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What are the Drivers of Deindustrialization in Indonesia?: An Autoregressive Distributed Lag-Bounds Model Approach

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Abstract

The remarkable economic development in Indonesia from the 1970s through the 1990s cannot be separated from the role that its manufacturing sector played during the same period. As an important engine of growth, the manufacturing sector helped Indonesia in the process of capital accumulation, technology transfer, and productivity growth. However, since the Asian Financial Crisis (AFC) in 1997–1998, the manufacturing sector has tended to grow slower and its share to GDP began to decline in 2001. The purpose of this study is to analyze the determinants of deindustrialization in Indonesia by examining three hypotheses, which are the Secular, Dutch Disease, and Trade hypotheses. Our findings show that all hypotheses hold the econometric ground of cointegration. From a policy standpoint, the results imply that proper exchange rate management and promotion of industries that cater to expanding domestic demand could be effective policies to boost manufacturing share to GDP again.

Keywords: Deindustrialization, ARDL-Bounds Model, Manufacturing Sector, Indonesia.

1. Introduction

The manufacturing sector has been viewed as an important engine of growth for the economy. Countries that are currently categorized as developed countries experienced gradual and significant development in their manufacturing sectors before their economies moved to the services sector. There are a number of investigations that support the important role of the manufacturing sector for development (Kaldor 1966; Lewis 1954; UNCTAD 2016; Weiss & Jillian 2016; World Bank 2012). Most of them emphasize the advantage of the manufacturing sector for growth through capital accumulation, technological transfer, and productivity growth.

In light of the history of successful industrialization that has occurred in many developed countries, most developing countries attempt to follow a similar path of development. However, some developing countries fail to develop their industries while the other developing countries face premature deindustrialization, which is indicated by the decline of the manufacturing sector earlier

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than ever experienced by developed countries (Rodrik 2015). Countries that start deindustrializing when their income per capita and degree of industrialization relatively low, are prone to growth-reducing structural change, involving the low-productivity informal services that offer a little potential for growth. Moreover, this premature deindustrialization became a threat to sustained economic growth in the future (UNIDO 2015).

Since 1966, Indonesia entered a period of rapid and sustained economic growth with average annual growth from 1966 to 1996 of around 6.5 percent (BPS 2015). This remarkable economic growth lasted for more than three decades until the Asian Financial Crisis (AFC) hit Indonesia's economy in 1997-1998. This tremendous economic growth experience cannot be separated from manufacturing sector development during that period (Booth 1992; Hill 1997). However, since early 2000 to 2017, Indonesia’s manufacturing sector has plummeted with average annual growth rate of the manufacturing sector was only 4.69 percent (BPS 2015). This growth rate is less than half of the manufacturing growth rate of before the financial crisis, which was more than 10 percent on average. Along with this, the share of manufacturing in Gross Domestic Product (GDP) also gradually decreased from its highest share at 29 percent in 2001 to around 23 percent in 2017.

Deindustrialization in Indonesia has been a key issue for more than one decade. Since the role of the manufacturing sector is important for the Indonesian economy, it is crucial to reverse deindustrialization. World Bank (2012) argues that the manufacturing sector still matters for Indonesia because it gives an opportunity for employment creation due to its greater linkages and spillover effects as compared to those of other sectors. Moreover, the study also identifies that the manufacturing sector can create sustainable high economic growth through capital accumulation, integration with global production network and technological transfer. In addition, Indonesia needs high economic growth to escape from the middle-income trap, and manufacturing is an effective way to improve productivity.

The main contribution of the current study lies in the identification of the hypothesis of deindustrialization relevant to Indonesia. This study aims to show key factors that have been driving the process of (de)industrialization in Indonesia during the period of 1967-2017. Unlike the most of the existing deindustrialization analyses conducted on cross-country or panel data, this study tries to conduct a country-specific time series analyses for Indonesia using the Autoregressive Distributed Lag (ARDL)-Bounds Model approach. As compared to conventional cointegration tests, the ARDL bound test is more robust and suitable for small sample time series analyses.

The remainder of the study is organized as follows. Section 2 of this study investigates explanations for the fall in the share of manufacturing in GDP in Indonesia based on several common hypotheses. Section 3 describes the deindustrialization process in Indonesia. Description of the data, methodology, and an econometric estimation of deindustrialization are presented in Sections 4 to 6. Section 7 presents a simulation of Indonesia manufacturing sector in the future. Finally, Section 8 summarizes the study and provides policy recommendations.

2. Literature Review

Both developed and developing countries experience a deindustrialization phenomenon. The difference is that the deindustrialization occurs in many developed countries is caused by the transition from the manufacturing sector to the services sector along with substantial development (Rowthorn & Ramaswamy 1997). Therefore, in general, deindustrialization in many developed countries is categorized as positive deindustrialization. Meanwhile, deindustrialization in developing countries is quite complex as it occurs due to many factors. However, most of this deindustrialization is categorized as negative deindustrialization since it is not accompanied by a significant increase in per capita income as in developed countries.

There are at least three main hypotheses regarding the causes of deindustrialization in developing countries. The first hypothesis is known as the "Secular" hypothesis, a secular shift in employment from manufacturing to services due to productivity differences (Rowthorn & Ramaswamy 1997). Higher productivity attained in the manufacturing sector releases redundant labor to the services sector, and therefore, wages attract labor out of the manufacturing sector. As proposed by Clark (1957), this type of deindustrialization is common in many developed countries and follows the secular path of development. Nevertheless, this deindustrialization process may also occur in some developing countries that have a comparative advantage in the services sector.

Secondly, researchers have identified the “Dutch-Disease” phenomenon as a factor contributing to deindustrialization (Corden & Neary 1982; Palma 2008). This phenomenon can be explained by the Real Effective Exchange Rate (REER) appreciation resulting from a commodity export boom. Theoretically, in the classic economic model, there are two mechanisms for explaining the Dutch Disease, which are the “resource movement effect” and “spending effect” mechanisms (Corden & Neary 1982). The resource-movement effect happens if a resource (commodity) boom increases labor or capital demand and causing shifts to the booming resources sector. This condition will cause deindustrialization directly in terms of declining labor as well as capital in the manufacturing sector. Meanwhile, the spending effect occurs as a result of the increase of government revenue from the commodity export. This condition leads to an increase in government spending and an increase in demand for goods and labor in the non-tradable sector. This condition will make domestic inflation higher than foreign inflation and will create REER appreciation.

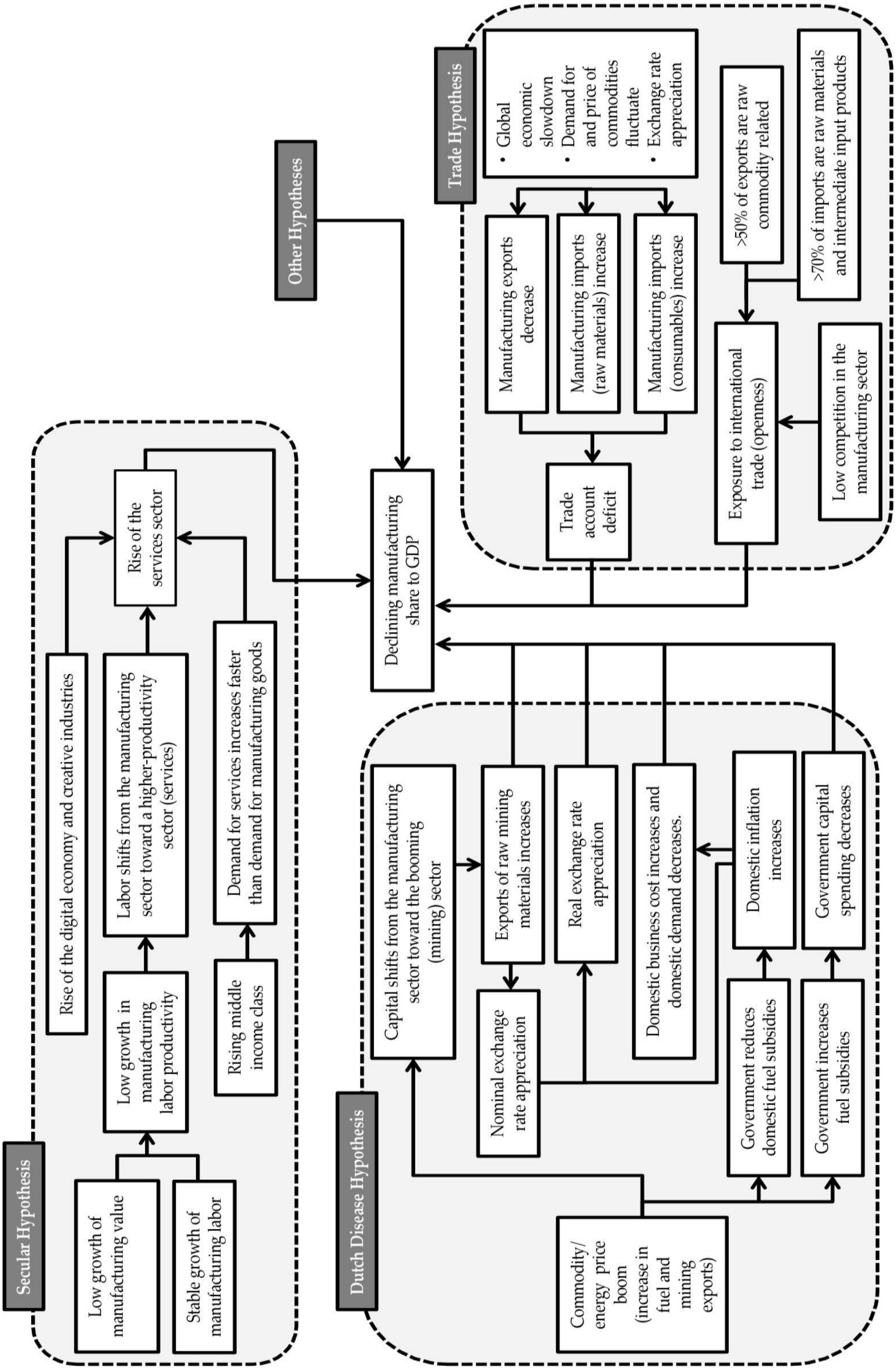
The third hypothesis is the Trade hypothesis. Rowthorn and Coutts (2004) show that trade has been a significant factor causing deindustrialization in many countries. The trade specification of a country will determine its pattern of trade. For instance, a country that specializes in manufacturing goods export typically will have a larger manufacturing sector rather than the countries that specialize in the export of raw materials and services. In addition, Tregenna (2016) also believes that international trade affects manufacturing development in developing countries in different ways from developed countries. A major issue is competition with Chinese industries, especially related to China’s capability to manufacture goods at a lower unit cost. The inability to make domestic manufacturing competitive in the global market will tend to reduce the domestic manufacturing share of GDP.

3. Deindustrialization in Indonesia

Since the Asia Financial Crisis (AFC) hit Indonesia's economy in 1997-1998, Indonesia has begun to experience deindustrialization, and the share of manufacturing of the country’s GDP is gradually decreasing. However, the deindustrialization mechanism does not follow the mechanism of advanced industrialized countries in Asia such as Japan and South Korea, in which deindustrialization was preceded by an increase of labor productivity. For Indonesia, the economic situation in terms of market size, energy dependency, global market challenges, and government targets is not only different from advanced industrialized countries but also from other developing countries (Kim & Lee 2014). Therefore, this section tries to describe the possible channels of deindustrialization in Indonesia using three main deindustrialization hypotheses, which are shown in Figure 1.

According to the Secular hypothesis, there is a relationship between economic development and the predominant types of occupations (Clark 1957). When countries become advanced, the number of workers in agriculture tends to decline relative to the manufacturing sector, which, in turn, will decline relative to the numbers of workers in the services sector. For Indonesia, during the last decade, the average growth of manufacturing productivity has been below that of the economy-wide average. This condition was caused by poor performance of manufacturing export as well as high labor and logistic costs. Therefore, labor shifts from the manufacturing sector toward a higher-productivity sectors (Allen 2016; Tabor 2015). In addition, the rising middle-income class, the development of the digital economy and the creative industries also caused the rise of the services sector through a rise in demand, which later decreased the share of manufacturing value-added to GDP (Feher et al 2017; Ginting & Aji 2015).

Figure 1 The Various Factors Causing Deindustrialization in Indonesia



Source : Author construction

According to the Dutch Disease hypothesis, the deindustrialization mechanism should have begun in 2004, when Indonesia became a net oil importer. The increase of world fuel and commodity prices impacted Indonesia economy in two ways. The increase in fuel price has burdened the economy due to the hike of domestic fuel subsidies (OECD 2012). On the other hand, the increase in commodity prices, such as palm oil and coal prices, has caused capital movement from the manufacturing sector toward the booming sector (Pelzi & Poelhekke 2018). Consequently, both channels caused appreciation both in the nominal and real (effective) exchange rates and will lead to deindustrialization.

Finally, according the Trade hypothesis, the channel of deindustrialization can be mostly explained by the external shocks such as exchange rate appreciation, the low demand for domestic manufacturing due to Global Financial Crisis of 2008 – 2009, and a regional free trade agreement which caused increasingly fierce global competition. For instance, the rise of China as the world's largest manufacturer has impacted domestic trade performance (ADB 2019). While, in the regional context, Thailand and Vietnam have emerged as the main competitor for Indonesia in terms of key exports such as fabrics, footwear, and automotive parts while having ample availability of low-skilled labor for industry. The establishment of the Asian Economic Community (AEC) in 2015 has forced member countries, including Indonesia, to face the existing structure of comparative advantage and relative competitiveness due to this regional framework.

4. Data

In this study, annual time series data from Indonesia, which cover the period 1967 to 2017, are utilized. All data are gathered from two main sources, the Indonesia Central Bureau of Statistics and World Development Indicators. The data are represented in percentage ratio or specific values are logarithmically transformed in to have a simple interpretation for the elasticity of the results. This study uses manufacturing share to GDP as the dependent variable for estimating deindustrialization. The reason for using manufacturing sharing to GDP rather than manufacturing employment to total employment are due to data availability and not significantly represent industrialization and deindustrialization in Indonesia.

This study divides the independent variables into three groups based on the Secular, Dutch Disease, and Trade hypotheses. For the Secular hypothesis, this study applied the GDP Per Capita, Squared GDP Per Capita and the Services Share to GDP. While for the Dutch Disease hypothesis, this study used the following explanatory variables: the REER, the Energy Price, the Fuel and Metal Exports to Merchandise Exports, and the Government Expenditure of GDP. Finally, for the Trade hypothesis, this study used the Manufacturing Exports to Total Merchandise Exports, the

Manufacturing Imports to Total Merchandise Imports, and the Openness.

This study also utilizes some control dummy variables, a variable that takes on the value zero or one, in order to indicate the presence and absence of several effects that may influence the outcome variable. The dummy of the Asian Financial Crisis (AFC) represents the AFC that happened in 1997 to 1998. The dummy of exchange rate system represents the shifting of the exchange rate system from a fixed to flexible exchange rate in 1998. The last dummy variable is the dummy of the fuel price boom. This dummy represents oil price shocks in the particular years under observation.[1]

5. Methodology

In this study, the analysis will conduct model specification and cointegration-testing using the Autoregressive Distributed Lag - Error Correction Model and Bound Test Procedure (ARDL-ECM Bounds) developed by Pesaran, Shin & Smith (2001), which can be written as the equation below:

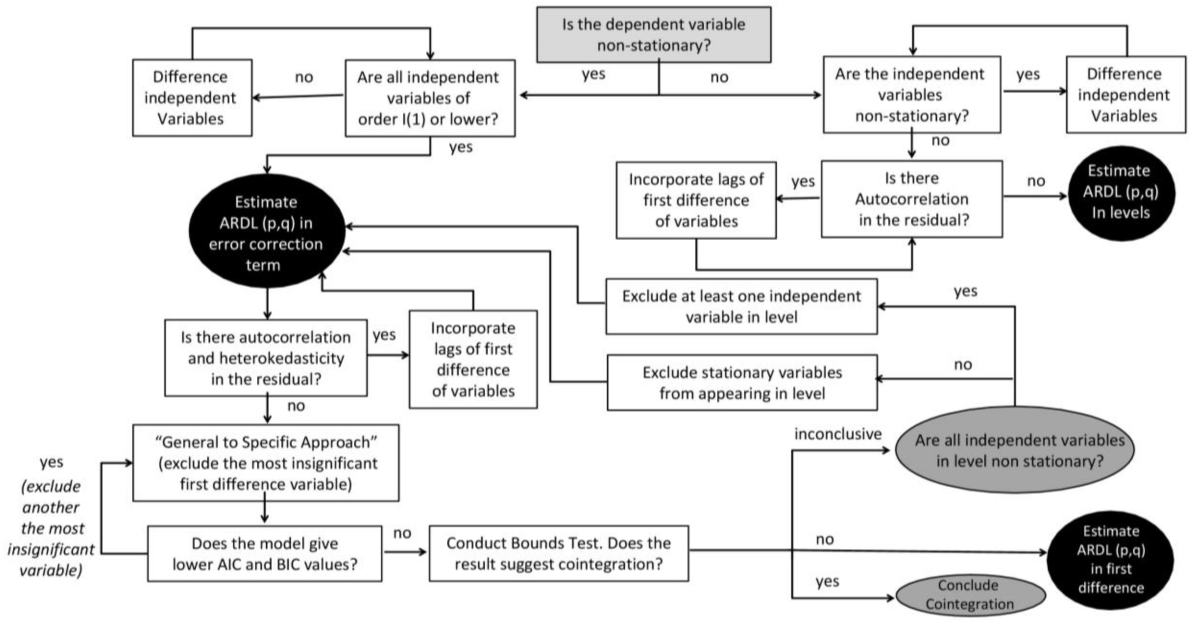
$$\Delta y_t = \alpha_0^* + \theta_0 y_{t-1} + \theta_1 x_{1,t-1} + \cdots + \theta_k x_{k,t-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-1} +$$

$$\sum_{j=0}^{q_1} \beta_{1j} \Delta x_{1,t-j} + \cdots + \sum_{j=0}^{q_k} \beta_{kj} \Delta x_{k,t-j} + \varepsilon_t$$

Where α_0^* = constant-coefficient from the Error Correction Model and Cointegrating relationship, and θ_0= -α, indicating a negative sign and being significant in order to hold long-run equilibrium relationship. The coefficient of the lagged value of x_k, θ_k, can be combined with y_{t-1}, θ_0, the lagged dependent variable, in order to extract the long-run multiplier (Philips 2018). The β_{1j} represents the effect of the same period from the independent variables. Since the problem of autocorrelation may exist, the model can include additional lag order, up to *p* lags and *q* lags of the first difference of the dependent variable and the independent variables (Pesaran, Shin, & Smith 2001). Manufacturing Share to GDP is applied as the dependent variable (represented by *y*), while the explanatory variables (represented by x_k) are divided into three groups of hypothesis. The dummy variables are included in each model to capture unobserved effects.

This study modify the ARDL-Bounds procedure suggested by Philips (2018), in order to have a parsimonious ARDL model (see Figure 2). In general, the ARDL-Bounds procedure involves four steps. First, ensuring the orders of integration of dependent variable is I(1). Secondly, ensuring that the orders of integration of independent variables are not higher than I(1). Third, estimating the model using the ARDL-Bounds model in error correction form and conducting post-estimation tests, such as autocorrelation and heteroskedasticity tests. In addition, in order to get a parsimonious model, the study uses a general to the specific procedure developed by Hendry & Krolzig (2003) and compares some criteria value in order to get the best model, one that has a lower value of Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) or higher value of Adjusted R-Square. Fourth and finally, is conducting the bounds test for cointegration.

Figure 2 The ARDL-Bounds Procedure's Comprehensive Approach



Source: Author modification from Philips (2018)

In order to ensure that the dependent and independent variables have orders of integration I(1) and not higher than I(1), this study conducts four types of unit root tests. The first and second tests are the standard unit root test implemented in many time series analyses, which are Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) tests. Moreover, a powerful unit root test, such as the Dickey-Fuller Generalized Least Square (DF-GLS) and a unit root test to capture a potential break in the trend developed by (Zivot & Andrews 1992) are also conducted.

The cointegration test is conducted using the bound test, which tests the cointegration equation between the dependent variable and independent variables with the null hypothesis of no cointegration (Pesaran, Shin, & Smith 2001). By running F-test, a one-sided t-test may be used to test the null hypothesis (F-test is below I(0) critical value), while the alternative hypothesis suggests cointegration (F-test is higher than I(1) critical value). Likewise, when the F-test value between I(0) critical value and I(1) critical value shows inconclusiveness, there needs to be re-estimating of the ARDL model through eliminating independent or stationary variables (Philips 2018).

However, ARDL-ECM models may have dynamic specifications, including multiple lags, first difference, and lagged first difference, which creates difficulties when interpreting the short and long effects of independent variables. Since the model results can be dynamically complex, this study applies the recent Stata program **dynamac** developed by Jordan and Philips (2018). This Stata program includes a command for cointegration test estimation by using **pssbounds** and for producing simulations of a complex ARDL-style by using **dynardl**.

6. Results

This section will begin by conducting the unit root tests for all variables in order to identify the order of integration, while the following two discussions will present the model selection process of ARDL-Bounds Model and the regression results of the ARDL-Bounds Model for the deindustrialization hypotheses.

6.1. Unit Root Tests

Referring the ARDL-Bounds Procedure's Comprehensive Approach in Figure 2, the unit root test has to be established in order to ensure the orders of integration of the dependent variable are I(1) and all explanatory variables are higher than I(1). As shown in Table 1, Manufacturing Share to GDP as the dependent variable can confirm that the variable is I(1). This result can be seen from all four tests that show the rejection of the null hypothesis of an I(1) series. Furthermore, the unit root test results in Table 1, Column 7 show that all regressors are I(1), except the (*log*) GDP Per Capita and the OPENNESS that is tentatively confirmed as I(0).

Table 1 Unit Root Test of ARDL-ECM Bounds for Deindustrialization Hypotheses

(1)	(2)	(3)	(4)	(5)		(6)		(7)
	ADF Test 1st Different	*PP Test 1st Different*	*DF-GLS 1st Different*	*ZA Test Level*		*ZA Test 1st Different*		Conclusion
Variables	*Trend*	*Trend*	*Trend*	k	DU	k	DU	
Manufacturing Share[1]	-2.89 (0.16)	-8.21 (0.00)***	-3.96*** (k=1)	2	-4.32 (TB 2001)	1	-5.60** (TB 1998)	I(1)
(log) GDP PerCapita	-4.60 (0.00)***	-5.34 (0.00)***	-4.29*** (k=1)	1	-8.65*** (TB 1998)	0	-6.72*** (TB 1998)	I(0)/ I(1)
(log) GDP PerCapita_Squared	-4.61 (0.00)***	-5.26 (0.00)***	-4.37*** (k=1)	1	-8.39*** (TB 1998)	0	-6.76*** (TB 1998)	I(1)
Services Share[1]	-4.08 (0.01)***	-5.23 (0.00)***	-4.88*** (k=1)	1	-4.39 (TB 1983)	0	-5.63*** (TB 1997)	I(1)
(log)Real Effective Exchange Rate	-5.67 (0.00)***	-7.33 (0.00)***	-5.29*** (k=1)	0	-3.75 (TB 1998)	0	-8.09*** (TB 1999)	I(1)
(log) Energy Price	-5.12 (0.00)***	-6.82 (0.00)***	-4.82*** (k=1)	0	-3.33 (TB 1986)	0	-7.56*** (TB 1975)	I(1)
Fuel and Metal Export[2]	-3.160 (0.09)*	-5.478 (0.00)***	-3.63*** (k=1)	1	-3.29 (TB 1986)	0	-6.53*** (TB 1976)	I(1)
Government Expenditure[1]	-5.83 (0.00)***	-8.76 (0.00)***	-5.74*** (k=1)	0	-3.69 (TB 1987)	0	-10.16*** (TB 1999)	I(1)
Manufacturing Export[2]	-2.75 (0.22)	-4.09 (0.01)***	-3.65** (k=1)	1	-3.22 (TB 1986)	0	-5.61*** (TB 1994)	I(1)
Manufacturing Import[2]	-5.52 (0.00)***	-8.03 (0.00)***	-3.81*** (k=2)	0	-3.99 (TB 1999)	0	-8.69*** (TB 1978)	I(1)
OPENNESS	-6.28 (0.00)***	-9.07 (0.00)***	-5.92*** (k=1)	0	-6.335*** (TB 1998)	0	-9.400*** (TB 1999)	I(0)/I(1)

Note: 1. ***,** and * indicate significance at critical value of 1%, 5% and 10%
2. Superscript [1] indicates as ratio to GDP, in percentage; and [2] indicates as ratio to total merchandise, in percentage.
Source: Author calculation

6.2. ARDL-ECM Model Selection Process

After ensuring that the dependent variable is I(1) and all regressors are not more than I(1), then the ARDL-Bounds Models can be developed for analyzing the determinants of deindustrialization in Indonesia. Table 2 shows the ARDL Bounds Model selection process following the ARDL-Bounds Procedure's Comprehensive Approach developed by Philips (2018), which is modified by conducting the General to Specific modeling approach in order to account for over-parameterization in the model (Hendry 2009).

For the Secular hypothesis, the model with optimal lag has no multicollinearity or heteroskedasticity problems. However, the model gives the bounds-test estimation of the ARDL-Bounds model between the lower and upper stationary bounds. As suggested by Phillips (2018), if the bounds-test estimation shows an inconclusive result, then we need to exclude at least one independent variable at that level. This study concludes that there is cointegration after excluding variable Service Share to GDP.

Table 2 Summary of ARDL- ECM Bounds Model Selection Process

Model Specification	*Adj-R^2*	*AIC*	*BIC*	*DW d-stat*	*BG-LM test (P-value)*	*White's test (P-value)*	*Bounds test (F-Test)*	*Conclusion*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Secular hypothesis								
ARDL-ECM (**1**,0,0,0,0,0)[a]	0.294	139.5	162.2	2.054	0.508	0.432	3.65	Inconclusive[1]
- Omit Services Share	0.309	137.8	158.6	2.042	0.529	0.393	4.32	Cointegrating[2]
Dutch Disease hypothesis								
ARDL-ECM (**1**,1,0,1,1,0,0)[b]	0.476	127.3	157.6	1.648	0.095	0.433	6.29	Cointegrating[2]
- Omit ΔFuel&MetalExport$_t$	0.488	125.7	154.1	1.641	0.097	0.433	6.73	Cointegrating[3]
- Omit ΔGovtExpenditure$_t$	0.499	124.0	150.5	1.646	0.097	0.433	6.88	Cointegrating[3]
Trade hyothesis								
ARDL-ECM (**1**,1,1,1,0,0,0)[c]	0.564	117.8	146.2	1.743	0.217	0.433	5.97	Cointegrating[3]
- Omit ΔManufacturExport$_t$	0.576	115.8	142.3	1.741	0.218	0.433	6.75	Cointegrating[3]
- Omit ΔOPENNESS$_t$	0.588	113.8	138.4	1.745	0.224	0.433	7.01	Cointegrating[3]

Note: 1. Superscript a, b and c indicate the optimum lag of the first difference of the Secular, Dutch Disease and Trade hypotheses
2. Superscript 1 indicates inconclusive at critical value 5 %; Superscript 2 and 3 indicate the cointegrating relationship at critical value 5% and 1%.
3. Lower (L) and Upper (U) Bounds Test for each hypotheses are : Secular Hypothesis : (L = 2.900, H= 4.218); Dutch Disease Hypothesis : (L = 3.656, H= 5.331); Trade Hypothesis : (L = 3.656, H= 5.331);

Source: Author calculation

The best model with a white noise residual for the Dutch Disease hypothesis can be formed by ARDL-ECM (1,1,0,1,1,0,0). In order to deal with the over-parameterization problem, this study conducts the general to specific approach by excluding the most insignificant parameters in the short-run. However, the model keeps at least one parameter of each variable to see the short-run relationship in the hypothesis. As a result, the approach suggests excluding ΔFuel&MetalExport$_t$ and ΔGov'tExpenditure$_t$. By omitting these variables, the model becomes more robust. This is shown by the higher Adjusted R-Square and lower AIC and BIC values. Since the estimation result diagnostic can ensure that there is no autocorrelation and heteroskedasticity problems, then a cointegration testing using the bound test can be further applied. An F-test of the joint significance yield an F-statistic of 6.88, higher than the I(1) upper bounds. Therefore, this model indicates that all explanatory variables are cointegrating with the dependent variable.

By conducting a similar process, the estimation for the Trade hypothesis is conducted. From Table 2, it can be seen that the best model based on optimal lag is ARDL-ECM (1,1,1,1,0,0,0). The general to specific approach suggests excluding $\Delta ManufacturExport_t$ and $\Delta OPENNESS_t$ to get the parsimonious model with no autocorrelation and heteroskedasticity problems. This model indicates that all explanatory variables are cointegrating with the dependent variable based on the F-test of the joint significance that yielded a value of 7.01.

6.3. Estimation Results

Table 3 shows the estimation results of the three models. The estimation results of the Secular hypothesis indicate that in the short run, the Manufacturing Share to GDP is statistically determined by its lagged value. Meanwhile, the (log) GDP Per Capita, the Squared (log) GDP Per Capita and the Services Share to GDP do not have a statistically significant effect on the dependent variable. In the long run, however, both the (log) GDP Per Capita and the Squared (log) GDP Per Capita are significantly affect the dependent variable. These relationships confirm the existence of inverted-U relationship between the manufacturing share to GDP and per capita income. However, the insignificant of the Service Share to GDP term in explaining the evolution of manufacturing share indicates the low relevance of the Secular Hypothesis for Indonesia’s deindustrialization. Indonesia’s rising service sector, often informal, may not be productive or dynamic enough to replace manufacturing activities, yet. Moreover, these low-productivity informal services offer little potential for growth.

The estimation results of the Dutch Disease hypothesis model show that all independent variables significantly affect the dependent variable in the long-run. The relationship of (log) REER meets the theoretical expectation, which show that (log) REER appreciation has a negative effect on Manufacturing Share to GDP. Similar to the long-run relationship, (log) REER appreciation also has a negative effect on Manufacturing Share to GDP in the short-run. These long-run and short-run relationships indicate that the effect of REER appreciation on the declining manufacturing sector to GDP is very dominant, which is also shown by the high coefficient of (log) REER.

Table 3 Final Results of ARDL-Bounds Model for Deindustrialization in Indonesia

Variable	Dependent Variable: ΔManufacturing Share$_t$		
	Model (1)	*Model (2)*	*Model (3)*
	Secular Hypothesis	Dutch Disease Hypothesis	Trade Hypothesis
Manufacturing Share $_{t-1}$	-0.084 (0.07)	-0.137 (0.08)	-0.295 (0.09)***
(Log) GDP Per Capita$_{t-1}$	35.23 (14.11)**		
(Log)Squared GDPPerCapita$_{t-1}$	-2.380 (0.92)**		
(Log) REER$_{t-1}$	-	-1.787(1.05)*	-
(Log)Energy Price$_{t-1}$	-	0.848 (0.39)**	-
Fuel and Metal Export$_{t-1}$	-	0.028 (0.02)	-
Government Expenditure$_{t-1}$	-	-0.913 (0.23)***	-
Manufacturing Export $_{t-1}$	-	-	0.091 (0.03)***
Manufacturing Import $_{t-1}$	-	-	-0.105 (0.32)***
OPENNESS$_{t-1}$	-	-	0.029 (0.02)*
Δ Manufacturing Share $_{t-1}$	-0.401 (0.16)**	-0.420 (0.13)***	-0.310 (0.12)**
Δ(log) GDP Per Capita$_t$	-159.01 (208.27)	-	-
Δ(log) GDP Per Capita$_{t-1}$	-	-	-
Δ(log) Squared GDPPerCapita$_t$	10.40 (13.77)		
Δ(log) Squared GDPPerCapita$_{t-1}$	-		
Δ Services Share to GDP$_t$	0.056 (0.11)	-	-
Δ(log) REER$_t$	-	-1.959 (1.03)*	-
Δ(log) REER $_{t-1}$	-	-2.753 (1.22)**	-
Δ(log)Energy Price$_t$	-	-0.386 (0.49)	-
ΔFuel and Metal Export$_{t-1}$	-	-0.037 (0.03)	-
ΔGovernment Expenditure$_{t-1}$	-	0.416 (0.19)**	-
ΔManufacturing Export$_{t-1}$	-	-	-0.024 (0.05)
ΔManufacturing Import$_t$	-	-	0.040 (0.03)
ΔManufacturing Import$_{t-1}$	-	-	0.074 (0.03)**
ΔOPENNESS$_{t-1}$	-	-	0.028 (0.02)
Dum_Asian Financial Crisis	-0.833 (1.21)	-2.940 (0.89)***	- 0.433 (0.91)
Dum_Exchange Rate System	-0.326 (0.76)	-2.217 (0.52)***	-1.802 (0.53)***
Dum_Fuel Price Boom	-0.816 (0.342)**	-	-0.533 (0.38)
Constant	-127.13 (53.32)**	16.96 (6.04)***	10.43 (3.07)***
Observations	49	49	49
R-Squared	0.4533	0.6348	0.6912
D-W d-statistics	2.0422	1.6461	1.7448
B-G LM test (P-Value)			
AR(1)	0.5286	0.0967	0.2236
AR(2)	0.4514	0.0593	0.2190
White's test (P-Value)	0.3933	0.4328	0.4328
Bounds Test (F-Test)	4.32	6.88	7.01
Bound Test Conclusion	Cointegrating	Cointegrating	Cointegrating
Bound Test Critical Value	[2.90 < F-Test < 4.22][b]	[3.65 < F-Test < 5.33][a]	[3.66 < F-Test < 5.33][a]

Note: ***,** and * indicate significance at critical value of 1%, 5% and 10%
a,b,c, inducate Bound Test at critical value of 1%, 5% and 10%
Source: Author calculation

The (log) of Energy Price and the Fuel and Metal Export variables have a positive relationship in the long-run and negative sign in the short-run. The long-run relationship can be explained by the case of an energy price boom during the 1970s. At that time, Indonesia was still an (net) oil exporter (Thee 2012). Therefore, the increase in world energy prices had increased the government revenue.

Effective policy responses by the government, such as importing some physical capital for manufacturing sector development, devaluing the exchange rate, and creating several regulations that were pro-investment, successfully boosted manufacturing development until the 1990s.

However, since the fuel production continued to decline in the 1990s and Indonesia become a net oil importer in 2004, the increase of the world oil price started to impact the domestic economy negatively. Due to a partial subsidy of domestic fuel price, the increase of world fuel price might lead the government to increase the price of domestic fuel, which would cause high inflation. If the government increases its subsidy for domestic fuel consumption, then this fuel subsidy allocation will reduce the spending in productive sectors, which are crucial for industrial development.

The positive relationship of government expenditure in the short run indicates government spending for capital and the productive sectors might give benefit to the manufacturing sector. While in the long run, due to the decentralization system, there is a trend that the government budget will be allocated more to the local government and rural areas than to capital spending by the central government. Therefore, this policy might affect industrial development due to the limited budget that the central government can allocate for boosting manufacturing development.

For the Trade hypothesis, implies that Manufacturing Exports (positively) and Manufacturing Imports (negatively) affect the Manufacturing Share to GDP. The relative magnitude of the impact of Manufacturing Imports is higher than Manufacturing Exports in determining Manufacturing Share to GDP. The result also confirms the composition of imports that are still dominated by raw material imports for domestic production. Meanwhile, the other variable *OPENNESS* also significantly affects Manufacturing Share to GDP and shows a positive relationship in the long run. This coefficient indicates that the involvement of Indonesia in the global market or global value chains is positive but still low, which is shown by the low complexity of exports, including value-added exports and product diversification.

7. Where Is the Manufacturing Sector in Indonesia Headed?

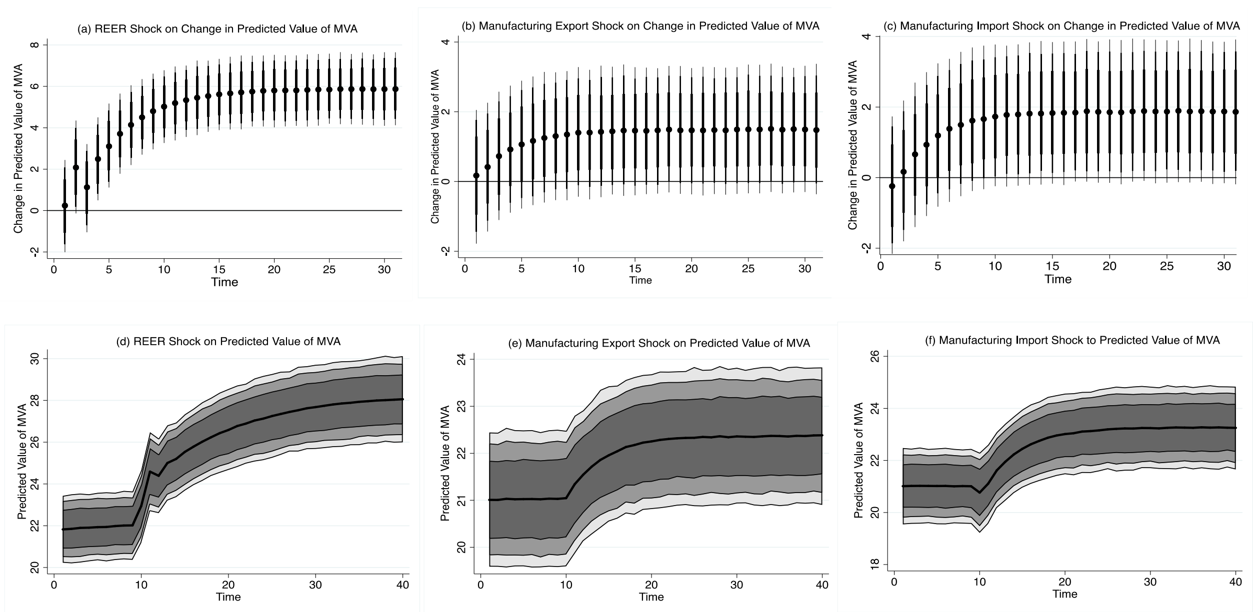
For understanding the complexity of the ARDL models, this study applied the **dynardl** command from **Stata** developed by Jordan and Philips (2018). By using the **dynardl** command, this study can apply a stochastic simulation technique as well as produce a plot of predicted values from the ARDL model. By holding others variables constant, the **dynardl** produces an output that can visualize the effect of a counterfactual change in an explanatory variable to the dependent variables, at a single point in time.

The simulations were focused on the variables of (log) REER, Manufacturing Export and

Manufacturing Import. There are several reasons for analyzing these variables. First, Indonesia's manufacturing development had a structural break along with the appreciation trend post 1998. Secondly, trade performance has become the main concern for Indonesia's policymakers since Indonesia has been experiencing a trade deficit in the last several years. Third, based on the estimation, those variables significantly affect the decline of Manufacturing Share to GDP and have a higher coefficient than other variables.

The results of the ARDL model simulation can be seen in Figure 3. The top graphs (Figure 3a to 3c) show the difference between the prediction values at each point relative to the predicted value on average before the shocks. While, the below graphs (Figure 3d to 3f) show the predicted future value based on the simulation. All the simulations are applied shocks at 10 percent from the last sample value of three variables, while holding the others explanatory variables constant.[2] By conducting these simulations, this study can evaluate the effect of a shock of a particular variable on the dependent variable.

Figure 3 Simulation Results of ARDL-Bounds Models Using the Dynardl Program on Stata



Note: 1. MVA stands for Manufacturing Value Added to GDP
2.The dots show the mean change in predicted value from the sample mean.
3. The shaded area shows (from darkest to lightest) the 75, 90 and 95 percent confidence intervals.
Source: Author calculation

In Figure 3a, it can be seen that the impact of REER depreciation (negative) at 10 percent, is fluctuating until t+3. The effect of the shock continuously increases from around 1% at t+1 and jumps to approximately 6% at t+20, and then the impact remains stable. In the short run, the effect of shock is not statistically significant. However, in the long run, the increase of change in the predicted value is statistically significant, even at a 95% confidence interval. The REER simulation on the predicted value of Manufacturing Share to GDP (Figure 3d) also indicates that the REER shock makes an immediate impact and last for a long time.

The graphs in Figure 3b and Figure 3c represent a simulation of shock on Manufacturing Export at as much as (positive) 10% and the Manufacturing Import at as much as (negative) 10%. A 10% shock of manufacturing export shares produces a small increase in the short run and is not statistically significant. After t+6, the increase of predicted value changes becomes statistically significant and brings to a new equilibrium at t+10 around 1.5 % change in predicted value. A similar response is also shown by the shock of manufacturing import share. However, compared to the manufacturing export share, the impact of manufacturing imports is greater and more immediate (Figure 3e and 3f). This result indicates that the policy shock on manufacturing imports is more effective in promoting domestic industries.

8. Conclusion and Policy Recommendations

The study finding supports the argument that the deindustrialization in Indonesia is similar to many developing countries, which does not follow the path of deindustrialization in developed countries. This condition indicates that the country is running out of industrialization opportunities earlier along with lower levels of income compared to early-industrialized countries' experience. Correspondingly, the result also confirms that Indonesia is undergoing premature deindustrialization.

The others main findings of this study are that deindustrialization in Indonesia is mostly determined by (i) REER appreciation, either caused by the effect of energy price increases or due to monetary policy as a response of market conditions; and (ii) manufacturing export and import performance, which shows poor performance in the past decade due to loss of competitiveness to others developing countries such as China (a manufacturing giant) and Vietnam and Thailand (export and investment attraction competitors in the Southeast Asia region).

Finally, from the dynamic simulation perspective, it can be concluded that the various policies that are carried out by policymakers will have a gradual impact on manufacturing development. It seems that exchange rate policy can be an effective policy in order to boost manufacturing sector performance. In addition, as an alternative policy, the government should focus their development plan on developing industries that can meet domestic demand rather than only focusing on developing export-based industries in order to increase the manufacturing sector share to GDP.

Notes

1 For the Dutch Disease hypothesis, this dummy variable is not included in the model estimation since the oil price shocks were already represented by the energy price index.

2 This study uses the value in 2017 as the last sample value of variables for the dynardl simulation.

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Appendix 1 Data Description

Variables	Definition	Unit	Source
Manufacturing Share to GDP	The share of manufacturing sector to Gross Domestic Product. (GDP as the denominator).	Percentage	Indonesian Statistics
GDP Per Capita	GDP per capita calculation based on purchasing power parity (PPP). Converted to international dollars at constant price 2011.	International US$	World Development Indicators (WDI)
Services Share to GDP	The share of services sector to Gross Domestic Product (GDP as the denominator).	Percentage	Indonesian Statistics
Real Effective Exchange Rate	The weighted average of national currency in relation to a basket of other major trading partner currencies, adjusted by inflation.	Indices	Bank of Int. Settlement
Energy Price	A composite Index including a group of Coal (4,7%), Fuel (84.6%) and Natural Gas Prices (10.8%) measured based on the weight of countries' export value.	Indices	World Bank Commodity Price
Fuel and Metal to Total Export	Fuel and metal consist of lubricants, related materials, and mineral fuels. While Ores and metals comprise of minerals nes, crude fertilizer, metalliferous scrap ores; and non-ferrous metals.	Percentage	WDI
Government Expenditure	Final expenditure on goods and services purchased by the government.	Percentage	WDI
Manufacturing Export to Total Merchandise Export	Export of manufactures comprises of chemicals, basic manufactures, machinery and transport equipment and miscellaneous manufactured goods excluding division in non-ferrous metals to total merchandise export	Percentage	WDI
Manufacturing Import to Total Merchandise Import	Import of manufactures comprise commodities (similar classification to Manufacturing Export to Total Merchandise Export) to total merchandise import	Percentage	WDI
OPENNESS	The total of merchandise exports and imports to GDP (GDP as the denominator).	Percentage	WDI