frac{P_{it}^d}{P_t^d}\right)^{-\theta} \left(\frac{P_{it}^d(\omega)}{P_{it}^d}\right)^{-\sigma} Y_t^T \text{ or} \\ &= \left(\frac{P_{it}^f}{P_t^f}\right)^{-\theta} \left(\frac{P_{it}^f(\omega)}{P_{it}^f}\right)^{-\sigma} Y_t^T \end{aligned} \tag{12}$$

The domestic and foreign inverse demand function for product ω are expressed as follows:

$$P_{it}^d(\omega) = \left[\frac{Y_{it}^T(\omega)}{Y_t^T}\right]^{\frac{-1}{\sigma}} \left[P_t^d\right]^{\frac{\theta}{\sigma}} \left[P_{it}^d\right]^{\frac{\sigma-\theta}{\sigma}} \tag{13}$$

$$P_{it}^f(\omega) = \left[\frac{Y_{it}^T(\omega)}{Y_t^T}\right]^{\frac{-1}{\sigma}} \left[P_t^f\right]^{\frac{\theta}{\sigma}} \left[P_{it}^f\right]^{\frac{\sigma-\theta}{\sigma}} \tag{14}$$

By substituting equations (8) and (9) into equations (13) and (14), the inverse demand function for product ω is given by:

$$P_{it}^d(\omega) = P_t^d [Y_{it}^T(\omega)]^{-\frac{1}{\sigma}} [Y_{it}^T]^{\frac{\sigma-1}{\sigma}} [Y_t^T]^{\frac{1}{\sigma}} \tag{15}$$

$$P_{it}^f(\omega) = P_t^f [Y_{it}^T(\omega)]^{-\frac{1}{\sigma}} [Y_{it}^T]^{\frac{\sigma-1}{\sigma}} [Y_t^T]^{\frac{1}{\sigma}} \tag{16}$$

3.2. Firm production and cost functions

According to Spence (1976), each firm produces a single differentiated product. The firm uses labor ($l_{it}[\omega]$), capital ($k_{it}[\omega]$), and raw materials ($m_{it}[\omega]$) to produce differentiated goods. It is assumed that labor arrived from the domestic market. However, this paper assumes that capital and raw materials come from domestic and foreign (import) market.

The production function of each firm to produce product ω follows the Cobb-Douglas form, and it is assumed to be identical. The production function is:

$$Q_{it}(\omega) = A_{it}(\omega) \left(\frac{l_{it}[\omega]}{\alpha_1}\right)^{\alpha_1} \left(\frac{k_{it}^d[\omega]}{\alpha_2}\right)^{\alpha_2} \left(\frac{m_{it}^d[\omega]}{\alpha_3}\right)^{\alpha_3} \left(\frac{k_{it}^f[\omega]}{\alpha_4}\right)^{\alpha_4} \left(\frac{m_{it}^f[\omega]}{\alpha_5}\right)^{\alpha_5} \tag{17}$$

where $A_{it}(\omega)$ is the firm's TFP (total factor productivity), $k_{it}^d[\omega]$ and $m_{it}^d[\omega]$ are domestic capital and domestic raw materials, and $k_{it}^f[\omega]$ and $m_{it}^f[\omega]$ are import capital and raw materials, respectively. Definition: $\rho = 1 - (\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)$ where the ρ parameter measures the degree of returns to scale, the notation ρ is above or below 0 indicates decreasing or increasing returns to scale, respectively. Meanwhile, when ρ equals 0, it indicates a constant return to scale.

The input market is assumed to be in the form of a perfectly competitive market. The prices of domestic labor, capital, and raw materials are denoted by w_t, r_t, v_t , respectively. In contrast, the prices of foreign capital and raw materials are r_t^f and v_t^f ,² respectively. The firm's cost function (the minimized cost for the given input price and output level) dual to the production function is:

$$\begin{aligned} C(w_t, r_t, v_t, e_t r_t^f, e_t v_t^f, Q_{it}(\omega)) &= w_t l_{it}^*[\omega] + r_t k_{it}^{*d}[\omega] + v_t m_{it}^{*d}[\omega] \\ &+ e_t r_t^f k_{it}^{*f}[\omega] + e_t v_t^f m_{it}^{*f}[\omega] \\ &= (\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5) \\ &\times \left(\frac{Q_{it}(\omega)}{A_{it}(\omega)}\right)^{\frac{1}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}} (e_t)^{\frac{\alpha_4 + \alpha_5}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}} (r_t)^{\frac{\alpha_2}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}} \\ &\times (w_t)^{\frac{\alpha_1}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}} (v_t)^{\frac{\alpha_3}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}} (r_t^f)^{\frac{\alpha_4}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}} \\ &\times (v_t^f)^{\frac{\alpha_5}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}} \end{aligned} \tag{18}$$

where $l_{it}^*[\omega]$, $k_{it}^{d*}[\omega]$, $m_{it}^{d*}[\omega]$, $k_{it}^{f*}[\omega]$, and $m_{it}^{f*}[\omega]$ are the form of the conditional factor demand function. Equation (18) is the firm's cost function which is assumed to be non-negative, homogenous of degree one, monotonically increasing, and concave in input and output prices (Nicholson & Snyder, 2012). Therefore, $\alpha_1 \geq 0, \alpha_2 \geq 0, \alpha_3 \geq 0, \alpha_4 \geq 0, \alpha_5 \geq 0$ and $\rho \geq 0$. This paper assumes that the cost function of each firm is identical. It aims to keep product ω in product group i with symmetrically $\alpha_1, \alpha_2, \alpha_3, \alpha_4$, and α_5 assumed to be the same for all firms.

3.3. Firm profit function

The total revenue of the monopolistic firm ω , $R(e_t P_{it}^f[\omega], Y_t^I, Y_{it}^I, Y_{it}^I[\omega])$, facing the inverse demand function in equations (15) and (16) is

$$R(e_t P_{it}^f[\omega], Y_t^I, Y_{it}^I, Y_{it}^I[\omega]) = P_{it}^d[\omega] Y_{it}^d[\omega] + e_t P_{it}^f[\omega] Y_{it}^f[\omega]$$

$$= e_t P_{it}^f [Y_{it}^I(\omega)]^{\frac{\sigma-1}{\sigma}} [Y_{it}^I]^{\frac{\theta-\sigma}{\theta\sigma}} [Y_t^I]^{\frac{1}{\theta}} \tag{19}$$

Based on the cost function (equation 18) and the total revenue (equation 19), it is assumed that there is a market-clearing condition between the total production and total demand for product ω , $Q_{it}(\omega) = Y_{it}^I(\omega)$, the profit function of each firm in manufacturing products ω is as follows:

$$\pi_{it}(\omega) = [e_t P_{it}^f [Y_{it}^I(\omega)]^{\frac{\sigma-1}{\sigma}} [Y_{it}^I]^{\frac{\theta-\sigma}{\theta\sigma}} [Y_t^I]^{\frac{1}{\theta}}] - [(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)$$

$$\times \left(\frac{Q_{it}(\omega)}{A_{it}(\omega)}\right)^{\frac{1}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}} (e_t)^{\frac{\alpha_4 + \alpha_5}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}} (r_t)^{\frac{\alpha_2}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}}$$

$$\times (w_t)^{\frac{\alpha_1}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}} (v_t)^{\frac{\alpha_3}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}} (r_t^f)^{\frac{\alpha_4}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}}$$

$$\times \left(v_t^f\right)^{\frac{\alpha_5}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}}], \omega = 1, \dots, m \tag{20}$$

3.4. Market equilibrium

Market equilibrium occurs at zero profit condition; therefore, equation (20) is written as $\pi_{it}(\omega) = 0$. By assuming that industry consists of m firms with a symmetric output equilibrium, the product ω by industry i is

$$Y_{it}^I = (m_{it})^{\frac{1}{\theta}} [(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)(r_t)^{\frac{\alpha_2}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}} (Y_t^I)^{\frac{-1}{\theta}}$$

$$\times (A_{it}(\omega))^{\frac{-1}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}} (w_t)^{\frac{\alpha_1}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}} (v_t)^{\frac{\alpha_3}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}}$$

$$\times \left(r_t^f\right)^{\frac{\alpha_4}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}} \left(v_t^f\right)^{\frac{\alpha_5}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}} \left(P_{it}^f\right)^{-1} (e_t)^{\frac{-(\alpha_1 + \alpha_2 + \alpha_3)}{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5}}]^{\frac{\theta}{\theta}}$$

$$\tag{21}$$

where $\vartheta = 1 - \frac{z(\alpha - \theta)}{\sigma\theta}$. Equation (21) is the output equilibrium produced by industry i .

3.5. Exchange rate elasticity of industry-level exports

The total supply of product group i from industry i in equation (21). Let δ_{it} be the export share in the supply of product group i . Then, the export of product group i from industry i is $Y_{it}^x = \delta_{it} Y_{it}^T$. Therefore, the log export equation of product group i from industry i as follows:

$$\begin{aligned} \ln Y_{it}^x &= \frac{z}{\vartheta} \ln(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5) + \frac{z\alpha_1}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} \ln(w_t) \\ &\quad - \frac{z}{\vartheta} \ln(P_t^f) + \frac{z\alpha_2}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} \ln(r_t) - \frac{z}{\vartheta\theta} \ln(Y_t^T) + \frac{1}{\vartheta} \ln(m_{it}) + \ln(\delta_{it}) - \frac{z}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} \ln[A_{it}(\omega)] \\ &\quad + \frac{z\alpha_3}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} \ln(v_t) + \frac{z\alpha_4}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} \ln(r_t^f) \\ &\quad + \frac{z\alpha_5}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} \ln(v_t^f) - \frac{z(\alpha_1 + \alpha_2 + \alpha_3)}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} \ln(e_t) \end{aligned} \quad (22)$$

The elasticity of industry-level exports to the exchange rate as follows

$$\varepsilon = \frac{\theta(\alpha_1 + \alpha_2 + \alpha_3)}{1 + \rho(\theta - 1)} \quad (23)$$

Equation (23) shows that the value of industry-level export elasticity to the exchange rate depends on the sign and magnitude of the consumer preference parameter for the product group i (θ), degree of returns to scale (ρ), and the technology used by the firm (α_1, α_2 , and α_3). This finding is different from the studies carried out by Dekle et al. (2010), which stated that exports decline when the exchange rate appreciates.

In this paper, the increase in industry-level export elasticity to the exchange rate is directly proportional to the high value of the firm's technology parameters (α_1, α_2 , and α_3) or the share of domestic input in the production function. The larger the share of domestic input, the higher the industry-level export elasticity to the exchange rate. However, the increase of industrial-level export elasticity to the exchange rate is inversely proportional to the degree of decreasing returns to scale with an increase in the value of ρ . The more decreasing returns to scale the production function, the smaller the industrial-level export elasticity to the exchange rate.

However, the effect of the parameter θ on the value of export elasticity, and the exchange rate is still ambiguous. When θ is above 1, the increase in industrial-level export elasticity to the exchange rate is directly proportional to the high value of substitution elasticity between product groups i (θ). Therefore, the larger the substitution elasticity between product groups i , the larger the industrial-level export elasticity to the exchange rate. However, when θ is below 1, the value of industry-level export elasticity to the exchange rate can be positive, negative, zero, or ambiguous. *First*, when $0 < \theta < 1$, the value of industry-level export elasticity to the exchange rate is positive, $\varepsilon > 0$, $0 \leq \rho \leq 1$. However, when ρ is above 1, the value of industry-level export elasticity to the exchange rate is ambiguous. *Second*, when θ equals 0 and $\rho \geq 0$, the value of industry-level export elasticity to the exchange rate is zero. It means that changes in exchange rates do not have an impact on industry-level exports. *Third*, when θ is below 0, the value of industry-level export elasticity to the exchange rate is negative with $\rho = 0$. However, when $\rho \geq 1$ and $0 < \rho < 1$, the value of industry-level export elasticity to the exchange rate is positive and ambiguous, respectively.

3.6. The industry level export equation

3.6.1. Total factor productivity

According to Syverson (2011), TFP (total factor productivity) captures variations in output that cannot be explained by changes in inputs. The firm TFP in this paper is stated as follows:

$$\ln A_{it}(\omega) = \mu_0 + \mu_1 \ln A_{it}^{obs}(\omega) + \varepsilon_{1it} \quad (24)$$

where $A_{it}^{obs}(\omega)$ is an observable firm productivity attribute, and ε_{1it} is unobservable idiosyncratic productivity.

3.6.2. Firm entry-exit factors

There are several factors that influence firms in the industry i which enable them to survive in conducting export activities. Cincera and Galgau (2005) classify these factors into three categories, namely (1) firm-specific factors (M_1), (2) industry-specific factors (M_2), and (3) country-specific factors (M_3). Based on these matters, the number of firms in industry i is stated as follows:

$$\ln m_{it} = \Omega_0 + \Omega_1 \ln M_{1it} + \Omega_2 \ln M_{2it} + \Omega_3 \ln M_{3it} + \varepsilon_{2it} \quad (25)$$

where ε_{2it} is an unobservable idiosyncratic factor.

3.6.3. Endogeneity of export shares

Following Ioannidis and Schreyer (1997), the factors that influence the export share of product groups i are divided into two types, namely technology, and non-technology factors. Therefore, the export share of product groups i from industry i is stated as follows:

$$\ln \delta_{it} = \varphi_0 + \varphi_1 \ln SH_{it}^T + \varphi_2 \ln SH_{it}^{NT} + \varepsilon_{3it} \quad (26)$$

where SH_{it}^T and SH_{it}^{NT} shows technology and non-technology factors, respectively, while ε_{3it} is unobservable idiosyncratic factors.

Substitution of equations (24), (25), and (26) to equation (22) so that the industry-level export equation in this paper can be stated as follows

$$\begin{aligned} \ln Y_{it}^x = & \left[\frac{z}{\emptyset} \ln(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5) - \frac{z\mu_0}{\emptyset(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} + \frac{\Omega_0}{\emptyset} + \varphi_0 \right] \\ & - \frac{z(\alpha_1 + \alpha_2 + \alpha_3)}{\emptyset(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} \ln(e_t) - \frac{z}{\emptyset} \ln(P_t^f) + \frac{z\alpha_4}{\emptyset(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} \ln(r_t^f) \\ & + \frac{z\alpha_2}{\emptyset(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} \ln(r_t) + \varphi_1 \ln SH_{it}^T + \varphi_2 \ln SH_{it}^{NT} + \frac{\Omega_1}{\emptyset} \ln M_{1it} + \\ & + \frac{\Omega_2}{\emptyset} \ln M_{2it} + \frac{\Omega_3}{\emptyset} \ln M_{3it} - \frac{z}{\emptyset} \ln(y_t^T) - \frac{z\mu_1}{\emptyset(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} \ln A_{it}^{obs}(\omega) \end{aligned}$$

$$\begin{aligned}
 & + \frac{Z\alpha_1}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} \ln(w_t) + \left[\frac{\varepsilon_{2it}}{\vartheta} + \varepsilon_{3it} - \frac{Z}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} \varepsilon_{1it} \right] \\
 & + \frac{Z\alpha_3}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} \ln(v_t) + \frac{Z\alpha_5}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} \ln(v_t^f) \tag{27}
 \end{aligned}$$

For simplicity, equation (27) can be written as follows:

$$\begin{aligned}
 \ln Y_{it}^X & = \psi_0 + \psi_1 \ln(e_t) + \psi_2 \ln(P_t^f) + \psi_3 \ln(r_t^f) + \psi_4 \ln(r_t) \\
 & + \psi_5 \ln(SH_{it}^T) + \psi_6 \ln(SH_{it}^{NT}) + \psi_7 \ln(M_{1it}) + \psi_8 \ln(M_{2it}) \\
 & + \psi_9 \ln(M_{3it}) + \psi_{10} \ln(Y_t^T) + \psi_{11} \ln(A_{it}^{obs}(\omega)) + \psi_{12} \ln(w_t) \\
 & + \psi_{13} \ln(v_t) + \psi_{14} \ln(v_t^f) + u_{it} \tag{28}
 \end{aligned}$$

where:

$$\begin{aligned}
 \psi_0 & = \frac{Z}{\vartheta} \ln(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5) - \frac{Z\mu_0}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} + \frac{\Omega_0}{\vartheta} + \varphi_0 \\
 \psi_1 & = -\frac{Z(\alpha_1 + \alpha_2 + \alpha_3)}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)}, \psi_2 = -\frac{Z}{\vartheta}, \psi_3 = \frac{Z\alpha_4}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)}, \\
 \psi_4 & = \frac{Z\alpha_2}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)}, \psi_5 = \varphi_1, \psi_6 = \varphi_2, \psi_7 = \frac{\Omega_1}{\vartheta}, \psi_8 = \frac{\Omega_2}{\vartheta}, \psi_9 = \frac{\Omega_3}{\vartheta}, \\
 \psi_{10} & = -\frac{Z}{\vartheta}, \psi_{11} = -\frac{Z\mu_1}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)}, \psi_{12} = \frac{Z\mu_1}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)}, \\
 \psi_{13} & = \frac{Z\mu_3}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)}, \psi_{14} = \frac{Z\mu_5}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)}, \text{ and} \\
 u_{it} & = \frac{\varepsilon_{2it}}{\vartheta} + \varepsilon_{3it} - \frac{Z}{\vartheta(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)} \varepsilon_{1it}
 \end{aligned}$$

4. Methodology

4.1. Real exchange rate misalignment

The real exchange rate is expressed by the REER (real effective exchange rate, 2010 = 100) index from CEPII (Center d'Etudes Prospectives et d'Informations Internationales). Following El-Shagi et al. (2016), the equilibrium real exchange rate is expressed by the synthetic real exchange rate obtained by the SCM (synthetic control method) approach. This approach was made by Abadie and Gardeazabal (2003) and developed by Abadie et al. (2010, 2015). Determinants of the equilibrium real exchange rate are divided into three groups, namely macroeconomic, structural, and institutional variables. Macroeconomic variables include GDP per capita, growth of GDP per capita, capital formation, the FDI (foreign direct investment) share of GDP, current account, and inflation. Structural variables consist of the share of exports and trade in GDP. Finally, institutional variables comprise of the size of the government sector, trade barriers, credit regulations, and economic freedom index. The variable data was obtained from the World Economic Outlook (WEO), the

World Development Indicator (WDI), and the Economic Freedom of the World (EFW). The sampling period is from 1980 to 2018.

Synthetic real exchange rates are built based on counterfactual with three different types of treatment or policy interventions, namely the implementation of a managed floating exchange rate system with managed floating II, crawling band, and free-floating exchange rate system. The validity of counterfactuals was evaluated using three types of tests, namely placebo test, pre-treatment fit index, and goodness of pre-treatment fit. We use three options for the robustness check to synthetic real exchange rates generated by the SCM approach, namely the choice of outcome lags used as predictors, the choice of other predictors, and the method for choosing predictor weights. Misalignment of the real exchange rate is defined as the difference between the actual and the equilibrium real exchange rate. If the actual real exchange rate is below the equilibrium real exchange rate, then the real exchange rate experiences an undervaluation, and vice versa (Béreau et al., 2009; Coudert et al., 2012).

4.2. Empirical model and data

In previous empirical studies, determinants of exports share related to technology are proxied by R&D (research and development) (Ioannidis & Schreyer, 1997). However, the unavailability of R&D data in Indonesia causes this variable to be included in unobserved idiosyncratic variables. Besides, this study also takes into account the determinants of manufacturing exports that are commonly used in previous empirical studies, namely foreign ownership, import content, and economic crisis of both the 1997/1998 economic crisis and the 2008 global crisis.

The empirical model used in this paper are:

$$\begin{aligned} \ln Y_{it}^x &= \beta_0 + \beta_1 \ln(e_t) + \beta_2 \ln(P_t^f) + \beta_3 \ln(r_t^f) + \beta_4 \ln(r_t) \\ &+ \beta_5 \ln(SH_{it}^{NT}) + \beta_6 \ln(M_{1it}) + \beta_7 \ln(M_{2it}) + \beta_8 \ln(M_{3it}) \\ &+ \beta_9 \ln(Y_t^I) + \beta_{10} \ln(A_{it}^{obs}(\omega)) + \beta_{11} \ln(w_t) + \beta_{12} \ln(v_t) \\ &+ \beta_{13} \ln(v_t^f) + \beta_j \sum_{j=14}^{17} Z_t + u_{it} \end{aligned} \quad (29)$$

where i is a cross-section, and t is time. All variables are expressed in logarithmic form, except for macroeconomic shocks and the firm's growth rate in the manufacturing industry variables. Therefore, the coefficient indicates the elasticity. All variables in the empirical model represent the determinants of manufacturing exports in both supply and demand side. Indonesian manufacturing export data is obtained from Manufacturing Industry Statistics/Large and Medium Industry Statistics published by the Central Bureau of Statistics (BPS). However, the latest Manufacturing Industry Statistics data is only for the 2017 period, while the data for 2016 period is unavailable. Based on the availability of these data, the research period of this study is limited to 1990-2015. The cross-sectional data consists of 22 manufacturing industries, which are classified according to the International Standard Industrial Classification (ISIC) revision 3.1. All variables, definitions, and sources of data used in this study are summarized in Table 1.

4.3. Estimation strategy: Augmented mean group methods

To estimate the impact of exchange rate undervaluation on manufacturing exports, this paper uses the AMG method developed by Eberhardt and Teal (2010). This method estimates the heterogeneous

coefficients for each cross-section by considering the problem of CD in panel data (Eberhardt & Teal, 2010). This method performs as a good estimator in estimating panel time-series data although the data are: (1) non stationary, (2) whether or not there is cointegration, and (3) have a problem of CD (Eberhardt, 2012). The AMG method is also feasible to analyse non-stationary panel data with heterogeneous slope although the variables are not co-integrated (Tita & Aziakpono, 2016).

5. Results and analysis

5.1. The real exchange rate misalignment

In this paper, the synthetic real exchange rate comes from the synthetic control group, which acts as a counterfactual. Counterfactual is built by the SCM approach using three types of treatments (policy intervention), namely the implementation of a managed floating exchange rate system with managed floating II, crawling band, and free-floating exchange rate system. Based on the validity test, as shown in Table 2, the counterfactual produced by the SCM approach when implementing the three exchange rate systems is valid.

The real exchange rate misalignment of rupiah in the period 1987–2018, as shown in Figure 1, was mostly undervalued, except for the period 1993–1996, when it faced an overvaluation. The real exchange rate was undervalued by 12.3–15.0% when Indonesia implemented the managed floating II exchange rate system for the period 1987–1992. The real exchange rate was overvalued by 0.77–8.12% when Indonesia implemented a crawling band exchange rate system for the period 1993–1997. However, the real exchange rate undervaluation was around 7.47% near the 1997/1998 economic crisis. Furthermore, when Indonesia implemented an exchange rate system of free-floating throughout 1998–2015, the real exchange rate experienced an undervaluation of 2.38–85.47%.

5.2. The real exchange rate undervaluation and Indonesia's manufacturing exports

5.2.1. Real exchange rate undervaluation and manufacturing exports

The AMG results on the relationship between real exchange rate and manufacturing exports are shown in Tables 3 and 4. We gradually add control variables in the column to test the robustness of the model. In all models, the addition of several control variables has slightly changed the significance of the main variables, but it did not change the consistency of the signs. In general, the results indicate that the models are generally robust to various additional control variables. This can be seen from the consistency of the sign of the main variables in all models after controlling for a series of usually suspected variables that contributes to manufacturing exports.

According to AMG results, as shown in Table 3, there seems to be no significant relationship between the misalignment of real exchange rate (Underval) and manufacturing exports. Misalignment of the real exchange rate, both undervaluation³ and overvaluation does not have a significant impact on increasing/decreasing manufacturing exports, respectively. This shows that misalignment of the real exchange rate is insignificant in affecting manufacturing exports. Likewise, when this study uses the real exchange rate at level, changes in the real exchange rate (depreciation/appreciation) also cannot significantly boost manufacturing exports (see Table 4). This shows that the exchange rate manipulation policy is not a dominant factor in strengthening the competitiveness of Indonesia's manufactured exports. Therefore, policies that aim to strengthen the competitiveness of manufactured products must be constantly revisited beyond just the exchange rate.

This finding is consistent with Etta-Nkwelle (2007) and Glüzmann et al. (2012) who found that exchange rate undervaluation does not have a significant impact on manufacturing exports. Ribeiro et al. (2019) also found that exchange rate undervaluation does not have a significant impact on the economic growth of developing countries. But exchange rate undervaluation only affects economic growth indirectly through income distribution and the level of technological

Table 1. Variable, definition, and source of data

Notation	Variable	Definition	Sign Hypothesis	Source
EXP	Manufacturing Exports	The value of manufacturing exports at constant prices 2010 = 100	-	BPS
Underval	Exchange Rate Undervaluation	Real Exchange Rate Undervaluation	Negative/ Positive	SCM approach
WorldGDP	World income	Real GDP from Indonesia's main trading partner countries	Positive	IFS—IMF
ForeignPrice	Foreign price	WPI of export	Positive	SEKI—BI
R	Domestic interest rate	Indonesia's deposit interest rate minus the inflation rate	Negative	SEKI—BI
RF	Foreign interest rate	LIBOR interest rate in US Dollar minus the inflation rate	Negative	Federal Reserve AS
LaborProd	Firm productivity	The output of manufacturing industry <i>i</i> divided by the number of workers in the manufacturing industry <i>i</i>	Positive	BPS
WageRiil	Real wages	Nominal wages are deflated with CPI	Negative	SEKI—BI
GrowthF	The growth rate of firms in the industry	Firm-specific factors: the average growth rate of the firm's output in the manufacturing industry <i>i</i>	Positive	BPS
Resoint	Resource intensity	Industry-specific factors: the ratio between the level of production (at current prices) and value-added (at current prices)	Positive	BPS
Shocks	Macroeconomic shocks	Country-specific factors: the employment growth or the number of labors in the manufacturing industry	Positive	BPS
WPID	Domestic raw material prices	WPI of domestic raw material	Negative	BPS
WPIF	Foreign raw material prices	WPI of foreign raw material	Negative	BPS
Export share determinants (SH_{it}^{NT})				
GDPCap	Domestic demand	Lag GDP per capita	Negative	WDI
ACFTA	-	Trade Agreement of ASEAN—China Free Trade Area	-	-

(Continued)

Table 1. (Continued)

Notation	Variable	Definition	Sign Hypothesis	Source
AKFTA	-	Trade Agreement of ASEAN—Korea Free Trade Area	-	-
AFTA	-	Trade Agreement of ASEAN Free Trade AREA	-	-
CWTO	-	China's accession to the WTO	-	-
Control Variables (Z_t)				
FO	Foreign ownership/ affiliation	Capital status of firms in the industry i	Positive	BPS
IMPC	Import content	The average ratio of the use of imported raw materials to the total raw materials used in the production process by firms in the industry i	Negative	BPS
D9798	-	The 1997/1998 economic crisis	-	-
D2008	-	The 2008 global economic crisis	-	-

Table 2. Validity tests to the counterfactual

The exchange rate regimes	Placebo test	Pre-treatment fit index	The goodness of pre-treatment fit
Managed Floating II	Conclusive	0.574*	0.93**
Crawling Band	Less Conclusive	0.174*	0.96**
Free-Floating	Less Conclusive	0.38*	0.61**

Source: Authors' calculations

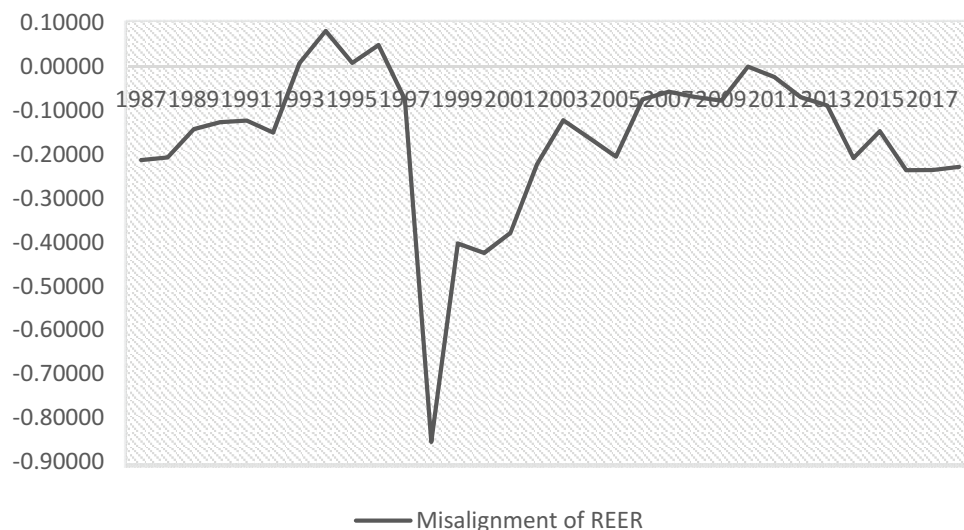
Notes: *Fit perfect if fit index approaches zero, **Fit is good if the goodness of pre-treatment fit approaches one.

capabilities. However, several studies have also found that the real exchange rate does not have a significant impact on exports (Guloglu & Bayar, 2016).

Ikhsan (2009) argues more dominant other policy instruments are factors that cause Indonesia's failure to utilize the exchange rate undervaluation as an instrument to encourage manufacturing exports. Besides, Indonesia is an emerging country whose institutional quality is still lacking hence the cost of exchange rate will result in the a loss of the positive impact of exchange rate undervaluation. This condition can be seen from changes in the composition of Indonesia's exports whereas the manufacturing sector contributes around 51% of Indonesia's total exports in the period 1995–1998. However, this share fell to 37% in the period 2008–2014 (Falianty, 2015).

Ahmed et al. (2015) argue that there are four types of explanations for the low responsiveness of exports to changes in real exchange rate. First, this condition may reflect the fact that trade growth has slowed down in Indonesia. Based on WDI (World Development Indicators) data from The World Bank, share of Indonesia's trade in GDP before the 1997/1998 economic crisis was around 45–55%. In

Figure 1. The plot of real exchange rate misalignment for period 1987–2018.



1999, the share reached 71%. However, it fell to 37–40% after the economic crisis. This fact shows that Indonesia’s share of exports in the world market tends to decrease (Ikhsan, 2009).

Second, trade policies may have become more responsive to real depreciations. This means that trade policies are designed to neutralize the impact of exchange rate undervaluation on exports. According to Ikhsan (2009), this condition causes the undervaluation of the exchange rate to be inferior compared to other policies (Ikhsan, 2009). Temporary trade barriers such as anti-dumping and countervailing duties are set in response to currency movements by trading partners (Ahmed et al., 2015). Third, the increase in number of importing firms in world trade leads the export volumes to respond less to currency depreciation (Ahmed et al., 2015). Fourth, the increase in import content of exports causes the impact of exchange rate depreciation on exports to decrease (Ahmed et al., 2015).

Besides, the insignificant impact of the real exchange rate undervaluation on manufactured exports is also driven by undervalued currencies of Indonesia’s competitors. Like the undervalued policy of the renminbi currency by China, the exchange rates of other countries did not work to encourage manufactured exports. The standard “beggar-thy-neighbour” inference from the Mundell-Fleming-Dornbusch model is that a country benefits from a depreciation of its currency through higher exports, whereas the other countries are adversely affected (Tille, 2000). During the 2008 global economic crisis, many countries in the world adopted an undervalued policy on their currencies to improve the competitiveness of their exports in international markets (Ahmed et al., 2015).

5.2.2. Other manufacturing export determinants

5.2.2.1. *Internal variables.* Other determinants of manufacturing exports are manufacturing exports in the previous period. In Table 3 (models 1–4) and Table 4 (models 1–3), this study found that manufacturing exports elasticity to manufacturing exports in the previous period are positive and significant at 1%, 5%, and 10% level. According to the results of this study, a one percent increase in manufacturing exports in the previous period leads to around 0.16%–0.23% increase in current manufacturing exports. This finding indicates that Indonesia’s manufacturing exports are experiencing a hysteresis. Hysteresis of manufacturing exports refers to the dependence of manufacturing exports not only upon the current period but also upon the previous period.

The current export performance also depends on the export performance in the previous period (Matteis et al., 2016). Besides, the finding of this study is similar to that of Sertić et al. (2015), Matteis et al. (2016), and Matteis et al. (2016) found that elasticity values of these two variables were at 0.73, compared to Sertić et al. (2015) which were at 0.207–0.443.

Table 3. Real exchange rate undervaluation and other manufacturing export determinants

Independent Var.	Regression					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Underval	0.135	-0.143	0.133	-0.054	-0.341	-0.315
LnEXP(-1)	0.201***	0.232***	0.195*	0.156**	-0.107	-0.176
LnWagerill	-0.184	-0.161	-0.318	-0.103	-0.453	-0.139
LnForeignPrice	0.503***	0.443***	0.543***	0.402***	0.608***	1.049**
LnWorldGDP	-0.109	-0.022	0.110	0.169	0.005	-1.000
R	-0.012***	-0.010***	-0.014**	-0.016***	-0.004	0.011
RF	-0.024*	-0.006	-0.013	-0.018	0.037	0.111
LnWPID	0.331	-0.083	0.435	0.342	0.858	-0.083
LnWPIF	-0.256	0.118	-0.380	-0.189	-0.668	0.011
LnLaborProd	0.039	0.032	0.163*	0.057	0.222***	-0.072
GrowthF	-0.016 ^(o)	0.043 ^{(o)**}	0.008 ^(o)	0.041 ^(o)	-0.002 ^(o)	0.045 ^(o)
LnResoint	0.035	-0.057	-0.091	0.032	-0.090	-0.015
Shocks	0.002	-0.005 ^(o)	0.002	0.056	0.062 ^(o)	0.002
LnGDPCAP	0.682		1.402	-0.135	1.806	0.273
ACFTA		0.066	0.054	-0.007	0.139	0.574
AKFTA		-0.034	-0.031	-0.012	0.019	-0.042
AFTA		-0.070	-0.109	-0.113	0.155	-0.032
CWTO		-0.025 ^(o)	0.086	0.012	0.067	-0.362**
LnFO				0.035	-0.095	-0.015
LnIMPC					-0.156	-0.133
D9798						0.614*
D2008						0.423
RMSPE	0.0842	0.0736	0.0575	0.0611	0.0415	0.0377

Source: Authors' calculations

Notes: * p < 0.1, ** p < 0.05, and *** p < 0.01, ^(o) coefficient multiplied by 10⁻²

Table 4. Real exchange rate and other manufacturing export determinants

Independent Var.	Regression					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
LnREER	0.509	0.269	0.101	0.810	0.812	-0.162
LnEXP(-1)	0.182**	0.163**	0.183*	0.164	-0.037	-0.463
LnWagerill	0.017	-0.378**	0.112	-0.401	-0.425	-0.994
LnForeignPrice	0.604***	0.602***	0.499***	0.735***	0.934***	2.488**
LnWorldGDP	0.123	0.095	-0.007	0.468*	0.632***	-1.553
R	-0.010**	-0.011**	-0.012***	-0.015*	-0.015	0.022
RF	-0.020*	-0.012	-0.011	-0.001	0.035	0.202*
LnWPID	-0.447	-0.245	-0.260	-0.091	-0.015	-0.308
LnWPJF	0.498	0.231	0.380	0.179	0.035	-0.732
LnLaborProd	0.125	0.069	0.062	-0.190	0.028	-0.396
GrowthF	-0.011 ^{o)}	-0.002 ^{o)}	0.035 ^{o)} *	0.001**	0.076 ^{o)}	0.001
LnResoint	-0.074	0.004	-0.078	0.078	0.057	0.095
Shocks	0.008 ^{o)}	0.056 ^{o)}	-0.049	-0.002	-0.088 ^{o)}	-0.003
LnGDPCAP	-1.064***		-0.704*	0.260	-0.361	0.142
ACFTA		0.009	0.090	-0.074	-0.053	1.298
AKFTA		-0.105	-0.023	-0.156	-0.075	0.044
AFTA		-0.120	-0.169	0.067	0.140	0.546
CWTO		0.028	-0.038	-0.023	-0.104	-0.290
LnFO				0.021	0.050	-0.695
LnIMPC					-0.100	0.567
D9798						1.020***
D2008						0.879
RMSPE	0.1063	0.0869	0.0761	0.0484	0.0494	0.0340

Source: Authors' calculations

Notes: * p < 0.1, ** p < 0.05, and *** p < 0.01, ^{o)} coefficient multiplied by 10⁻².

According to Greenaway et al. (2007), the firm's export status in the previous period also affects the current exports. If the status of a firm in the previous period was an exporter, there was a tendency for the firm to export. Or in other words, if a firm/an industry engage in export activities in the previous period, a firm/an industry has the opportunity to continue exporting over the subsequent periods. This condition is related to the costs incurred by firms when entering the international market. These costs are known as sunk costs (Greenaway et al., 2007). When a firm bear sunk costs, there is a tendency that the firm will increase its exports. This is because the decline in exports and/or firm's withdrawal from the international market will cause them to suffer losses.

This study also found that high real wages are associated with low manufacturing exports. According to the results of this study, a one percent increase in real wages leads to around 0.38% fall in manufacturing exports. This condition shows that the lower the real wages, the greater the competitive advantage gained by firms in the industry. This is expected to increase exports from these firms. These findings are in line with previous studies by Saygili (2010), Sertić et al. (2015), and Saygili (2010) found that the elasticity values of the two variables are -1.56 . Several other studies have found a negative relationship between real wages/labour unit costs and exports (Guloglu & Bayar, 2016). Sertić et al. (2015) found that although labour costs are negative for manufacturing exports, the effect is not statistically significant (Sertić et al., 2015).

Our result confirmed that the domestic interest rate is negatively associated with manufacturing exports and significant at 5% or better significance level. Based on the results of this study, a 10% increase in the domestic interest rate leads to around 0.1%-0.16% fall in manufacturing exports. Rising domestic interest rates will increase the cost of domestic capital. This increase will drive up production costs, thereby reducing product competitiveness in the international market. This will consequently drive manufacturing exports down. These findings support the results of Dekle et al. (2010) which found that the elasticity values of the two variables were 0.23–0.35.

AMG estimation results in Table 4 (models 1 and 3) show that domestic demand is negatively associated with manufacturing exports and significant at 5% or better significance level. According to AMG results, as domestic demand for manufactured products rose by 10%, exports of manufactured products decreased by around 7%-10.6%. This finding supports the result of Ahmed et al. (2015) who found that domestic demand variables (proxy by real GDP in the previous period) correlated negatively with manufacturing exports.

This study also found that the coefficient of labour productivity variable is positive and significant at 5% or better significance level. The coefficient of this variable shows that an increase in labour productivity of 10% will encourage an increase in manufacturing exports of around 1.6%-2.2%. This finding supports earlier studies from Saygili (2010), Guloglu and Bayar (2016), and Saygili (2010) found that the elasticity values of the two variables were 1.03, compared to that of Guloglu and Bayar (2016) which were around 0.2–0.4.

The last internal variable that significantly affects manufacturing exports is firm growth. The firm growth variable is positively correlated with manufacturing exports and significant at 10% or better significance level. According to AMG results, when a firm experiences a growth of 10%, their manufacturing exports will increased by around 0.004%-0.01%. This finding supports the previous result from Jongwanich (2009) who found that high production capacity improves export performance.

5.2.2.2. External variables. In all models, both Table 3 and Table 4, the coefficient of the foreign price variable is positive and significant at 5% or better significance level. An increase in foreign prices by one percent will encourage an increase in manufacturing exports of around 0.4%-2.5%. Besides, the significant relationship between the two variables shows the importance of foreign prices for Indonesia's manufacturing exports. When the price of exports increase, producers of manufactured

goods will increase their exports. The aim is to maximize profit through overseas sales (exports). This finding is in line with that of Falianty (2015) who found that the elasticity values of the two variables are 0.914 and Safuan (2017) which is around 0.014–0.031. This finding supports the results of Dekle et al. (2010) which showed that the elasticity value is between 0.5–0.7.

According to AMG results, Table 4 (models 4 and 5), the impact of world demand on manufacturing exports is positive and significant at 5% or better significance level. A one percent increase in world demand will increase manufacturing exports by around 0.47%–0.63%. This finding is in line with the results of Jongwanich (2009), Ahmed et al. (2015), and Ahmed et al. (2015) found that the elasticity values of the two variables are 1.37.

One of the variables in the price of production inputs is foreign interest rates or the price of imported capital. As depicted in Tables 3 and 4 (model 1), foreign interest rates have a negative impact on manufacturing exports. The coefficient signs are in line with the hypothesis, except for model 6 in Table 4. Based on AMG results, a 10% increase in interest rates leads to 0.2%–0.24% drop in manufacturing exports. Similar to domestic interest rates, an increase in foreign interest rates will increase the cost of foreign capital. This increase can reduce international competitiveness, and eventually cause manufacturing exports to decline. Whether domestic or foreign interest rate variables, this study supports the Correa-Lopez and Domenech (2017). Using input price variable, Correa-Lopez and Domenech (2017) found that input prices have a significant negative impact on exports.

Besides, China's accession to the WTO caused a significant decline in Indonesia's manufacturing exports. This condition shows that China's accession to the WTO is a threat for Indonesian manufactured products. This is caused by the inability of Indonesia's manufactured exports to compete with other countries such as China, Thailand, and Malaysia (Hidayat & Widarti, 2005). This finding supports the results of Ikhsan (2009) which found that joining China in WTO membership caused Indonesia's manufacturing exports to decline.

Another determinant of manufacturing export is the 1997/1998 economic crisis. The AMG results presented in Table 3 and Table 4 (model 6) explain that the 1997/1998 economic crisis boosts manufacturing exports significantly. This finding contradicts with that of Mardani (2014) who uses manufacturing exports in value (US\$). According to Mardani (2014), the 1997/1998 economic crisis caused export volumes to increase, but the value of exports to decrease. In comparison, this finding also contradicts with that of Wie (2000) who found that the 1997/1998 economic crisis caused the value of Indonesia's manufacturing exports to decline, but the volume of manufacturing exports to increase.

6. Conclusions

This paper aims to investigate the impact of exchange rate undervaluation on Indonesian manufacturing exports in the period 1990–2015. Using the AMG method, it is found that the real exchange rate undervaluation has an insignificant impact on manufacturing exports. This means that the undervaluation of the exchange rate insignificantly increases manufacturing exports. Likewise, when the real exchange rate changes in level, depreciation/appreciation, the changes insignificantly boost manufacturing exports. This finding indicates that the exchange rate manipulation policy is not an important factor in strengthening the competitiveness of Indonesia's manufacturing exports.

In contrast to the previous studies, this study confirms that exchange rate cannot be manipulated to affect manufacturing exports. Therefore, the focus of the exchange rate policy should be directed towards maintaining the real exchange rate at its equilibrium level. Furthermore, this study also confirms that the policy instruments must be developed beyond the exchange rate in order to boost manufacturing exports.

Based on our findings, there are several policy variables beyond the exchange rate which seems to be more dominant in driving manufacturing exports. **First**, important variables beyond the exchange rate to encourage manufacturing exports are manufacturing exports in the previous period. This condition can be achieved if the business climate is competitive and conducive.

Secondly, high amount of support from the banking sector also plays an important role in driving manufacturing exports, such as by reducing domestic interest rates. This policy will encourage competitiveness of manufacturing goods by reducing production costs through lower cost of capital. **Third**, competitive real wages is another important factor in driving manufacturing exports. One of which through labour system reformation. **Fourth**, another important factor to boost manufacturing exports is an increase in labour productivity. Labour productivity is positively correlated to labour skill and ability. **Fifth**, the last important factor that can drive manufacturing exports is firm growth. Firms in the manufacturing industry will expand when their output grow.

In analysing the relationship between the exchange rate and manufacturing exports, this study has several limitations. First, this study found that the real exchange rate insignificantly increases manufacturing exports. However, the cause cannot be explained by both internal and external sides. On the internal side, one way to find out the cause is by using the concept of Global Value Chains (GVCs). However, due to the limitation of GVCs data period and research period, this study did not include the concept of GVCs. On the external side, the implementation of the Beggar-Thy-Neighbour theory can help to explain the insignificant effect of the real exchange rates on manufacturing exports. Therefore, future research that incorporates the concept of GVCs and Beggar-Thy-Neighbour theory will facilitate deeper analysis of the relationship between the real exchange rates and manufacturing exports.

Second, this study uses several aggregate variables in proxy variables for each manufacturing industries, such as foreign prices. This condition certainly does not reflect the movement of these variables in each manufacturing industries. Therefore, future research that uses disaggregated variables according to the characteristics of each manufacturing industries is expected to facilitate a more in-depth analysis of these variables.

Third, although this study found that the exchange rate is an ineffective instrument to boost manufacturing exports, it is estimated that within certain limits, the exchange rate will affect manufacturing exports. Therefore, future research that analyses certain restrictions or threshold of exchange rates are of an importance. This condition is beneficial for the monetary authority in maintaining the level of exchange rates that can support manufacturing exports.

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Notes

1. Summarized from Auboin and Ruta (2012).
2. The price of foreign capital and raw materials (r_t^f and v_t^f) are stated in foreign currency. Using the law of one price, $P_t^d = e_t P_t^f$, $P_{it}^d = e_t P_{it}^f$, the price of

foreign capital and raw materials can be stated in domestic currency as follows: ($e_t r_t^f$ and $e_t v_t^f$).

3. Undervaluation of exchange rates: underval variables are positive.

Disclosure of potential conflicts of interest

The authors declare no competing interest.

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