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Revitalizing Indonesia's manufacturing: the productivity conundrum

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Abstract

In light of continuing importance of the manufacturing sector, but declining dynamism, this paper investigates trends in productivity at firm levels. It finds that labour productivity has been either stagnant or falling in labour intensive manufacturing. The paper uses firm level cross-sectional and time series data and employs GMM techniques to estimate determinants of productivity. It finds that real wage is the most important variable that influences firm level productivity, followed by capital intensity. Contrary to the common perception, foreign ownership and export-orientation are not found to have statistically significant influence on firm level productivity. This finding is consistent for firms of all sizes – large, medium, small and micro. This implies that Indonesia can use wages policy, as Singapore did during the late 1970s-mid 1980s, to upgrade its manufacturing to higher value added activities.

Keyword: manufacturing, productivity, firm-size, real wage, GMM

JEL classification: E24; J24; J38; O14; O53

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Revitalizing Indonesia's manufacturing: the productivity conundrum

I. Introduction

The manufacturing sector has been the main driving force in Indonesia's transformation until the 1997 Asian Financial Crisis (AFC) with an average annual growth of around 9 per cent during 1970-1997, higher than the economy-wide average growth of around 6.5 per cent. However, manufacturing seems to have lost its dynamism during the post-crisis period. Its average annual growth rate declined to 4.9 per cent during 2003-2015 when the economy grew at an average annual rate of 5.6 per cent. The persistent decline in relative importance of the manufacturing sector has led a number of observers to note a case of premature de-industrialization in post-crisis Indonesia.[2] In fact, one study identified the beginning of the decline in traditional manufacturing competitiveness even few years before the onset of the crisis (Dhanani 2000). The post-crisis manufacturing growth has also been labelled as jobless growth as the sector experienced the steepest decline in employment-to-output elasticity relative to other economic sectors (Aswicahyono, Hill and Narjoko 2011, 2013; Tadjoeddin and Chowdhury 2012; Narjoko and Putra 2015; Yusuf et al. 2013).

Recent data on Indonesia's exports by ISIC also point to manufacturing sector's declining relative position. In 2009, manufacturing products contributed to almost 63 per cent to the total export and this figure dropped to around 59 per cent in 2012 and 2013. Meanwhile, the share of non-manufacturing export increased from 37 per cent in 2009 to over 42 per cent in 2012.

The above developments have been summarized in the latest assessment of the World Bank in the following words:

> Indonesia's manufacturing growth experienced a structural break following the 1997/98 Asian financial crisis. Real manufacturing growth plummeted from 11 percent annually between 1990 and 1996 to 4.8 percent in the period from 2001 to 2014. … and the country experienced a "premature deindustrialization". Following a rapid rise in the 1990s, the share of manufacturing in total output has fallen sharply since 2005, giving way to a rapid expansion of low-end services absorbing labor released from rural activities…. [T]his structural change occurred at a low level of per capita income and before industrialization reached maturity, reflecting a premature "de-industrialization. (World Bank 2016, p. 27)

However, despite the reversing trend, the manufacturing sector continues to play an important role in the Indonesian economy. Furthermore, the need to revitalize the Indonesian manufacturing sector has been advocated by all quarters (e.g., World Bank 2012a, World Bank 2012b, ADB 2013).

[2] See Aswicahyono, Hill and Narjoko (2013), Naude (2013) and Raz (2013) and World Bank (2016). Concerns on the de-industrialization have also been featured in popular media, among others, see *Bisnis Indonesia*, 4 February 2015 (Pertumbuhan Industri Gagal Capai Target, Gejala Deindustrialisasi?), *Bisnis Indonesia*, 7 May 2014 (Deindustrialisasi Kembali Intai Indonesia), Koran Tempo, 7 November 2013 (Indef: Indonesia Terjebak Deindustrialisasi), *Kompas*, 22 December 2010 (LIPI: Indonesia Menuju Deindustrialisasi).

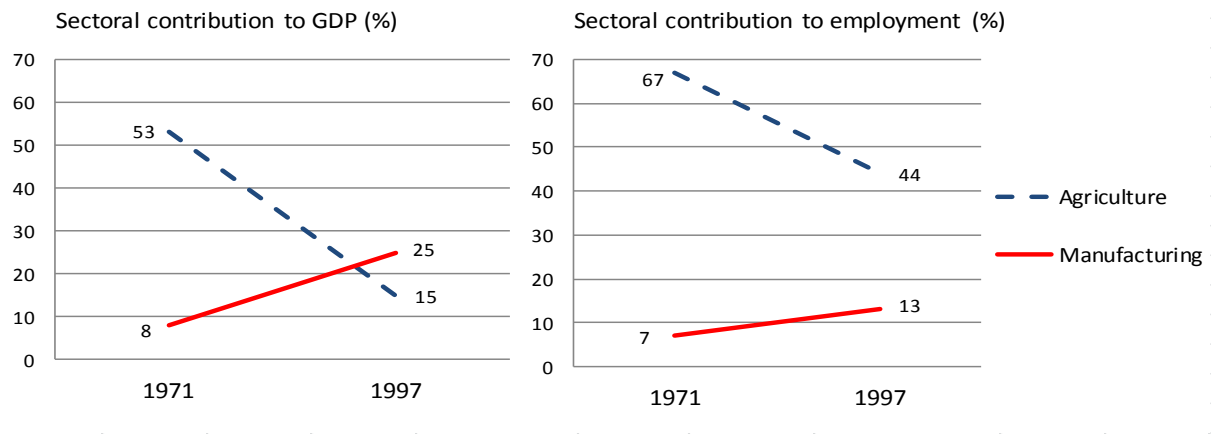
This is because of an overarching argument that 'manufacturing offers greater opportunities for job creation (in terms of quantity and quality), facilitates positive structural transformation, exhibits higher labour productivity than other sectors, provides an important conduit for social upgrading and promotes opportunities to close the gender gap.' (World Bank 2012a, p. 3). Asian Development Bank also stresses the importance of manufacturing in the context of structural transformation of the economy as industrialization is a step that, in general, is difficult to bypass on the path to becoming a high-income economy (ADB 2013).

In light of the above, this paper will attempt to investigate the proximate causes of manufacturing sector's relative decline. In particular, it will look at productivity trends within the manufacturing sector by firm size and some key characteristics, such as factor intensity, ownership (foreign) and export orientation. It is possible to analyse productivity trends and investigate factors driving these trends at a disaggregated level due to availability of two sources of firm level data for the manufacturing sector: the long standing Large and Medium Manufacturing Survey (*Survei Industri Besar dan Sedang*) and the newly introduced Micro and Small Manufacturing Survey (*Survei Industri Mikro dan Kecil*). The paper is organized as follows: Section II reflects on the "de-industrialization" phenomenon; section III examines the transformation or dynamism of the manufacturing sector; section IV discusses productivity trends within manufacturing; section V presents results of econometric exercises for the determinants of firm level productivity. Section VI contains concluding remark, highlighting policy implications.

II. Structural transformation and "de-industrialization" of the Indonesian economy

During the three decades prior to the Asian financial crisis, the Indonesian economy was following the classical route of structural transformation from agriculture to manufacturing. Figure 1 depicts the transformation during 1971-1997. As can be seen, the agricultural sector's contribution to overall GDP dropped sharply from 53 per cent to only 15 per cent, while the manufacturing sector's share in the overall GDP jumped from 8 per cent to 25 per cent during 1971-1997. Commensurate with this shift, the respective shares of agriculture and manufacturing in total employment also changed, albeit slightly slowly – falling from 67 per cent to 44 per cent in the case of agriculture and rising from 7 per cent to 13 per cent in the case of manufacturing.

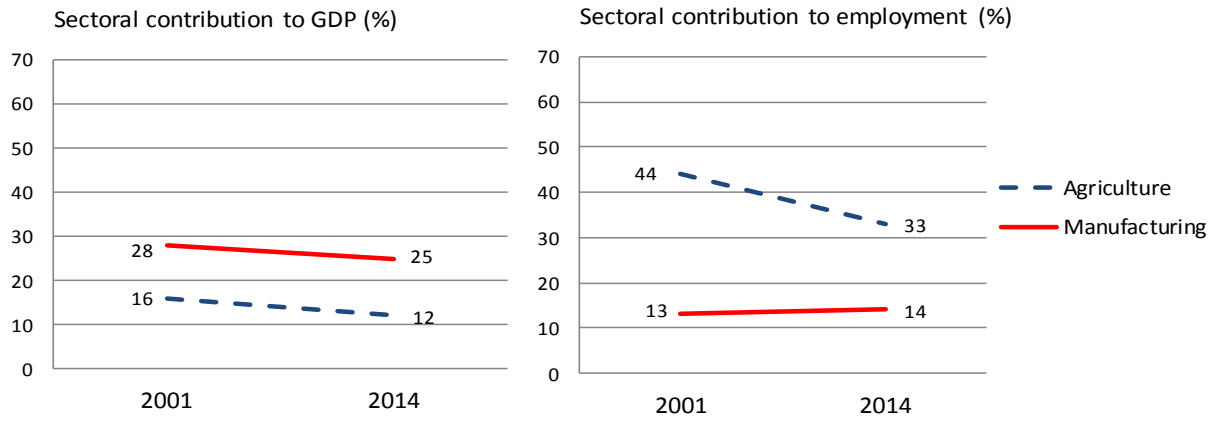
Figure 1: Structural transformation, 1971 and 1997



Source: Calculated from Statistics Indonesia (BPS) data (National Income Account[3] and National Labour Force Survey/Sakernas[4]).

This trend of structural transformation has changed during the post-crisis period (2001-2014) when the GDP and employment shares of the agricultural sector continued to decline as expected, but the manufacturing sector's contribution to GDP fell from 28 per cent to 25 per cent. Manufacturing sector's contribution to employment was relatively stagnant, barely increased from 13 per cent to 14 per cent (Figure 2). Thus, Indonesia seems to be experiencing a process of de-industrialization. The term of de-industrialization refers to the declining shares of either manufacturing sector's GDP or employment in the overall economy (Tregenna 2013).

Figure 2: De-industrialization, 2001 and 2014



Source: Calculated from BPS data

[3] Statistics Indonesia (BPS) has regularly published the *National Income Account* yearly and quarterly since the mid-1970s. In addition, BPS also publishes regional income account at provincial and district levels.

[4] The Sakernas was initiated in 1976 to cover national labour market characteristics of all working age individuals within sampled households. However, it was regularly conducted on regular basis only since 1986. It was conducted on quarterly basis (1986–93), annually (1994–2004), biannually (2005–10) and again quarterly (2011 onwards). The August Sakernas has the largest sample size of around 200,000 households. Furthermore the survey quality has been constantly improved.

De-industrialization is a natural process of development. Rowthorn and Ramaswamy (1997) argued that de-industrialization in advanced economies is not a negative phenomenon, but a natural consequence of further growth. The main reason for de-industrialization is the faster growth of productivity in manufacturing than in services. This is labelled as positive de-industrialization. Rowthorn and Wells (1987, p. 5) defined positive deindustrialization as:

> '… the normal result of sustained economic growth in a fully employed, and already highly developed, economy. It occurs because productivity growth in the manufacturing sector is so rapid that, despite increasing output, employment in this sector is reduced, either absolutely or as a share of total employment. However, this does not lead to unemployment, because new jobs are created in the service sector on a scale sufficient to absorb any workers displaced from manufacturing. Paradoxically, this kind of de-industrialization is a symptom of economic success.'

On the other hand, negative de-industrialization is 'a product of economic failure and occurs when industry is in severe difficulties … labour shed from the manufacturing sector—because of falling output or rising productivity—will not be reabsorbed into the service sector. Unemployment will therefore rise.' (Rowthorn and Wells 1987, p. 5).

Aswicahyono, et al. (2013), however, advanced the idea that the Indonesian economy seems to be experiencing 'premature' de-industrialization that the Indonesian economy passed the peak of manufacturing industry's contribution to the overall GDP at around 28 per cent, which is quite low. In advanced economies, the peak of manufacturing sector's contributions to GDP was achieved in 1960s and the turning point was were much higher, e.g., around 36 per cent in Japan and 32 per cent in the European Union; the average for industrial countries was 30 per cent (Rowthorn and Ramaswamy 1997). More importantly, at the peak of the industrialization in advanced economies, the employment share of the manufacturing sector was more or less comparable to the sector's share of GDP. In Indonesia, employment share of the manufacturing sector is far lower than its share in GDP, indicating the failure of this sector in absorbing surplus labour from the agricultural sector, *a la* the Lewis (Lewis 1954) model. The majority of the 9.4 percentage points decline of agriculture's employment share was absorbed by the *service* sector (4 percentage points), *construction* sector (2.2 percentage points), trade sector (2.5 percentage points). The manufacturing sector which is supposed to be more dynamic did not absorb any.

Thus, Indonesia's manufacturing sector during the past decade resonates with the negative de-industrialization scenario.[5] A further indication of negative de-industrialization is manufacturing sector's slow productivity growth. During 2001-2014, the manufacturing sector's productivity growth was only 3.7 per cent, below that of agriculture and trade (4.6 per cent and 4.5 per cent respectively),

[5] A similar argument is also put forward by Priyarsono, Lestari and Dewi (2010).

and less than the overall productivity growth of the economy (4.6 per cent), see Table 1. Services and construction were two sectors with productivity growth at only 1.7 per cent and 2.1 per cent respectively, much lower than the overall productivity growth of the economy. The service sector's slow productivity growth indicates that post-crisis Indonesia has aborted the historical path of structural transformation (*a la* Chenery, 1960 and Kuznets, 1971) that advanced countries, including the newly industrialized ones, followed, where the high productivity services sector took over the dynamism from the manufacturing sector.

Table 1: Sectoral GDP, employment and productivity, 2001 and 2014

	2001		2014		Productivity growth	Change in employment share (% point)
	% Employment	% GDP	% Employment	% GDP	(% annual)	
Agriculture	43.8	15.5	34.0	12.1	4.6	-9.8
Mining	1.0	11.7	1.3	6.7	-1.8	0.2
Manufacturing	13.3	27.7	13.3	25.5	3.7	0.0
Electricity	0.2	0.6	0.3	0.8	1.6	0.1
Construction	4.2	5.6	6.4	6.7	2.1	2.1
Trade	19.2	16.2	21.7	18.0	4.5	2.4
Transportation	4.9	4.9	4.5	10.9	22.6	-0.4
Finance	1.2	8.6	2.6	9.9	-1.0	1.4
Services	12.1	9.3	16.1	9.4	1.7	4.0
Total	100	100	100	100	4.6	0.0

Source: Calculated from BPS data.

Paradoxically, however, the manufacturing sector remains the most important sector in the Indonesian economy, despite apparent de-industrialization. During 2001-2014, among the nine economic sectors, the manufacturing sector recorded the highest contribution (25.5 per cent) to the overall GDP and the main engine of growth with the largest contributor (23 per cent) to the overall GDP growth. Nevertheless, the sector's importance in terms of employment contribution was much less. As mentioned earlier, the post-crisis manufacturing growth has been labelled as jobless.

Further analyses show how depressed is the manufacturing sector in post-crisis Indonesia. The following three arguments are in order. *First*; manufacturing sector's contribution to regular waged-employment has significantly declined – from 18.6 per cent in 2001 to 23.8 per cent in 2014, while the contribution to the overall employment remained unchanged in 2014 at 13.3 per cent (Table 2). Note that regular waged-employment accounts for more than 90 per cent of formal employment.

Second; consistent with the above trend, there has been an increase in the level of casualization of the employment in the manufacturing sector. Between 2001 and 2014, the share of casual employment in the manufacturing sector increased from 3.1 per cent to 5.1 per cent.[6]

Table 2: Regular waged-employment: sectoral share and wage index, 2001-2014

	Total employment share (%)		Regular waged employment share (%)		Wage index of regular-waged employment (Indonesia = 100)	
	2001	2014	2001	2014	2001	2014
Agriculture	43.8	34.0	10.6	7.9	60	66
Mining	1.0	1.3	1.5	1.9	146	177
Manufacturing	*13.3*	*13.3*	*28.6*	*23.8*	*88*	*89*
Electricity	0.2	0.3	0.4	0.6	147	134
Construction	4.2	6.4	7.3	6.8	87	95
Trade	19.2	21.7	11.4	15.5	83	80
Transportation	4.9	4.5	5.6	5.4	115	120
Finance	1.2	2.6	3.8	5.9	161	143
Services	12.1	16.1	30.8	32.2	122	111
Total	100	100	100	100	100	100
Inter-sector wage inequality (CV)					0.348	0.345

Source: Calculated from the Sakernas.

Third; the real wages of regular employees in the manufacturing sector was under relative depression vis-à-vis other sectors. The last two columns in Table 2 present wage index across sectors by assigning the value of 100 for the average wage. The wage index of the manufacturing sector remained virtually unchanged between 2001 and 2014, after declining in 2012, while the level of wages in the sector was below the average wages of all regular employees. More disturbingly, the divergent pattern of the manufacturing wages was being observed when wages were converging across sectors as indicated by the declining trend of the coefficient of variation of sectoral wages.

The argument for reversing the trend of negative de-industrialization, or a case for re-industrialization, has been widely advocated on the ground that the manufacturing sector in Indonesia has not matured yet. The problems lie with the fact that the Indonesian manufacturing sector seems to have failed to move to a higher level and diversify into more sophisticated manufacturing activities

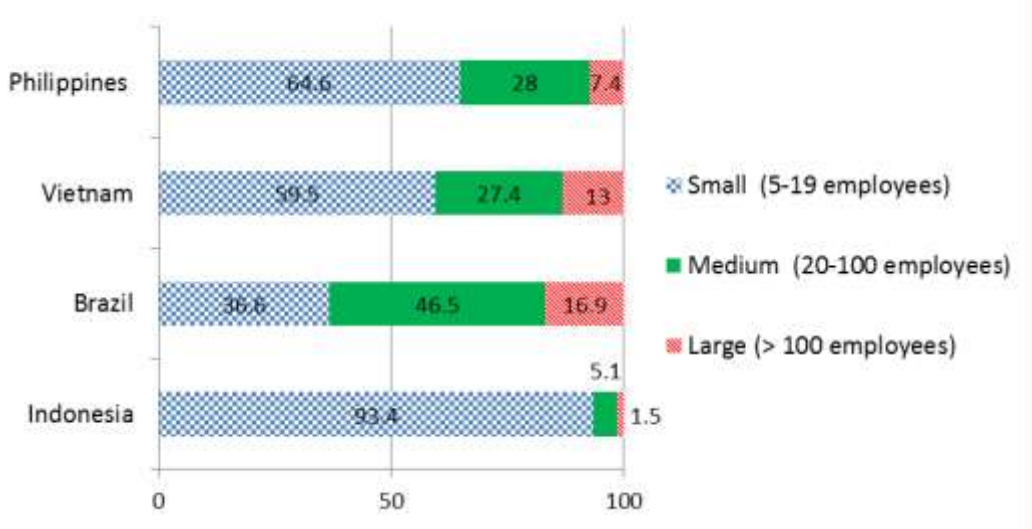
[6] Matsumoto and Verick (2011) also argued for the increased of casualization of employment in the Indonesian economy, but they did not provide disaggregated analysis into the sectoral level. The category of casual employment was introduced for the first time in the 2001 National Labour Force Survey (Sakernas), prior to that, it was part of regular wage employment.

beyond the traditional resource-based and labour intensive industries. On a smaller note, the recent policy attention to the creative industry is also a step in the right direction.[7]

III. Transformation of manufacturing

This section looks at the characteristics of Indonesia's manufacturing sector and its transformation. Indonesian manufacturing sector has been characterized with a severe imbalance. It has a disproportionately large presence of small firms, relative to other developing countries (Figure 3). This phenomenon is known as the 'missing middle' with a large portion of small firms, and a comparatively small number of middle-sized firms transitioning from small into large. Anas (2013) finds that the 'missing middle' situation is also observable in the Indonesian manufacturing exports.

Figure 3: Distribution of manufacturing firms by size, 2008



Source: World Bank, Enterprise Survey 2008, quoted from World Bank (2012a:8)

Table 3 shows the relative position of large-medium (LM) and small-micro (SM) manufacturing activities. Following the Statistics Indonesia definition, large firms have 100 workers or more, medium firms have 20-99 workers, small firms have 5-19 workers and micro firms have less than 5 workers. As can be seen, in terms of employment, SM firms dominate the manufacturing sector. They contribute 44 per cent to manufacturing output and their employment share increased from 64 per cent in 2001 to 68 per cent in 20011. The value added share of LM firms in overall manufacturing industry stagnated at 56 per cent, while their share in manufacturing employment declined from 36 per cent to 32 per cent during (2001-2011).

[7] South Korea is an excellent example for the case of the development of creative economy after the country has been successful in catching up the industrial developments of Japan, North America and Western Europe. The newly elected Korean President laid down a vision of creating a 'Second Miracle on the Han River' through the development of a 'creative economy' in her February 2013 inaugural address (Connell 2013).

Table 3: Employment and value added shares of LM and SM firms

	Manufacturing Employment share (%)		Manufacturing Value added share (%)	
	2001	2011	2001	2011
Large-medium	36	32	56	56
Small-micro	64	68	44	44
Total	100	100	100	100

Source: Calculated from BPS data.

Table 4 Shows that the manufacturing sector has not transformed much in recent years. For example, the share of labour-intensive food, textile, wood and paper in MVA remained almost unchanged during 2010-2014, after significantly declining between 2000 and 2010 (from around 60 per cent to 47 per cent). Their share in MVA was around 46 per cent in 2014. On the other side of the transformation picture, the share of capital-intensive activities (chemical, non-metalic mineral, basic metal, fabricated metal) in MVA increased dramatically from 39.6 per cent in 2000 to 52.1 per cent in 2010; but then remained virtually unchanged (53.2 per cent in 2014) since then. Thus, it seems that the manufacturing sector's transformation from labour-intensive activities to capital-intensive activities stalled in recent years.

Table 4: Manufacturing value added by sub-sectors (%)

	2000	2010	2014
31. Food	33.8	29.1	29.8
32. Textile	13.7	9.5	9.1
33. Wood	6.1	3.5	3.1
34. Paper	6.0	5.0	4.2
35. Chemical	13.0	13.2	12.4
36. Non-metalic mineral	3.1	3.0	2.8
37. Basic metal	2.8	1.4	1.5
38. Fabricated metal	20.7	34.5	36.5
39. Other manufacturing	0.8	0.7	0.6
All manufacturing (non-oil gas)	100	100	100

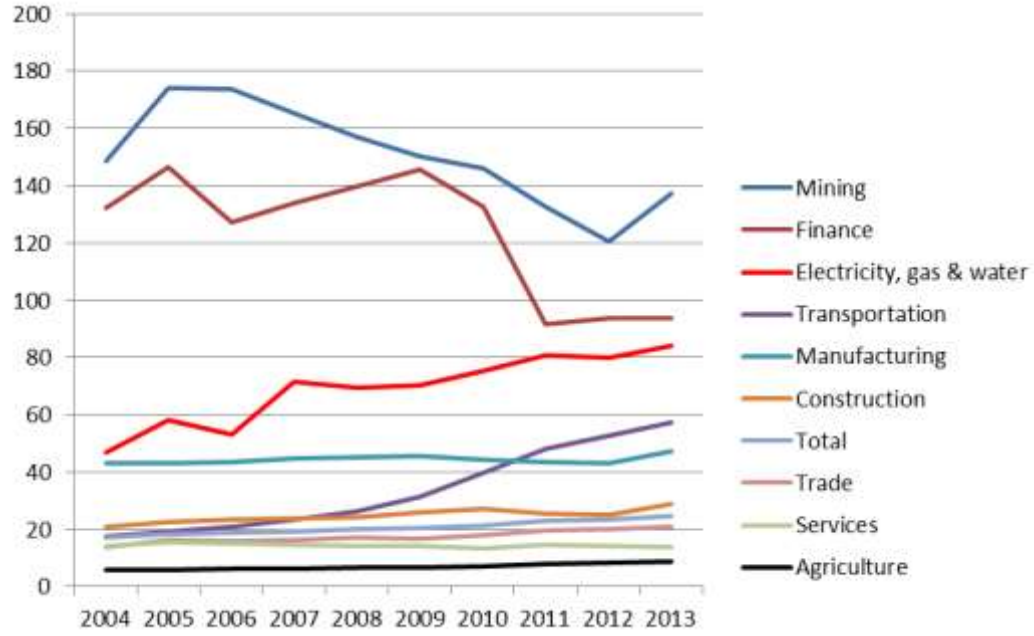
In order to understand the sector's dynamism, the next section examines productivity trends in manufacturing.

IV. Productivity trends in manufacturing

Labour productivity is generally understood as total value added (output) per employee. In developed economies with more sophisticated available data, productivity is measured as value added per worker per hour of work (Sharpe, Arsenault and Harrison 2008). In the Indonesian context, however, differences in hours of work between workers are difficult to factor in.

Labour productivity of the manufacturing sector is roughly twice of labour productivity in the overall economy (Figure 4). But labour productivity in manufacturing remained stagnant and below mining, EGW, finance and transport-construction sectors. Interestingly, the only sector that experienced rising productivity is the non-tradable transport-construction.

Figure 4. Labour productivity (IDR Million, 2000 constant price, GDP deflator)



Source: Calculated from BPS data (Sakernas and National Account)

To understand manufacturing's productivity stagnation, we have disaggregated data by firm size and factor intensity. According to employment size, firms are categorized into large, medium, small and micro. There are two sources of firm level data for the manufacturing sector: the long standing Large and Medium Manufacturing Survey (*Survei Industri Besar dan Sedang*) and the newly introduced Micro and Small Manufacturing Survey (*Survei Industri Mikro dan Kecil*). Statistics Indonesia publishes aggregate data on employment and value added disaggregated at ISIC 2 level. Furthermore, the ISIC 2 manufacturing sub-sector can be aggregated into three categories of factor intensity: labour intensive, resource intensive and capital intensive. Table 5 details the grouping of ISIC 2 sub-sectors into three categories of resource intensity following the approach of Aswicahyono, Hill and Narjoko (2010).

Table 5: The grouping of ISIC 2 manufacturing sub-sector based on factor intensity

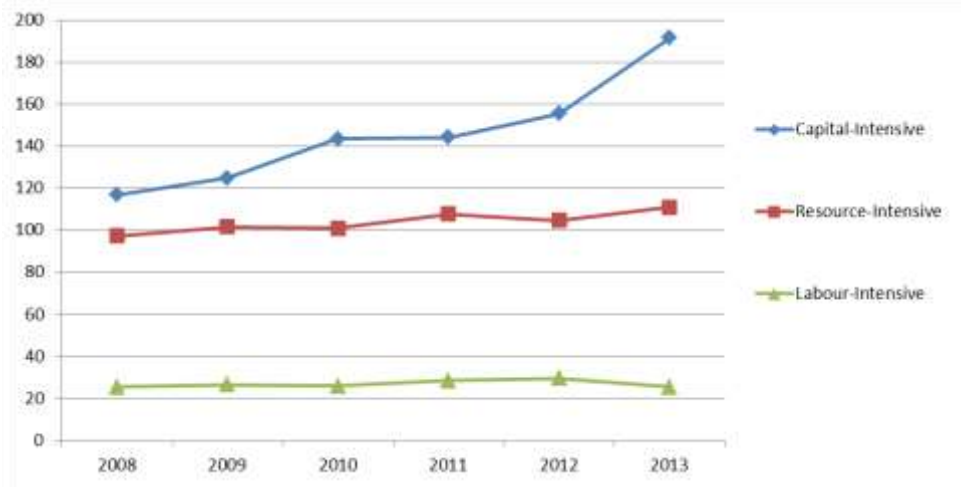
ISIC 2	
	Labour Intensive
13	Manufacture of textiles
14	Manufacture of wearing apparel
15	Manufacture of leather and related products
16	Manufacture of wood and of products of wood and cork, except funiture
31	Manufacture of furniture
32	Other manufacturing
33	Maintenance and repair of machinery and equipment
	Resource Intensive
10	Manufacture of food products
11	Manufacture of beverages
12	Manufacture of tobacco products
17	Manufacture of paper and paper products
18	Printing and reproduction of recorded media
19	Manufacture of coke and refined petroleum products
20	Manufacture of chemicals and chemical products
21	Manufacture of basic pharmaceutical products and pharmaceutical medicine
22	Manufacture of rubber and plastics products
	Capital Intensive
23	Manufacture of other non-metallic mineral products
24	Manufacture of basic metals
25	Manufacture of fabricated metal products, except machine
26	Manufacture of computer, electronic and optical products
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment n.e.c.
29	Manufacture of motor vehicles, trailers and semi-trailers
30	Manufacture of other transport equipment

Large and medium (LM) firms

We begin with disaggregated productivity data for the LM firms by factor intensity. The productivity data are presented in IDR million per year in 2000 constant prices, where the nominal value is adjusted with GDP deflator of non-oil-gas manufacturing sector.

Figure 5 shows that among the labour intensive firms productivity is the lowest and stagnating, (and falling in recent years). The levels of productivity are the highest among capital intensive firms, and rising followed by firms belonging to resource intensive categories.

Figure 5. Productivity in Large-Medium firms (manufacturing), IDR million, 2000 constant price, GDP deflator.



Source: Calculated from BPS data

Micro and small firms

Tables 6a and 6b present productivity data of micro and small firms disaggregated into the three factor intensity categories (labour, resource and capital). One characteristic of micro and small firms relates to their informality, where significant portions of their employment are unpaid workers.

Table 6a. Productivity: Micro firms (IDR million, 2000 constant prices, GDP deflator)

	2010	2011	2012	2013	2014
Labour intensive	4.2	1.0	3.5	4.0	5.9
Resource intensive	6.1	0.8	3.5	3.9	4.9
Capital intensive	5.8	1.5	5.6	5.6	8.3

Source: Calculated from BPS data

Table 6b. Productivity: Small firms (IDR million, 2000 constant prices, GDP deflator)

	2010	2011	2012	2013	2014
Labour intensive	13.4	2.2	6.9	10.0	15.5
Resource intensive	9.2	1.8	9.1	10.2	11.6
Capital intensive	12.0	1.8	7.2	11.1	14.6

Source: Calculated from BPS data

The following anomaly is noticeable in the productivity data of both micro and small firms presented in Tables 6a and 6b. The productivity levels of micro and small firms in 2011 were far lower than other years (2010, 2012 and 2014). Such significant drop could only be explained by irregularities in the 2011 data. Nevertheless, a quick comparison between 2010 and 2014 data reveals a broad trend of increasing levels of productivity in micro and small firms across the three categories of factor intensity. It has to be noted that, however, most of micro firms operate in the informal sector, and the

majority of their workers are unpaid. Jobs in micro firms are not regular wage jobs, but largely categorized as self-employed involving family members in running their micro firms.

The above diagnostic of firm level data indicates that the stagnating productivity in the overall manufacturing sector is due to stagnating and/ or falling productivity of labour intensive large-medium firms. Figures 6a and 6b show that labour productivity in major labour-intensive sub-sectors (food, beverages and tobacco industries, and Textile, Leather Products and Footwear Industries) has been falling.

Figure 6a: Labour productivity (sub-sector: food, beverages and tobacco industries)
IDR million/year/worker, 2000 constant prices

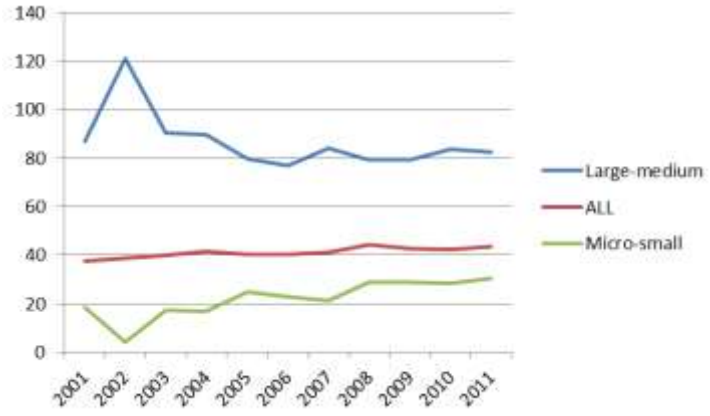
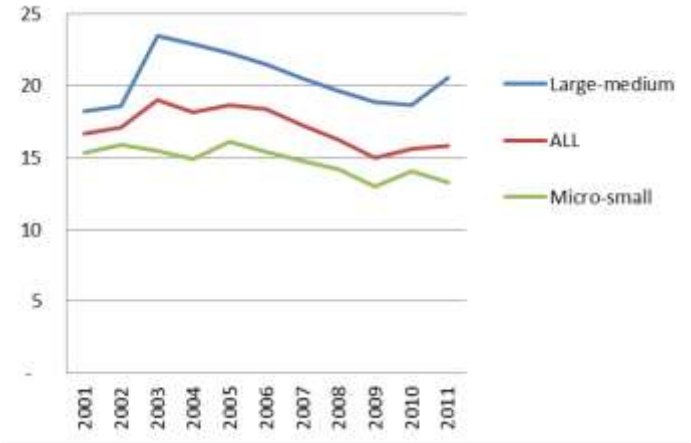


Figure 6b: Labour productivity (sub-sector: Textile, Leather Products and Footwear Industries)
IDR million/year/worker, 2000 constant prices



V. Productivity and firms characteristics – an econometric investigation

In this section, we intend to investigate, using an econometric model, determinants of productivity. Again, this section is divided into two parts: large-medium firms and small-micro firms.

Large and Medium firms

It is hypothesized, following the efficiency wage theory, that productivity is driven by wage. That is, firms faced with the asymmetry of information regarding workers' efforts, pay higher than market clearing wage. Workers, in return, feel more loyal and devote to the company. With a higher wage, they may also fear losing their job if caught shirking and may not get another with a similarly higher pay. So they are likely to work harder. Therefore, although the firm pays more, they get more productivity from their workers. Following the general belief, we also assume that capital-intensity, export-orientation and foreign ownership would have positive impacts on productivity. To remain competitive in the international market, export-oriented firms must improve their productivity. Due to access to better technology and management practices, foreign firms are likely to have higher productivity. Thus, our productivity function for Large and Medium firms is as follows:

$$\ln PROD_{it} = \alpha_0 + \alpha_1 \ln PROD_{it-1} + \alpha_2 \ln RW_{it} + \alpha_3 \ln CAP_{it} + \alpha_4 EXPORT_{it} + \alpha_5 FOREIGN_{it} + u_i + \varepsilon_{it} \qquad (1)$$

PROD represents labour productivity, RW stands for real wage, CAP denotes capital intensity per worker, EXPORT stands for percentage of exported output to total value of firm output and FOREIGN denotes percentage of foreign investment to total firm investment. The lag dependent variable is included to capture path dependence or the dynamic nature of overtime progress of wage and productivity, meaning that current realizations of the dependent variable is influenced by its past value. The remaining components in the model are the error terms: u_i represents time-invariant heterogeneity across firms and $\varepsilon_{i,t}$ is the time-variant error term. The relationship between wages and productivity is denoted by α_2 in the form of elasticity. Assuming that α_2 is positive, productivity (PROD) will increase by α_2 per cent if real wages (*RW*) increases by 1 per cent. The same is true for the variable of capital intensity (CAP).

The productivity function is estimated with dynamic panel data (DPD) regression of difference GMM (generalized method of moment) that is suitable for situations with "small T, large N" panels, meaning few time periods and many individual firms (Roodman 2006). In the GMM model, by default, the lag dependent variable is included as an independent variable in each regression. The choice of difference GMM implies that the firm-fixed effects have been controlled for. In addition to this, we also include year-fixed effects to the estimations in order to net out from the estimates the effect of common time shocks on firms' productivity.

In estimating panel data, two options are available, the static one, either fixed or random effects, and the dynamic one, which is called generalized method of moment (GMM). The inclusion of a lagged dependent variable (lagged productivity) as one of our explanatory variables makes our model

dynamic; however, the inclusion of a lagged dependent variable as a regressor may cause the problem of serial correlation. More importantly, the model may suffer from the problem of acute endogeneity between the dependent variable and the regressor (in this case between productivity and wages) since causality may run in both directions. A popular remedy for the endogeneity problem is to find instruments that correlate with the endogenous independent variables but are uncorrelated with the dependent variable. The GMM regression technique offers remedies to these problems by drawing instruments from within the dataset using lagged variables.[8] In running the GMM, the real wage (RW) variable is specified to be endogenous.

The consistency of GMM estimator depends on the validity of the assumption that the error terms do not display serial correlation and on the validity of the instruments. Two specification tests are used to deal with the problems (Arellano and Bond 1991; Arellano and Bover 1995; Blundell and Bond 1998). The first is Arellano-Bond test that examines the hypothesis that the error terms are not serially correlated. The second is a Sargan test of over-identifying restrictions, which tests the overall validity of the instruments. Failure to reject the null hypotheses of both tests provides support to our model specifications. Non-stationarity is not a big concern for panel data with small T (time periods).

Having foreign ownership and export orientation as independent variables could be problematic because the two could be positively related, as found by Ramstetter and Takii (2006) in pre-crisis Indonesia and Fu, Wu and Tang (2010) in China. We have checked for this possibility and confirmed that foreign ownership is not a significant determinant of firm exports during the period of our analysis (2008-13) across firm size and factor intensity using dynamic panel estimation.[9]

Our unit of analysis is manufacturing firm from the six series (2008-2013) of Large and Medium Manufacturing Survey annually conducted by the BPS-Statistics Indonesia. We construct a balance panel of manufacturing firms during the period meaning that we exclude firms that are not present for the whole period due to entry and exit. Dealing with this, we check for the selection bias by performing seemingly unrelated estimation (Suest) test.

Table 7 presents the robust one-step regression results for determinants of productivity in LM firms as formulated in equation (1). As can be seen, real wage exerts more influence than any other variables on productivity across the board – for both in large and medium firms as well as in labour-, capital- and resource-intensive firms. Elasticities of real wage with respect to productivity are much higher and statistically significant at 1 per cent level. Contrary to the general perception, neither export-orientation nor foreign ownership is found to play a significant role. This also contrasts the situation prior to the Asian Financial Crisis of the late 1990s, when productivity gains of export

[8] See Roodman (2006) for more discussions on the application of GMM.
[9] Detail results are available from authors.

orientation and foreign ownership were significant. As expected capital intensity has positive and statistically significant effect on productivity. A point to note is that the effect of capital intensity on labour productivity in large firms is nearly twice as that of medium firms.

Table 7. Determinants of labour productivity (Difference GMM regression)

		Firm size		Factor intensity		
Variable	All	Medium	Large	Labor	Resource	Capital
Ln productivity (lag)	.271***	.15***	.309***	.203***	.319***	.266***
Ln Real wage	.134***	.121***	.142***	.101***	.139***	.236***
Ln capital intensity	.078***	.053**	.094***	.051***	.115***	.066*
Export orientation	-6.80E-05	6.30E-04	-4.80E-04	-3.60E-04	1.20E-04	-1.70E-04
Foreign investment	3.00E-04	-9.40E-04	7.10E-04	9.30E-04	-1.20E-03	1.80E-03
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	6819	2825	3994	3312	2287	1220
No. of firms	2143	1005	1394	1051	759	390
No. of instruments	29	29	29	29	29	29
AR(2), P-value	0.6760	0.2807	0.4700	0.2807	0.1558	0.8522
Sargan test, P-value	0.0012	0.0005	0.0314	0.0000	0.0840	0.2155

Notes: ***, ** and * indicate 1%, 5% and 10% levels of significance respectively. Each regression is with a constant and robust standard errors.

All our regressions in Table 7 survive the Arellano-Bond test. For the Sargan test, however, only two (resource intensive and capital intensive) out of the six regressions pass the test at 5 per cent level of significance. We rerun the other four regressions with fixed-effect estimation with the inclusion of time fixed-effects without lag dependent variable and we obtain consistent results.[10] But the coefficients of real wage from the GMM regressions tend to be smaller than the coefficients from the fixed-effects regressions.

In order to check a possible selection bias due to the exclusion of newly listed firms and those which exited the market and the inclusion of only the firms that form a balance panel dataset during the observation years of 2008-2013, we perform the seemingly unrelated estimation (Suest) test. OLS regressions are run for equation (1) for the whole survey sample and for only firms included in the balance panel for each observation year. Then, the coefficients of independent variables of the two sample groups (all and selected) are systematically compared. The Suest test is highly significant in three out of six observation years indicating the general presence of selection bias; however the bias

[10] Detail results are available from authors.

is downward. The average real wage coefficient of the selected sample is 4 per cent lower than that of the overall sample.[11] That is, the estimated elasticity of wage with respect to productivity in the panel setting and tends to be lower than the elasticity for the overall samples.

Small and Micro firms

We model productivity function for micro and small firm with a different set of firms characteristics, which include:[12] (a) capital ownership, measured as percentage of business capital originated from own internal source, (b) firm age, measured by how many years the firm has been in operation, (c) cooperative membership, indicating whether a firm is a member of any cooperative association, (d) business licence type, indicating whether a firm has any type of business license. These small and micro firm characteristics are different from those for large and medium firms and these differences are simply dictated by the differences in the design of manufacturing surveys for large-medium and micro-small firms.

The basic estimation model is expressed as follows:

$$\ln PROD_{it} = \phi_0 + \phi_1 \ln PROD_{it-1} + \phi_2 \ln RW_{it} + \phi_3 \ln OWNCAP_{it} + \phi_4 AGE_{it} + \alpha_5 COOP_{it} + \phi_6 LIC_{it} + u_i + \varepsilon_{it} \quad (2)$$

As in the previous model, PROD represents labour productivity and RW stands for real wage. OWNCAP denotes capital ownership, measured as percentage of business capital originated from own internal source. AGE stands for firm age, COOP is a dummy variable for firm membership in any cooperative association and LIC is a dummy variable indicating whether a firm has any type of business license. Lag dependent variable is included to capture path dependence or the dynamic nature of overtime progress of wage and productivity, meaning that current realizations of the dependent variable influenced by past ones.

We employ two approaches to estimate the models: pooled cross-section and pseudo panel. In the pooled cross-section setting, the productivity function can be simply estimated with OLS regression. However, the firms without wage information might constitute a self-selected sample, not a random sample. If this case is true, the OLS will be biased. Therefore, we estimate the productivity function using the Heckman method, in addition to the OLS. The Heckman selection model allows us to use information from non-wage paying firms to improve the estimates of the parameters in the regression model. The Heckman selection model provides consistent, asymptotically efficient estimates for all parameters in the model. We use Heckman Maximum Likelihood (ML) estimation which allows for robust estimation option.[13]

[11] Detail regression results and related Suest test are available from authors.
[12] The different set of firms' characteristics is dictated by the manufacturing survey data.
[13] For more detail on the Heckman selection model, see Cameron and Triverdi (2010) and Wooldridge (2002).

In the absence of genuine panel data on micro and small firms and the availability of repeated cross sections data on these firms, constructing pseudo panel is an alternative option to the pooled cross sections approach. The pseudo-panel data approach was introduced by Deaton (1985) for the analysis of consumer demand. The pseudo-panels are formed by grouping observations into cohorts on the basis of invariant shared characteristics, and constructing the cohort variables as the mean values of the included observations. The cohorts are then traced over time in each of the annual surveys, forming a panel. In this study, the cohorts are formed based on the year of the firms are in operations (proxied by age and membership of cooperatives/associations) and the resource intensity of firms (labour, resource and capital).

In this study, for firms established prior to 1990, the cohorts are created using 5-year bands as there are only small observations for this type of firms. For firms established after 1990, there are slight differences in setting up the data. For all firms set up, averaging both micro and small, with relatively large observations of firms established every year after 1990, the cohort are created using 1-year band. Thus there are 91 cohorts created for overall data. While for micro firm data set up, for firms established during 1990-1999 with some years only less than 100 observations, 2-year band is employed to create the cohort. For micro firms established in 2000-2010 with more than 100 observations in each year of establishment, 1-year band is employed to create the cohort. Thus there are 78 cohorts created for micro firms. For small firms data set up, with less observation compared to micro firms, 3-year band is employed to create the small firm established after 1990 to 2010 cohort. This results in 51 cohorts for small firm data.

Both pooled cross section (Heckman) and pseudo panel regressions approaches find statistically significant and positive effect of real wage on productivity as presented in Tables 8a and 8b respectively. The elasticity of real wage with respect to productivity outweighs all other factors across all characteristics of small and micro firms. The Heckman model indicates that there is no sample selection problem in the overall sample (combined micro and small firms), thus OLS robust is not biased. All pseudo panel regressions survive the Arellano-Bond test of zero autocorrelation. But only one regression (micro firms) passes the Sargan test. For the other two (all firms and small firms), we rerun the model with fixed effect estimation and the results are consistent with the previous difference GMM output.

Table 8a. Determinants of Productivity in micro and small firms (Heckman)

	ALL (Micro + small)		MICRO FIRMS ONLY		SMALL FIRMS ONLY	
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	Heckman	OLS	Heckman	OLS	Heckman
	Robust	Robust	Robust	Robust	Robust	Robust
Ln real wage	0.663***	0.657***	0.645***	0.753***	0.687***	0.663***
	(0.0264)	(0.0319)	(0.0287)	(0.0541)	(0.0332)	(0.0422)
Own capital	-0.0003	-0.0003	-0.0024**	-0.0019*	0.0014*	0.0014***
	(0.0002)	(0.0002)	(0.0003)	(0.0008)	(0.0005)	(0.0004)
Cooperative	-0.110**	-0.111***	-0.0952	-0.0732	-0.104*	-0.109**
	(0.0142)	(0.0127)	(0.0371)	(0.0501)	(0.0365)	(0.0373)
Firm age	-0.00253	-0.00255	-0.00486	-0.00434*	0.00137	0.00126
	(0.0016)	(0.0016)	(0.0023)	(0.0019)	(0.0014)	(0.0014)
Firm age (squared)	0.00003	0.00003	0.00007	0.0001	-0.00004	-0.00004*
	(0.00003)	(0.00003)	(0.00005)	(0.00006)	(0.00002)	(0.00002)
Business license	0.101	0.109	0.0674*	-0.0714	0.138	0.164
	(0.0572)	(0.0588)	(0.0198)	(0.117)	(0.0844)	(0.0959)
Rho		0.0358		-0.658		0.132
Sigma		1.141		1.239		1.136
Lambda		0.0409		-0.815		0.150
P-Value for LR test		0.468		0.00237		0.0113
Test age & age-sq	0.3486	0.0000	0.1724	0.0000	0.2786	0.0000
Obs	40678	48940	24400	29617	16278	19323
R-sq	0.210		0.219		0.206	
Year dummies	YES	YES	YES	YES	YES	YES

Notes: ***, ** and * indicate 1%, 5% and 10% levels of significance respectively. Standard errors are in parentheses. Each regression is with a constant.

Table 8b. Determinants of productivity in micro and small firms (pseudo panel, difference GMM)

Variable	All	Micro	Small
ln Productivity (lag)	-0.2099	-0.0375	-0.0732
ln Real wage	0.753***	0.925***	1.04***
Firm age	0.137***	0.145***	0.159**
Firm age (sq)	-5.2e-04*	-1.3e-03***	-4.80E-04
Own capital	8.50E-04	-2.40E-03	-4.80E-03
No. of observations	224	186	94
No. of groups	84	69	38
No. of instruments	17	17	17
AR(2), P-value	0.0574	0.0729	0.9373
Sargan test, P-value	0.0381	0.7575	0.0185

Notes: ***, ** and * indicate 1%, 5% and 10% levels of significance respectively. Each regression is with a constant and robust standard errors.

VI. Concluding remark

The finding that real wage plays the most critical role in influencing productivity across the whole spectrum of manufacturing has significant policy implications. This, of course, raises the question, would a flexible labour market with a minimum interference from the government with instruments, such as minimum wage legislations or requiring better working conditions, be able to achieve the objective of industrial upgrading?

The general perception is that such legislations are adversely affecting the manufacturing sector, especially in creating employment. Here the policy makers face a dilemma between labour intensity and productivity. Raising labour intensity for improving the employment rate can reduce labour productivity as they are inversely related. In a dynamic setting an ideal situation is high wage-high productivity driving the economy.

Salter (1960) provided a formal analysis of productivity-linked wage increases and industrial restructuring. It is generally believed that wage increases according to productivity growth are noninflationary. As Russell (1965) noted the capacity to pay should be determined by the growth in real GNP, and wage should be adjusted by following “prices-plus-productivity” rule. However, as pointed out by Salter (1960), this may adversely affect structural change as low-productivity industries would be able to continue operating while the high-productivity activities would lack incentive because their profit margin would remain stagnant. As a result, the overall economic growth would be low and inadequate for lowering the unemployment rate.

As a matter of fact, low-wage countries often have lower productivity. Malinvaud (1982) showed that a reduction in the wage rates had a depressing effect on capital intensity. As Salter (1960) noted, the availability of a growing pool of low-paid workers makes the firms complacent with regard to innovation and technological or skill upgrading. Deakin and Wilkinson (1989, p. 44) provided a very succinct explanation: "Dependence upon under-valued labour provides a way by which inefficient producers and obsolete technologies can survive and compete. Firms become caught in low-level productivity traps from which they have little incentive to escape." Wilkinson (1989, p. 12) described the phenomenon as "a form of Gresham's Law," whereby bad labour standards drive out good.

Singapore's experience in the 1980s offers an excellent example of how wage and labour market policies can be used for industrial restructuring. It is well-kwon that Singapore used labour-market, in particular high wage policies since the late 1970s until mid-1980s, to restructure its industries by phasing out labour-intensive activities. Singapore has a long-standing tripartite system under the guidance of the National Wages Council (NWC) to guide wage developments. Beginning in the early 1980s, the NWC started recommending high wage with a view to forcing the economy to move towards high skill, high value added activities. By de-linking productivity-based wage increases at the enterprise level and adhering to the industry-wide average productivity-based wage increases, the system raised the unit labour cost of firms with below-industry-average productivity, thereby forcing them to exit. This also meant that firms with above-industry-average productivity enjoyed lower unit labour costs, hence higher profit rates for reinvestment.

Another key instrument was the Skills Development Fund (SDF), introduced in 1979 to collect levies from the "sunset" industries (low-skill, low-wage), thereby encouraging firms to retrain workers and making sure they remain employable. Employers were also required by law to contribute to workers' retirement funds. The government, by legislating compulsory employer contribution to the government-managed Central Provident Fund (CPF), has been able to create a sense of fairness in industrial relations. As the sunset firms exited under the pressure of rising costs, their workers did not fear losing their entitlements.[14]

Finally, the symbiotic relationship between the union and the government helped Singapore to restructure the economy without union resistance. Being part of the policy-making process, trade union leaders understood the need for economic restructuring to remain internationally competitive. Trade union leaders also helped the government devise compensation packages and retraining programmes for workers who lost jobs due to restructuring.

[14] See Chowdhury (2008) for a discussion of labour market policies as an instrument of industry policy in Southeast Asia

Perhaps Indonesia could consider adopting a similar wage and skill development policies as Singapore. However, the Singapore experience also shows that there is a danger of following wage-productivity–based industrial restructuring strategies too aggressively. Singapore used this mechanism aggressively during late 1970s to mid-1980s when wage increases were above industry-average productivity growth. This not only forced the exit of low productivity activities but also caused a profit squeeze for firms with average productivity. As a result, the country experienced growth recession in 1985–1986 (see Kirkpatrick 1988). Therefore, getting a right pace of restructuring is also important. Secondly, the two countries differ significantly in their characteristics; so the specific mechanisms have to vary, instead of blind emulation. In particular, any wage-setting mechanism that also performs as an instrument for industrial restructuring in Indonesia has to take into consideration Indonesia's large informal sector and its regional diversity.

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