Labour Productivity Growth in the Industrial Sector of Indonesia: Structural Bonus or Structural Burden?

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Abstract: The economic structural change on the output side is accompanied by the reallocation of labour from the agricultural sector to the industrial sector. Some studies show the different effects of labour reallocation on labour productivity growth. This study analyses labour productivity growth in the manufacturing sector in relation to economic structural changes in Indonesia. The analytical methods used are shift-share and panel data regression models using secondary data of 30 provinces from 2003-2014. The results show economic structural change through labour reallocation decreases growth of labour productivity (structural burden) although productivity continues to grow.

Keywords: Input reallocation, labour productivity growth, structural bonus, structural burden, structural change
JEL classification: L60, O14, O40

1. Introduction

According to the Central Bureau of Statistics (Badan Pusat Statistik, BPS, 2014), Indonesia's economic growth fluctuates between 3.64 percent and 6.49 percent during the years 2000 to 2014, increasing at an average of 5.42 percent per year. Paralleling this economic growth are structural economic changes. In Indonesia, as in other developing

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countries whose GDPs were initially dominated by agriculture, the industrial sector – that is, manufacturing – exceeds the agricultural sector in every year of that period.

There are nine economic sectors in the Indonesian economy. The agricultural and industrial sectors are two sectors that contribute more than other sectors in GDP formation. Table 1 compares the contributions of these two sectors.

Table 1. Agricultural and industrial sectors in Indonesian GDP (%)

Year	Agriculture share of GDP	Industry share of GDP
2003	15.24	28.01
2004	14.92	28.37
2005	14.50	28.08
2006	14.21	27.83
2007	13.82	27.39
2008	13.67	26.78
2009	13.58	26.17
2010	13.17	25.80
2011	12.78	25.72
2012	12.53	25.59
2013	12.26	25.55
2014	12.06	25.54

Source: BPS, 2014.

Increased manufacturing needs more labour. Although the change in the labour share fluctuates, it has a tendency to increase, from 11.39 percent of total labour in 2003 to 13.31 percent of the total labour in 2014. In other words, the shift from agriculture to industry in GDP is accompanied by a shift in labour from agriculture to industry.

At the same time, labour employed in agriculture decreased from 46.38 percent of total labour in 2003 to 34 percent in 2014. The shift in labour towards the industrial sector is less as a percentage of the whole than the shift in output. This is in line with Kuznets (1966) theory.

Although the manufacturing sector has dominated GDP from 2003 to 2014, the share tends to decrease from 28.01 percent in 2003 to 25.54 percent in 2014. From nine economic sectors in Indonesia (not only agriculture, industry and services), the industrial sector contributes the most to GDP. Development in the manufacturing sector has been stagnant and even tends to decrease. This condition has lessened Indonesia's economic performance. According to the Asian Productivity Organization (APO) (2014), the Indonesian total factor productivity growth fluctuated with a declining tendency from 1970-2013 with an average increase of only 0.9 percent per year.

The APO (2015) mentioned that Indonesian labour productivity growth for the six years, 2000 to 2005 is 3.7 percent, whereas it increases by only 3.4 percent in the nine years from 2005 to 2013[1], resulting in an average increase of 3.5 percent per year

[1] This data is sourced from APO (2015) which is different from the data source in Table 1. The APO data (2015) covers the research period (2003-2014).

for the thirteen years from 2000 to 2013. In more detail, manufacturing contribution to labour productivity growth in Indonesia declined between 1990 and 2000 from 1.1 percent of the total productivity growth (with contribution share to aggregate labour productivity of 53 percent) to 0.9 percent between 2000 and 2013 (with contribution share to aggregate labour productivity of 27 percent).

These conditions indicate that although the manufacturing sector plays the largest role in GDP during the period 2003-2014[2], productivity growth is relatively low and tends to decline. In fact, some reviews show that manufacturing is the engine of economic growth (McMillan & Rodrik, 2011; Ocampo, 2005).

The effects of structural changes and input reallocation on economic performance are interesting. Some researchers show that these effects are significantly positive (Akkemik, 2005; Barthélemy & Söderling, 2001; Bosworth & Collins, 2008; Chen, Jefferson, & Zhang, 2011; Nelson & Pack, 1999). Others find very small, zero, or even negative effects (Carree, 2003; Fagerberg, 2000; Peneder, 2003; Timer & Szirmai, 2000).

The industrial sector has an essential role in promoting economic growth and productivity. Paying attention to the industrial sector performance in Indonesia as well as to the empirical studies that show different effects of structural change on economic performance, this study examines more deeply the relationship between the industrial sector's structural change and productivity in Indonesia.[3] Manufacturing in Indonesia is predominantly labour-intensive and based on natural resources (BPS, 1990-2014). The results of this research are expected to provide input for policy makers who by reallocating labour to the manufacturing sector will benefit the economy overall.

2. Literature Review

Neoclassic structural approach assumes that there are imperfect forecasts, limited production factor movements and imbalances (not fully optimal resources) in any economy (Meier & Rauch, 2005). This approach assumes that there are numerous marginal productivity variations which indicate the allocation inefficiency of inputs in various sectors. Structural transformation may resolve the allocation inefficiency and may encourage productivity growth (Denison, 1962; Lewis, 1954; Ranis & Fei, 1961).

Syrquin (1988) argued that structural transformation is a prerequisite for increasing growth, reducing poverty and supporting sustainable development. Bonet (2006) and Caselli and Coleman (2001) agreed with this view. Kuznets (1966) examined the pattern of development in the US and other developed countries using cross-sectional data. The results show that labour reallocation from the less productive sector to the more productive sector contributes about one-fifth of the overall growth in labour

[2] The research period, 2003-2014 is based on availability of data. In addition, up to 2014, the number of economic sectors in the Indonesian economy consisted of nine sectors while from 2015 onwards the number of economic sectors has changed to 17 sectors. The 2014 close-off preserves the integrity of the data.

[3] Labour productivity is measured by GDP per worker. APO (2014) showed that the large discrepancy in GDP per capita between Asia and the US is explained by Asian productivity being less than 50 percent of America's.

productivity and the rest comes from productivity growth in each sector. Solow (1956) agreed that reallocating labour from the sector with lower productivity to a higher one can increase economic growth.

The labour reallocation process has a different impact on labour productivity growth. The effect on productivity can be positive, nil or negative. The structural bonus hypothesis postulates that there is a positive relationship between structural change and economic growth. It assumes that the economy progressively switches from industries with a low added value per labour unit to industries with a higher added value. This hypothesis directly refers to labour reallocation (Peneder, 2003). Timer and Szirmai (2000) stated that the progression from startup to middle to well-established industries parallels the technological improvement which benefits the manufacturing sector's aggregate productivity growth. The structural bonus hypothesis is in line with the idea proposed by McMillan & Rodrick (2011) that any shift in resources from low to high productivity activities may result in a structural change bonus which they call "growth-enhancing structural change".

Structural change may also negatively influence aggregate growth, as expected by Baumol's hypothesis of unbalanced growth (Baumol, 1967). The difference among industries in their efforts to improve labour productivity (at a specified demand level) shifts larger labour market share from so-called progressive industries with high productivity growth to so-called stagnant industries with low productivity growth. In the long run, the structural burden of the increasing share of labour employed in the stagnant industry tends to reduce the prospect of aggregate growth in per capita income. This expectation is called the structural burden hypothesis.

Some studies show that structural change can spark increased productivity (structural bonus). Among them are Akkemik (2005) whose study is on Singapore with the shift-share analysis model, Bosworth and Collins (2008) who researched China and India using the decomposition of growth model, Chen et al. (2011) who used sectoral translog stochastic frontier production functions, dynamic decomposition and panel regressions from 38 manufacturing industries in China, and Marouani and Mouelhi (2016), whose research is on Tunisia with decomposition methods and regression models using sectoral data.

Both explicitly and implicitly, the structural bonus hypothesis is present in various models of industrial development. Chenery, Robinson and Syrquin (1986) showed that the standard perception of industrial development is a general shift from light to heavy industry, improving labour productivity overall (a structural bonus) (Timmer and Szirmai, 2000).

The shift from the beginning industry to the medium and the high end one is identical to a process of improving technology, and this should encourage a bonus for aggregate productivity growth in the manufacturing sector (Chenery & Taylor, 1968). Harberger (1998) and Nelson and Pack (1999) showed that inter-industry productivity growth rates vary, and that capital and labour move towards faster-growing industries. Growth is determined by the effectiveness of policy support and by the availability of skilled labour.

Lucas (1993) emphasised the beneficial effects of structural changes driven by economic liberalisation. When a country liberalises its domestic market and opens itself

up to foreign direct investment (FDI), then the neoclassical theory predicts that inputs move towards more productive and more efficient activities.

Timmer and Szirmai (2000) examined productivity of the manufacturing sector in four Asian countries during the period 1963-1993, using the shift-share and TFP growth decomposition analyses. The results do not support the structural bonus hypothesis. For rapid growth, developing countries need high investment, financial and business services, extensive physical infrastructure, and people who have technological competence. This is in line with the opinion of Abramovitz (1989). With adequate technology, developing countries will progress in all manufacturing areas (Timmer & Szirmai, 1999).

Fagerberg (2000) identified the effect of structural changes on manufacturing productivity growth in 39 countries (in Europe, Asia, America and some African countries) and 24 manufacturing industries between 1973 and 1990 using shift-share and two-stage least squares (2SLS) regression models. The results obtained with the shift-share analysis show that structural changes do not significantly affect productivity growth. Similarly, Peneder (2003) analysed the industrial structure and aggregate growth in OECD member countries from 1990 to 1998 with shift-share and panel data regression models. The results indicate that structural change has only a weak effect on labour productivity (i.e., robust structural burden).

Carree (2003) commented on Fagerberg's (2000) research into technological progress, structural change and productivity growth using International Standard Industrial Classification (ISIC 5) data from manufacturing industries for 20 OECD countries. The period 1972-1992 is divided into four sub-periods using the panel data regression model. The results show that changes in the labour share of the manufacturing industry signal a structural burden, and that the initial level of productivity has a significant negative effect on productivity growth. It means that there is technological convergence between manufacturing industries.

Research on the same topic conducted by different people in different research periods show discrepancies, due to differences in analytical methods, scope of research, variables used, and specific characteristics of each research object such as sectoral conditions and industrial sub-sectors, and government policies. The discrepancies directly affect the structural changes variables and also influence other variables from the same topic of analysis.

The terms *structural bonus* and *structural burden* are directly related to the effect of structural change variables on labour productivity growth. If the effect is positive it means a structural bonus and if the effect is negative it means a structural burden. Other variables are control variables.

In most studies that show structural bonuses, the investment variable has a significant positive effect on productivity growth. Fagerberg (2000) study showed an insignificant negative impact. Peneder (2003) and Carree (2003) found a significant positive effect and no significant effect at all, respectively.

The other variable is foreign investment. Chen et al. (2011) showed foreign investment has a significant positive effect on labour productivity growth but Marouani and Mouelhi (2016) showed that it is not significant. Likewise with the education level variable in the research of Marouani and Mouelhi (2016) that supported structural

bonus, education does not significantly influence productivity growth. However, in the study of Fagerberg (2000) which showed a structural burden, this variable has a significant positive impact, where higher education attainment increases labour productivity.

McMillan, Rodrik and Gallo (2014) examined 38 countries (29 developing countries and nine higher income countries) in the period 1990-2005 using decomposition and regression methods. They showed that countries in Asia experienced productivity-enhancing structural change, whereas countries in Africa and Latin America experienced productivity-reducing structural change. The difference is due to the structural patterns. In Asia, labour moves from low productivity activities to higher ones, while in Latin America and Africa, it does the opposite. They reported that countries with a more flexible labour market experienced growth-enhancing structural change.

In view of this gap, the present study analyses the relationship between changes in sectoral roles through the process of reallocating labour towards the manufacturing sector, and the growth of labour productivity in Indonesia at the provincial level. This research adds several control variables that are relevant to Indonesian conditions, including provincial dummy and interaction dummy variables.

Provincial data shows that regions with different characteristics grow at different rates. Provinces whose economies are below the established level will grow faster than more developed provinces, and in the end, there will be convergence in income levels. This condition is known as conditional convergence which is based on the Solow growth model.

3. Data

This research uses panel data of 30 provinces in Indonesia from the years 2003 to 2014. Secondary data consists of real GDP and gross domestic regional product (GDRP) at a constant price of 2000, sectoral and national labour, economic sector contribution proportion to GRDP, labour share and labour productivity in various economic sectors, investment, average length of education, infrastructure, number of FDI, inflation rate and wages. The data are obtained from the Central Bureau of Statistics (*Badan Pusat Statistik*, BPS) and from the Indonesian Ministry of Industry.

4. Research Model

4.1 Shift-share Analysis

Shift-share analysis is one instrument used to investigate the labour productivity growth and labour reallocation between sectors which may influence the aggregate growth. This method shows either the structural bonus or structural burden conditions depending on the relationship between structural change and productivity growth (Peneder, 2003). This research adopts the shift-share decomposition used by Peneder (2003) with the following formula:

$$Growth(LP)_{\tau} = \frac{LP_{\tau,fy} - LP_{\tau,by}}{LP_{\tau,by}} \quad (1)$$

$$= \frac{\overbrace{\sum_{i=1}^{n} LP_{i,by}(S_{i,fy} - S_{i,by})}^{\text{I. Static-shift effect}} + \overbrace{\sum_{i=1}^{n}(LP_{i,fy} - LP_{i,by})(S_{i,fy} - S_{i,by})}^{\text{II. Dynamic-shift effect}} + \overbrace{\sum_{i=1}^{n}(LP_{i,fy} - LP_{i,by})S_{i,by}}^{\text{III. Within-shift effect}}}{LP_{\tau,by}} \quad (2)$$

where *LP* is labour productivity, b_y is *base year*, f_y is *final year*; τ represents all of the economic sectors, S_i is labour share of sector *i* in total employment, while *i* represents the nine economic sectors (1 – agriculture, livestock, forestry, and fishery, 2 – mining and quarrying, 3 – manufacturing, 4 – electricity, gas, and water supply, 5 – construction, 6 – trade, hotel, and restaurant, 7 – transportation and communication, 8 – financial, real estate and business services, 9 – services).

Part I of equation (2) shows a static-shift effect. If the static-shift effect is positive, it indicates a structural bonus which means that sectors with high productivity level may attract more labour resources that may increase the sector's share in total employment, and vice versa.

Part II of equation (2) shows the dynamic-shift effect. If the dynamic-shift effect has a negative value, it indicates a structural burden which means that the economic sector with high labour productivity growth is unable to manage the labour share in total employment causing a decline in labour share. The interaction between high productivity growth and a decrease in the labour share will reduce labour productivity as a whole.

Part III of equation (2) shows within-shift effect indicating the labour aggregate productivity growth assuming that there is no structural shift (Peneder, 2003).

4.2 Econometric Analysis

The shift-share decomposition model uses data from only the initial and final year of the study, thus it cannot capture variations in the conditions that occur during the study period. Therefore, to confirm the results of the shift-share analysis, to be able to capture possible variations in conditions during the study period, and to be able to analyse other productivity determinant factors, this study uses the econometric analysis. Indonesian structural changes indicate a shift in labour towards the industrial (manufacturing) sector, and the econometric model analyses specifically the effect of labour reallocation on the growth of manufacturing labour productivity.

The econometric model of this study follows Carree (2003). Apart from using proxy variables for structural changes, this study also adds relevant control variables following Khan and Senhadji (2001), Mihaljek and Saxena (2010), Paus (2004), Peneder (2003), Wakeford (2004) and Yildirim (2015).

According to Paus (2004), the factors influencing productivity growth are technological change, domestic technological capabilities, conducive social and economic environment influenced by macroeconomic and political stability, access to technological know-how, requisite physical infrastructure, and human capital development. Technology may follow openness to FDI. This is in line with Kemeny (2010). When adequate domestic technological capabilities accompany openness, then FDI will trigger sustainable productivity growth and broader FDI spillover.

De Mello (1997) and Zhang (2001) stated that FDI coming into the developing countries has the potential to increase capital stock and technological know-how which may increase output, labour productivity and tax revenue for the host country. On the other hand, incoming FDI may negatively influence a country's growth prospect, for example when FDI increases the return flow of profit and dividend remittance, or when the multinational companies extract a tax concession from the host country. This negative influence may continue if the expected positive spillover effect from the technology transfer is limited due to the existence of intellectual property rights, or due to the transferred technology not meeting the host country's conditions.

Another variable influencing productivity growth is macroeconomic stability. One indicator of this variable is the inflation rate. Inflation reduces labour productivity through four mechanisms: workers' decreasing purchasing power, information distortion on prices, investment plan disruption, and capital accumulation decrease (Christopoulos & Tsionas, 2005; Clark, 1982; Freeman & Yerger, 2000; Jaret & Selody, 1982).

The other factor influencing the industrialisation process is wages. There is a positive relationship between real wages and productivity (Mankiw, 2006; Storm & Naastepad, 2007). Based on the macroeconomic framework, a real wage increase enables the company to replace labour with capital. The real wage increase may improve the marginal productivity of reduced labour (Mihaljek & Saxena, 2010; Wakeford, 2004; Yildirim, 2015).

In addition to the variables previously mentioned, this study adds provincial dummy and interactions dummy variables. The addition of provincial dummy variables clarifies the heterogeneity of the initial conditions of productivity growth in each region before the structural change occurs, while the addition of interactions dummy captures the influence of differences in regional characteristics on the labour reallocation process influencing labour productivity growth in the manufacturing sector.

The research period is divided into four sub-periods, each consisting of three years (M = 3): 2003-2005, 2006-2008, 2009-2011 and 2012-2014. This division into sub-periods is intended to capture the intra-period variations and to increase the sensitivity to the business cycle change (Carree, 2003). Thus, the research model is as follows:

$$\ln\left(\frac{Y_{i,t}}{Y_{i,t-M}}\right) = \alpha + \beta_1 \ln Y_{i,t-M} + \beta_2 (X_{i,t} - X_{i,t-M}) + \beta_3 X_{i,t-M} + \beta_4 \ln INVT_{i,t-M} + \beta_5 \Delta \ln INVT_{i,t} + \beta_6 HC_{i,t} + \beta_7 \ln INFST_{i,t} + \beta_8 FDI_{i,t} + \beta_9 INFLS_{i,t} + \beta_{10} \ln W_{i,t} + \beta_n \sum_{n=11}^{39} D_i + \beta_k \sum_{k=40}^{68} (X_{i,t} - X_{i,t-M}) * D_i + \varepsilon_{i,t} \quad (3)$$

The research variables are described in Table 2. Variables ($X_{i,t} - X_{i,t-M}$) and $X_{i,t-M}$ are proxies of structural change, reflecting the reallocation of labour towards the manufacturing sector in each province. Proxy variables may be positive (structural bonus) or negative (structural burden). The initial labour productivity variable, estimated to be negative, indicates the convergence of labour productivity growth in the manufacturing sector among provinces. Both investment variables are expected to be positive. Human capital, infrastructure and wages are expected to be positive while inflation is expected to have a negative effect.

Table 2. Description of variables

Variable	Description	Measurement
$\ln(Y_{i,t}/Y_{i,t-M})$	Labour productivity growth in manufacturing sector	Change in ratio of manufacturing sector's GDRP to number of manufacturing labourers (percent)
$Y_{i,t-M}$	Initial labour productivity	Ratio of manufacturing sector's GDRP to the number of manufacturing labourers at initial sub-period (million rupiah per person)
$(X_{i,t} - X_{i,t-M})$	Changes in labour share	Difference in share of manufacturing labour at the beginning and end of sub-period (percent)
$X_{i,t-M}$	Initial labour share	Ratio of number of manufacturing labourers to total labour at beginning of sub-period (percent)
$INVT_{i,t-M}$	Initial total investment (short-term capital deepening proxy)	Ratio of gross fixed capital formation to number of manufacturing labourers at beginning of sub-period (million rupiah per person)
$\Delta INVT_{i,t}$	Change in total investment (long-term capital deepening proxy)	Difference in the ratio of gross fixed capital formation to number of manufacturing labourers at beginning and end of sub-period (million rupiah per person)
$HC_{i,t}$	Human capital	Average length of education of working age population (year)
$W_{i,t}$	Wage	Provincial minimum wages (rupiah per month)
$INFST_{i,t}$	Infrastructure	Kilometres of paved road in province
$FDI_{i,t}$	Number of foreign direct investment (proxy of easy access to technology)	Number of FDI (Unit)
$INFLS_{i,t}$	Inflation	General price increase (percent)
D_i	Province dummy	D = 0 for base province, D = 1 for observed province
$D_i^*(X_{i,t} - X_{i,t-M})$	Interaction dummy	Interaction between province dummy and changes in labour share (percent)

The division into four sub-periods facilitates an analysis of the different labour productivity growth conditions taking place during the research period.

5. Results and Discussion

5.1 Shift-share Analysis

The shift-share analysis results can be seen in Table 3. Based on the table, labour productivity growth in Indonesia is influenced by static-shift effect, dynamic-shift effect and within-shift effect. The average labour productivity growth mostly comes from the

Table 3. Aggregate productivity growth decomposition in Indonesia between 2003 and 2014

Economic sector	Labour productivity growth	Static-shift effect	Dynamic-shift effect	Within-shift effect
Total	0.839	0.367	-0.1002	0.572
Agriculture		-0.069	-0.042	0.158
Mining and quarrying		0.106	-0.043	-0.073
Manufacturing		0.035	0.009	0.126
Electricity, gas and water supply		0.006	0.0008	0.002
Construction		0.044	0.009	0.020
Trade, hotel, restaurant		0.046	0.019	0.116
Transportation and communication		-0.015	-0.039	0.240
Financial, real estate, and business service		0.133	-0.015	-0.017
Services		0.081	0.0005	0.001

within-shift effect contribution. The results agree with previous studies (Fagerberg, 2000; McMillan & Rodrick, 2011; Peneder, 2003; Timmer & Szirmai, 2000) that the overall within-shift effect dominates the contribution to labour productivity growth.

The total static-shift effect, reflecting initial level of productivity, is positive. This means that sectors with high levels of productivity attract more workers, thereby increasing the share of the sector in total employment. In other words, the reallocation of labour takes place from less productive sectors to more productive ones. The total dynamic-shift effect, reflecting productivity growth is negative, meaning that the economic sector that has high labour productivity growth is unable to manage its share of labour in total employment, thereby reducing the share of labour. This condition indicates that the employment share shifts from the progressive sector with higher labour productivity growth to the sector with lower labour productivity growth. The interaction between high productivity level in initial conditions and a decrease in the labour share may cause a reduction in overall labour productivity. This condition indicates a structural burden. The structural burden hypothesis occurs when the value of dynamic-shift effect is negative (Peneder, 2003). Although the other two effects have only a small contribution to labour productivity growth compared to the within-shift effect, both are important parts of productivity growth and need attention, especially since the effects of total dynamic shifts show negative values.

The results of aggregate economic sector decomposition show the static-shift effect is positive, while the dynamic-shift effect is negative. It can be said that the process of reallocating labour among sectors in Indonesia shows a tendency for structural burden that can reduce the growth of labour productivity where labour shifts from the high productivity sector to the low one, although initially the level of sector productivity is high. This result is in line with the conclusion of Peneder (2003) which shows the structural burden hypothesis is unequivocally confirmed.

5.2 Analysis of Panel Data Regression Model

Using panel data is one way to overcome multicollinearity because the number of observations becomes larger. However, to get more certainty, a multicollinearity test uses the correlation matrix between the independent variables. If the correlation value is greater than 0.8, it is assumed that the model contains multicollinearity (Gujarati & Porter, 2012). The results of the multicollinearity test are shown in Table 4. The correlation value for all variables is less than 0.8, indicating that there is no multicollinearity in the research model.

The panel data estimation uses the feasible generalized least squares (FGLS) method to minimise the weighted sum of squared residuals in meeting the ordinary least squares assumption which may result in the best linear unbiased estimator (Gujarati & Porter, 2012).

The model estimation results, using West Java Province as the reference area in the provincial dummy calculation, are shown in Tables 5, 6 and 7. The model estimation results are robust as seen from the relatively high R^2 value with the explanatory variables which are most significant at α = 1%, 5%, and 10%. The F-statistic value is also significant at α = 1%.

Model 1 has three main variables, namely the initial labour productivity variable, and two more which are proxies of structural changes, namely the variable changes in the labour share and the initial labour share. Model 2 is an expanded Model 1 with seven control variables added.

The terms *structural bonus* and *structural burden* are directly related to the effect of structural change variables on labour productivity growth. Structural change

Table 4. The correlation matrix

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
X1	1.000	0.172	-0.282	0.544	-0.140	0.273	0.147	0.010	0.144	0.156
X2	0.172	1.000	-0.285	0.250	-0.518	-0.122	0.162	-0.062	0.134	-0.059
X3	-0.282	-0.285	1.000	-0.658	0.119	0.080	0.100	0.359	0.011	-0.202
X4	0.544	0.250	-0.658	1.000	-0.357	0.050	0.077	-0.079	-0.061	0.316
X5	-0.140	-0.518	0.119	-0.357	1.000	0.117	-0.094	-0.088	0.070	0.070
X6	0.273	-0.122	0.080	0.050	0.117	1.000	-0.181	0.413	-0.182	0.411
X7	0.147	0.162	0.100	0.077	-0.094	-0.181	1.000	0.024	-0.132	0.028
X8	0.010	-0.062	0.359	-0.079	-0.088	0.413	0.024	1.000	-0.142	0.306
X9	0.144	0.134	0.011	-0.061	0.070	-0.182	-0.132	-0.142	1.000	-0.482
X10	0.156	-0.059	-0.202	0.316	0.070	0.411	0.028	0.306	-0.482	1.000

Note: X1 to X10 represents the variables in equation 3. X1 is initial labour productivity ($Y_{i,t-M}$), X2 is change in labour share ($X_{i,t} - X_{i,t-M}$), X3 is initial labour share ($X_{i,t-M}$), X4 is initial total investment ($INVT_{i,t-M}$), X5 is change in total investment ($\Delta INVT_{i,t}$), X6 is human capital ($HC_{i,t}$), X7 is infrastructure ($INFST_{i,t}$), X8 is number of foreign direct investment ($FDI_{i,t}$), X9 is inflation ($INFLS_{i,t}$), X10 is wage ($W_{i,t}$).

variables are the two main variables in this analysis. If the effect is positive it means a structural bonus and if the effect is negative it means a structural burden.

Based on Table 5 in Models 1 and 2, the initial labour productivity variable and the structural change proxy variables consistently show a significant negative coefficient value at α = 1%. The coefficient value of the initial labour productivity variable is significantly negative. It means that the province with the industrial sector's labour productivity higher than 1% in the initial sub-period may have lower productivity growth than other provinces in the same sub-period. It shows that the convergence between provinces is taking place in the average labour productivity growth.

This condition is in line with the exogenous growth theory that various countries (or provinces) with different characteristics will have different growth rates. Countries with lower initial income will grow faster than countries with higher income, *ceteris*

Table 5. Model estimation results of industrial sector's productivity growth

Dependent variable	Estimated coefficient value	
	Model 1	Model 2
Constant	4.052843*** (11.98322)	0.193121 (0.241097)
$Y_{i,t-M}$	-0.781214*** (-12.13188)	-0.60672*** (-12.1371)
$X_{i,t} - X_{i,t-M}$	-0.110918*** (-21.34025)	-0.3914*** (-3.98222)
$X_{i,t-M}$	-0.078727*** (-11.34640)	-0.03984*** (-5.51232)
$INVT_{i,t-M}$		0.315647*** (5.731249)
$\Delta INVT_{i,t}$		0.323694*** (6.249456)
$HC_{i,t}$		0.082766*** (4.172264)
$INFST_{i,t}$		0.245876*** (4.174633)
$FDI_{i,t}$		-4.98E-05*** (-2.87634)
$INFLS_{i,t}$		0.018851*** (15.96546)
$W_{i,t}$		-0.03452 (-1.46147)
R^2 Adjusted	0.875960	0.997631
F-Stat	27.26142*** (0.000000)	737.8775*** (0.000000)

Note: *** significant at α = 1%, ** significant at α = 5%, * significant at α = 10%.

paribus, and vice versa, resulting in the convergence of state revenues (Mankiw, 2006). This condition is known as conditional convergence, which is based on Solow's growth model.

Also in line with the Solow model, Abramovitz (1989) stated that convergence is a process of economic growth in various countries or regions that have different conditions. This convergence can minimise the income gaps, productivity, or other economic indicators that occur between various countries or regions. The concept of convergence can be analogous to its use in labour productivity growth of provincial analysis units that have varied characteristics.

Fagerberg (2000) and Carree (2003) showed the existence of technological convergence between manufacturing industries. Timmer and Szirmai (1999) likewise stated that technological convergence is essential to support productivity growth. Where there are technological gaps between developing countries and developed countries, those developing countries with adequate technological capabilities have good opportunities to pursue technological progress and productivity growth in all manufacturing branches.

The coefficient of industrial sector's labour share variable in the initial sub-period in both Models 1 and 2 is negative and significant (α = 1%), with values of -0.0787 and -0.0398, respectively. If the industrial sector's labour share in the initial sub-period increases by an average of 1%, *ceteris paribus*, then the industrial sector's average labour productivity growth decreases by each variable's coefficient value.

The variable coefficient of change in the labour share in the industrial sector is significantly negative in both Models 1 and 2 with values of -0.1109 and -0.3914, respectively. This shows that if the labour share in the manufacturing sector in the beginning to the end of the sub-period increases by an average of 1%, *ceteris paribus*, then the labour productivity growth of the sector will decrease by the coefficient value. This means that the acceleration of growth in the manufacturing sector has a negative impact on labour productivity growth. In other words, the ability of the manufacturing sector to increase labour productivity has decreased.

According to Hasan, Lamba and Gupta (2014), an economy will grow more when it is driven by a large proportion of its workers. McMillan & Rodrik (2011) agreed that growth can also be driven by a reallocation of workers from low productivity sectors to higher productivity sectors.

Based on the estimation results of the two proxy variables for structural change, it can be said that labour reallocation towards the manufacturing sector in Indonesia has a negative impact on labour productivity growth of the sector. This result is in line with results of the shift-share analysis which shows a negative total dynamic-shift effect (which reflects productivity growth). Thus, it can be said that the reallocation of labour towards the manufacturing sector in Indonesia in aggregate shows the tendency of a structural burden. These results are in line with Carree (2003) and Peneder (2003).

The variable coefficient of total investment at the beginning of the sub-period and the variable coefficient of change in total investment are significantly positive (α = 1%) at 0.315647 and 0.323694. Capital deepening in both the short term and the long term has a positive effect on labour productivity growth in the manufacturing sector. The results of this study are in line with the results of Peneder (2003).

The variable of average length of education coefficient is positive and significant at α = 1% with a value of 0.082766. That is, if the average length of education[4] of workers increases for one year, *ceteris paribus*, then labour productivity growth will increase by 0.08 percent. This is in line with the research results of Fagerberg (2000) and Paus (2004) which showed that education has a significant positive impact on labour productivity growth.

The infrastructure variable coefficient, with the proxy of the provincial road length, is significantly positive at α = 1% with a value of 0.245876. That is, if there is an increase in the provincial road length by an average of 1 percent, it will increase labour productivity growth by an average of 0.25 percent. This result is in line with the study of Abramovitz (1989), Paus (2004) and Timmer and Szirmai (2000).

The variable number of foreign direct investments (FDI), as a proxy for ease of access to technology, shows a significant negative coefficient value of -4.98E-05 at α = 1%. It means that the ease of access to technology along with the increasing number of FDI has a small negative effect on labour productivity growth in the manufacturing sector in Indonesia. The results of this study are in line with the research results of Konings (2001).

The negative influence of FDI is because the number of FDI in Indonesia is still limited and uneven between provinces. Also, the benefits of technological access accompanying FDI are related to the quality of human resources, as stated by Paus (2004). Labour productivity growth in manufacturing sectors with human capital[5] intensive is higher than in manufacturing sectors with intensive labour and intensive resources. Paus (2004) stated that openness to FDI, if not accompanied by adequate development in domestic technological capabilities, does not lead to sustainable productivity growth. The findings concur with Fagerberg, Srholec and Verspagen (2010), Franco, Ray and Ray (2011), Kemeny (2010), and Naude, Szirmai and Lavopa (2013).

The inflation variable coefficient is significantly positive (α = 1%) at 0.0189. That is, if inflation increases by an average of 1 percent, *ceteris paribus*, then labour productivity growth in the manufacturing sector will increase by an average of 0.02 percent. Inflation can have a positive impact on economic performance. The New Keynesian theory shows the dynamics of the aggregate supply curve where there is a positive relationship between price and output (Mankiw, 2006). Inflation reflects an increase in aggregate demand. This increase will encourage companies to increase their production capacity to get higher profits.

In terms of the relatively low inflation rate, inflation is needed to develop the production side. It can encourage the economy to perform better with increasing national income and encourage people to work and invest. Based on data of BPS, the average annual inflation rate in various provinces during the study period ranged from 6.4 percent to 8.8 percent. That is, the inflation rate is considered acceptable. Various studies show that relatively low inflation has a positive impact on growth (Bruno &

[4] Some literature states that the higher the education of a worker, the more skilled they are in managing their work. Workers with higher education are referred to as skilled labour.

[5] In this context, Paus (2004) distinguished between human capital and intensive labour. Human capital is analogous to skilled labour while labour intensive is analogous to unskilled labour.

Easterly, 1998; Christoffersen & Doyle, 2000; Fischer, 1993; Ghosh & Phillips, 1998; Khan & Senhadji, 2001; Sarel, 1996). Each of these results shows a structural break in the relationship between inflation and growth. The structural break shows the threshold of the positive influence of inflation on growth. An inflation value higher than the threshold has a negative effect on labour productivity growth. Although the thresholds differ, researchers agree that excessive inflation can have a negative impact.

The variable wage coefficient is insignificant, because the provincial minimum wage is no more than a reference for employers. Most entrepreneurs pay less than the provincial minimum wage. Although the ILO (2015) stated that workers have a right to the minimum wage, they are vulnerable. About one third of workers receive wages below the provincial minimum wage (ILO, 2015).[6] The initial conditions of productivity growth in each region before the structural change reflect the provincial dummy coefficient values (Table 6).

From Table 6 each province has intercepts which vary compared to the reference province (West Java). That is when other variables are zero, the average growth in labour productivity in each province varies. All provinces show a significant negative dummy coefficient at $\alpha = 1\%$, except Banten, which has a positive non-significant coefficient value. That is, all provinces have different labour productivity growth rates which are relatively lower compared to West Java, except Banten which is no different from West Java. This condition can be understood because West Java and Banten are provinces with similar regional characteristics.

Furthermore, the value of the interaction dummy coefficient as a specific dummy is presented in Table 7. The interaction dummy variable shows the influence of regional characteristics on industrial sector labour productivity. This variable also indicates that each province has specific conditions which in this study are approached through demographic characteristics based on the quality of workforce skills and social values, such as culture and work ethics.

Table 7 shows that twenty-seven of thirty provinces have specific dummy coefficient values that are significant. These coefficients show that the manufacturing sector's labour share change (as a structural change indicator) influences the industrial sector's labour productivity growth in each province.

By adding dummy specific value from each province to the labour share change coefficient from the reference area, the amount of increase or decrease in labour productivity growth will be obtained. Because the positive dummy specific value is lower than the negative value of the labour share change coefficient, it is seen that in twenty-six provinces there is negative productivity growth, that is, productivity growth decreases.

Meanwhile, the productivity growth of Bali Province is significantly positive. It means that the characteristics of Bali may strengthen the influence of structural change on labour productivity growth. Meanwhile, in the other provinces, the regional characteristics may weaken the influence of structural change on labour productivity growth.

[6] ILO (2015) data covers the research period up to 2014.

The largest productivity decrease is in West Java. It is presumably related to the industrial structure characteristics in West Java dominated by resource-based and labour-based industries with a total proportion of up to 56 percent (BPS, 2015). Both industry groups are generally characterised by low productivity, unskilled labour and low-tech industries. Low-tech industries are characterised by labour-intensive and low-capital intensity (UNIDO, 2013). The labour is reallocated from the agricultural to the industrial sector with such majority characteristics as may be unable to encourage an increase in labour productivity growth, and even tend to reduce it. This is in line with the statement by ILO (2013).

Table 6. Provincial dummy coefficient value

Province	Dummy coefficient value	Constant value of West Java province	Difference
NAD	-1.705074***	0.193121	-1.511953
North Sumatera	-1.34598***		-1.152859
West Sumatera	-1.60381***		-1.410689
Riau	-1.561494***		-1.368373
Jambi	-1.459654***		-1.266533
South Sumatera	-1.347587***		-1.154466
Bangka Belitung Islands	-1.007017***		-0.813896
Bengkulu	-1.925237***		-1.732116
Lampung	-1.482271***		-1.28915
DKI Jakarta	-0.885974***		-0.692853
Banten	0.19691		0.390031
Central Java	-0.710421***		-0.5173
Special Region of Yogyakarta	-1.440605***		-1.247484
East Java	-0.910884***		-0.717763
Bali	-1.408158***		-1.215037
West Kalimantan	-1.329224***		-1.136103
Central Kalimantan	-1.887959***		-1.694838
South Kalimantan	-1.80617***		-1.613049
East Kalimantan	-0.839199***		-0.646078
North Sulawesi	-1.760934***		-1.567813
Gorontalo	-1.765867***		-1.572746
Central Sulawesi	-1.944085***		-1.750964
South Sulawesi	-1.622248***		-1.429127
Southeast Sulawesi	-1.860802***		-1.667681
West Nusa Tenggara	-2.098401***		-1.90528
East Nusa Tenggara	-2.836243***		-2.643122
Maluku	-1.528858***		-1.335737
North Maluku	-1.083365***		-0.890244
Papua	-2.336701***		-2.14358

Note: *** Significant at α = 1%.

Table 7. Provincial dummy specific coefficient value

Province	Dummy specific coefficient value	Labour share change coefficient (reference value: West Java province)	Productivity growth Decrease/Increase
West Java		-0.391397***	-0.391397
NAD	0.253885**		-0.137512
North Sumatera	0.340951***		-0.050446
West Sumatera	0.25344**		-0.137957
Riau	0.328906**		-0.062491
Jambi	0.320904***		-0.070493
South Sumatera	0.286117***		-0.10528
Bangka Belitung Islands	0.272044***		-0.119353
Bengkulu	0.257496**		-0.133901
Lampung	0.302418***		-0.088979
Jakarta	0.366263***		-0.025134
Banten	0.354228***		-0.037169
Central Java	0.335522***		-0.055875
Yogyakarta	0.381799***		-0.009598
East Java	0.300189***		-0.091208
Bali	0.467006***		0.075609
West Kalimantan	0.323097***		-0.0683
Central Kalimantan	0.231934*		-0.159463
North Sulawesi	0.290337***		-0.10106
Gorontalo	0.217829*		-0.173568
Central Sulawesi	0.23097**		-0.160427
South Sulawesi	0.322884***		-0.068513
Southeast Sulawesi	0.238128**		-0.153269
West Nusa Tenggara	0.302805***		-0.088592
East Nusa Tenggara	0.307648**		-0.083749
Maluku	0.293807***		-0.09759
Papua	0.279369***		-0.112028

Note: *** = significant at α = 1%, ** = significant at α = 5%, * = significant at α =10%.

The highest productivity increase occurred in Bali, that is, the reallocation of labour from the agricultural sector towards the manufacturing sector increases the productivity of its labour. The manufacturing sector in the province is supported by the development of the tourism sector, as well as by the cultural characteristics of the Balinese people who are predominantly Hindu with a high culture of creativity known as "Rasa Jengah" (Suda, 2016).

The low labour productivity of the manufacturing industry in almost all provinces is due to it being resource-based and labour-intensive. Sixty-eight percent of the total industries between 1990 and 2014 absorb 72 percent of the workers (BPS, 1990-2014). Most workers are unskilled and the need for capital is lower. Besides that, industrial

development in Indonesia, especially for industries that require more specific labour qualifications and more advanced technologies, faces the obstacle of job-skill mismatch.

The presence of regional characteristics also contributes to the low labour productivity of the manufacturing sector in Indonesia. The regional characteristics are: first, limited labour skills, and second, cultural work ethics. Most workers do not inherit a productive working culture, and an understanding associated with a positive working culture within an organisation or company is still unusual.

6. Conclusion

The structural change in Indonesia does not increase labour productivity in the industrial sector. Both the shift-share and econometric analysis reveals that structural change tends to be a burden holding back labour productivity growth in the industrial sector. Investment variables, human capital, infrastructure and inflation have a significant positive effect on labour productivity growth but the number of FDI has a significant negative impact, while wages have an insignificant impact.

This study has limitations. First, the shift-share model analyses only the supply side; it does not consider the demand side. Second, this study calculates only the shift between economic sectors. Further research is necessary to consider the demand side and decompose the shift-share analysis in the manufacturing sub-sector so that the effect of labour reallocation is known in more detail.

This study implies that to increase labour productivity growth in the manufacturing sector, the structural changes must be supported by government policies that improve the quality of human resources such as facilitating access to higher education for the wider community and providing better infrastructure such as increasing budget allocations to provide more paved roads in each province. Besides that, optimal policy support is needed to maintain macroeconomic stability by controlling the inflation rate. Thus, conducive conditions will encourage capital accumulation through various investment activities including FDI.

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