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What Explains the Increase of Labour Income Share in Malaysia?

Between Productivity, Technology, and Foreign Workers

Draft as at 3 November 2017

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Abstract:

Labour income shares have been falling in many advanced and emerging economies within the last few decades, driven in part by a combination of impacts from technology and the consequences of increased global integration. This in turn is associated with the relative slow growth of wages, especially for middle-skilled workers, and the worsening of income inequality in these economies. In contrast to these global trends, Malaysia's labour income share has instead been increasing since 2005, together with improvements in income inequality. We investigate this development in depth, exploring the differences in trends of labour income shares across different economic sectors and different firm sizes, as well as identifying factors that could explain the increase of labour income share in Malaysia. We found that the increase is broad-based across all major economic sectors, and is contributed mainly by the growing importance of the more traditional services sub-sectors, and SMEs in the economy. This in turn is associated with the lower adoption of technology and the higher reliance on low-skilled foreign workers in Malaysia during this period. These findings have important policy implications for Malaysia going forward, including with regards to the potential trade-off between driving productivity and fostering inclusiveness.

JEL classification numbers: JEL: E25, J30, J61, O33

'It was known for some time that the share of wages and share of profits in the national income has shown a remarkable constancy…'

- Nicholas Kaldor, 1957

1. Introduction

One of the defining developments in the global economy over the past few decades is the declining share of national income that goes to labour[1]. True for most advanced economies and many emerging economies, this development is explained by the decoupling of productivity growth and growth in real wages, especially for the middle-skilled workers, and is associated with the worsening of income inequality in these economies. This development is found to have been driven in a large part by the combination of impacts from technology and the consequences of increased global integration[2].

In contrast to the global trend, Malaysia's labour income share has instead been increasing since the official statistics is made available in 2005, together with improvement in income inequality. This paper attempts to provide an explanation of why this has been so for Malaysia. The next part of the paper outlines the overall development in the share of labour income in Malaysia since 2005. Section 3 investigates the data in greater depth, using shift-share analysis to ascertain if the change can be attributed to changes within each economic sector, or changes to the relative shares of different economic sectors in the overall Malaysia economy. The shift-share analysis is also repeated for different firm sizes. In section 4, we used panel regression estimation to identify the underlying factors that could explain the increase of labour income share in Malaysia. Section 5 concludes.

2. Labour income share in Malaysia

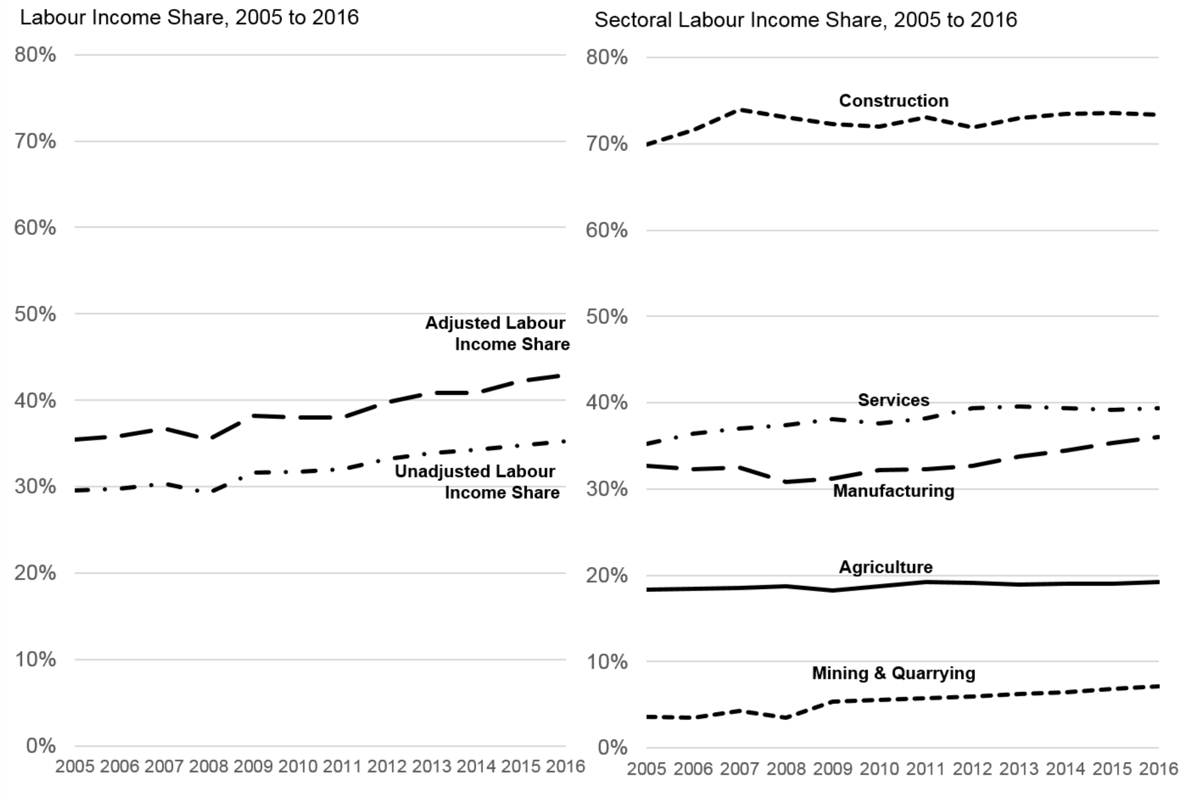
2.1. Trends since 2005

The Department of Statistics, Malaysia (DOSM) publishes nominal Gross Domestic Product by Income (GDPI) each year since 2005. The income-based approach decomposes GDP by measuring total income generated by production activity for

[1] As documented, for example, in IMF (2017) and Dao et. al. (2017)
[2] Ibid.

owners of capital, for labour and for government. Compensation of employees (CoE) component is the income that is generated for labour, which constitutes of wages and salaries, and contributions into employment-related social insurance schemes. LIS is the proportion of CoE within total GDP, measuring the share of income generated for labour to total income generated. For this paper, the primary source of data is from the DOSM's GDPI. Comprehensive listing of other data sources and detailed descriptions of all indicators used in this paper can be found in Appendix 1.

Figure 1: National and Labour Income Share by Sector, 2005 to 2016

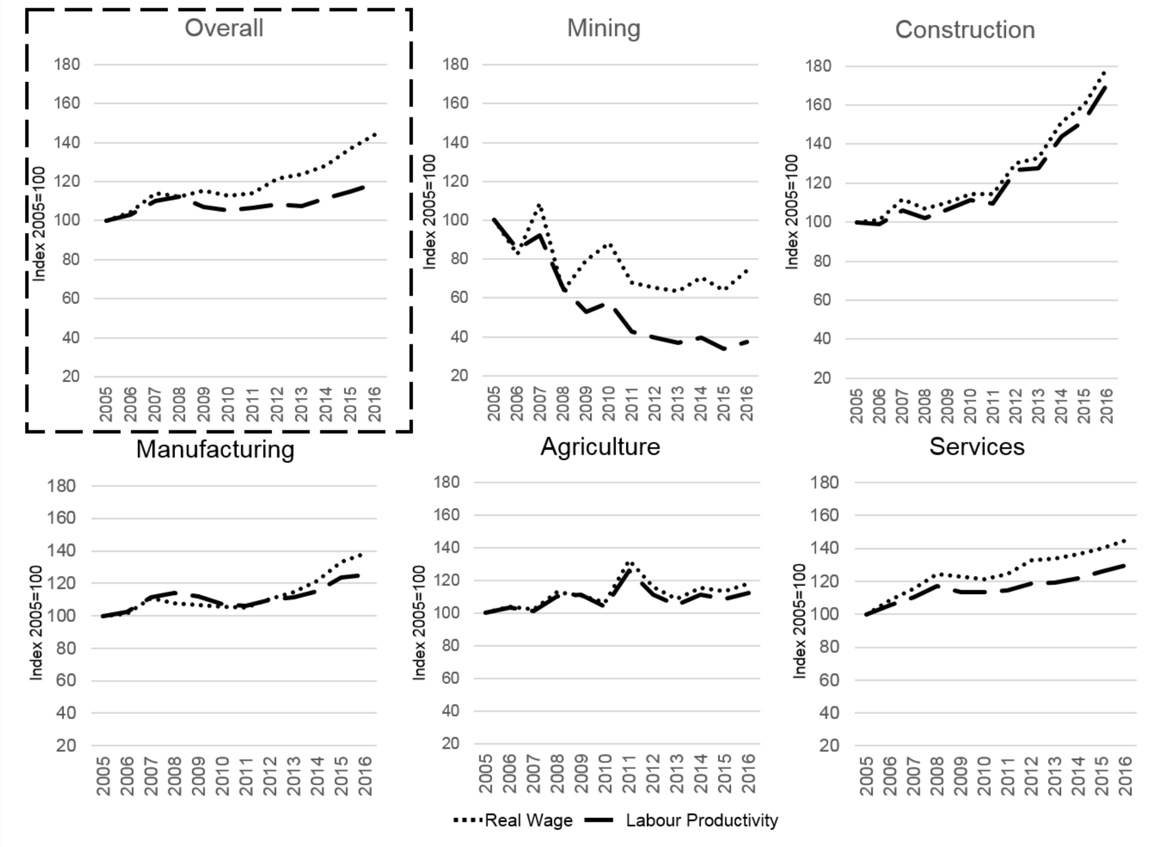


Source: DOSM (Various Years), Authors' Calculations

LIS calculated from CoE in GDPI excludes income earned by own account workers. As discussed in BNM (2014), this can be adjusted for by estimating LIS from own account workers, based on Gollin (2002). Figure 1 shows that unadjusted LIS increased from 29.5 percent in 2005 to 35.3 percent in 2016 (5.7 percentage points increase), while adjusted LIS, which includes income for own account workers, increased from 35.4 percent in 2005 to 42.9 percent in 2016 (7.5 percentage points increase).

Figure 1 also shows that LIS in all 5 major economic sectors increased between 2005 to 2016. The construction sector has the highest LIS, increasing from 70.0 percent in 2005 to 73.3 percent in 2016. This is followed by the services sector, from 35.2 percent in 2005 to 39.3 percent in 2016, and the manufacturing sector, from 32.7 percent to 36.1 percent. For the agriculture sector, it increased from 18.3 percent in 2005 to 19.2 percent in 2016. The mining & quarrying sector has the lowest LIS, increasing from 3.6 percent to 7.2 percent. The services sector LIS increased by 4.1 percentage points in this period, the largest increase in LIS, while the agriculture sector LIS increased only by 0.9 percentage points, the smallest increase in LIS from 2005 to 2016. Note that as employment numbers for own account workers for each sector is not available, LIS adjustment for own account worker is not calculated.

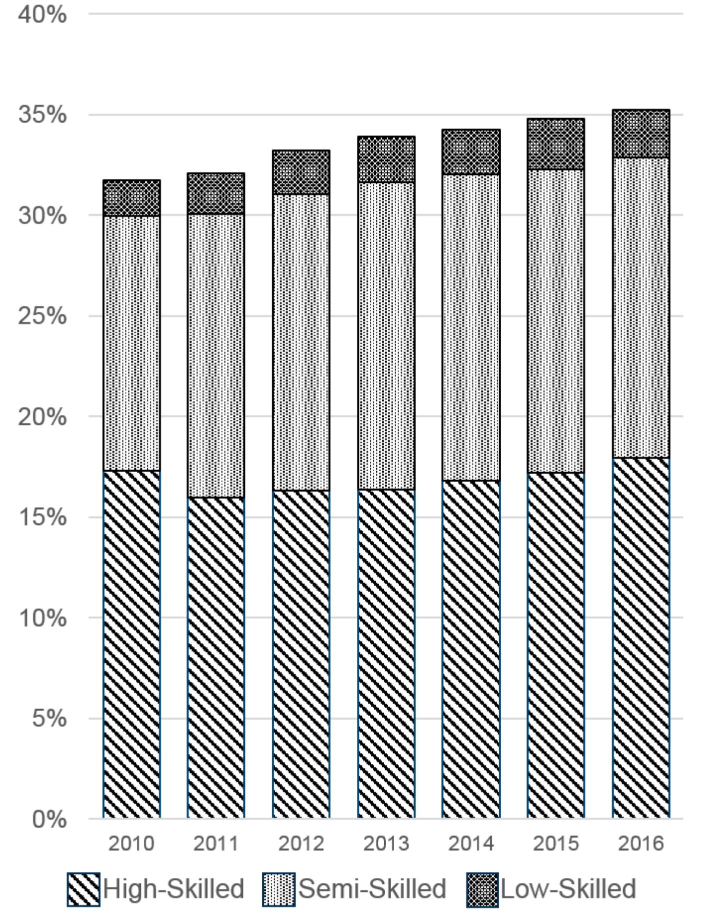
Figure 2: Real Wage per Worker and Labour Productivity, 2005 to 2016



Source: DOSM (Various Years), Authors' Calculations

A corollary of the increase in LIS is the positive divergence between real wage per worker and labour productivity. This is necessarily true by the definition of LIS. Increase in LIS implies more of the national income, in real terms, is going to labour compared to the change in the value-added per worker. Figure 2 shows that the increase in overall LIS is parallel to the greater increase in real wage compared to labour productivity. Overall real wage per worker has increased by 44.2 percent from 2005 to 2016, but labour productivity increased only by 19.1 percent. By sector, this can be clearly seen in the services sector, in which real wage per worker increased by 44.7 percent while labour productivity increased only by 29.5 percent. Similarly, for the manufacturing sector, real wage per worker increased by 38.2 percent, compared to labour productivity which increased by 25.3 percent. While real wage per worker and labour productivity for the mining & quarrying sector decreased, the former has fallen less than the latter.

Figure 3: Labour Income Share by Skill-Level, 2010 to 2016



Source: DOSM (Various Years), Authors' Calculations

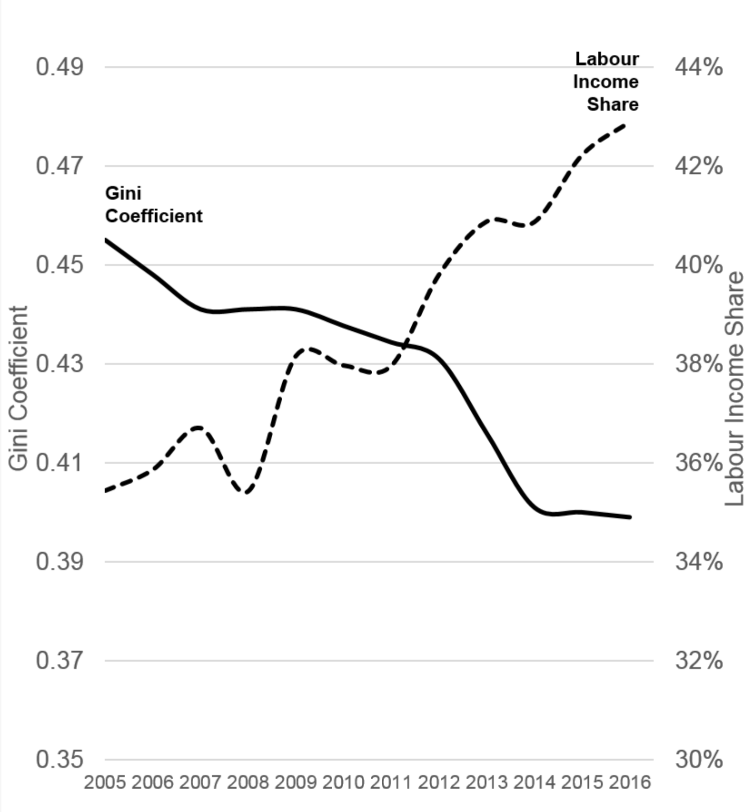
In terms of labour skill-levels, the largest change in LIS between 2010 and 2016 can be attributed to workers in the semi-skilled category. Figure 3 shows the estimated breakdown of LIS (unadjusted for own account workers) by workers of different skill levels[3]. LIS for high-skilled workers decreased from 17.3 percent in 2010 to 16.3 percent in 2012, before increasing up to 18 percent in 2016. LIS of semi-skilled workers increased from 12.7 percent in 2010 to 15.3 percent in 2013, but has since decreased to 14.9 percent in 2016. LIS of low-skilled workers increased from 1.8 percent in 2010 to 2.5 percent in 2015 before falling to 2.4 percent in 2016. In absolute terms,

[3] Compensation of employee of workers by skill-level is estimated by estimating compensation of employee from mean wages and population of workers in different skill levels. LIS is estimated by dividing the estimated compensation of employee with nominal GDP. Details on category of worker by skill-level is found in Appendix 2.

LIS for semi-skilled workers increased the most at 2.3 percent, while LIS for low-skilled workers increased the least at 0.7 percent.

2.2 Co-movement with income inequality

Figure 4: Gini Coefficient & Labour Income Share, 2005 to 2016



Source: DOSM (Various Years), Authors' Calculations

The increase in LIS has corresponded with the decrease in income inequality in Malaysia. Figure 4 shows that Gini coefficient has decreased from 0.455 in 2005 to 0.399 in 2016. It should be noted that it is not necessary for an increase in LIS to correspond with decrease in income inequality, but generally, income for labour is generally more equally shared across different income classes compared to income for owners of capital. Globally, lower LIS is found to strongly correlate with higher income inequality as measured by Gini coefficient[4]. Malaysia follows this global trend, but in the opposite direction.

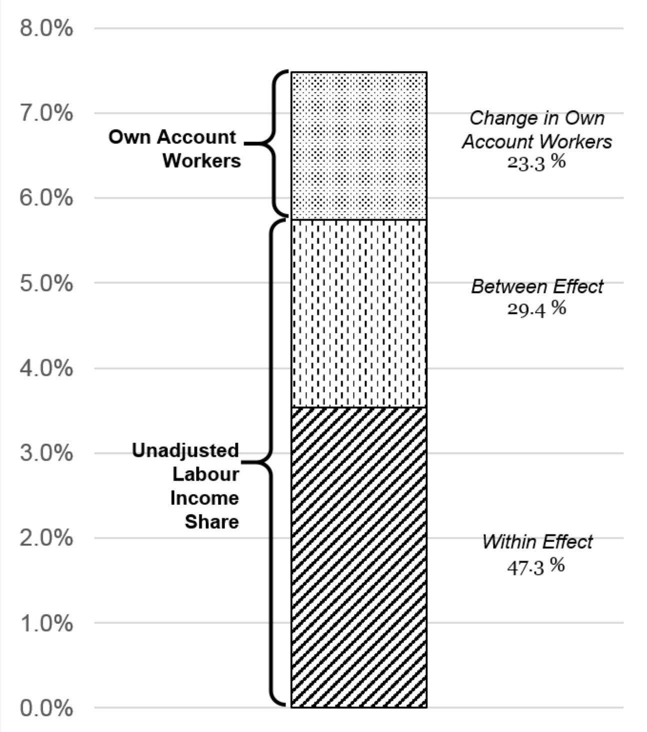
[4] See IMF (2017)

3. Shift-share analysis

3.1 By economic sectors

To further analyse the nature of the increase in LIS, a shift-share analysis is used to determine whether the change is explained internally within the economic sectors via wage structure changes or a resource reallocation between sectors by form of GDP share changes. The former is measured by the within effect while the latter by the between effect. Shift-share analysis on unadjusted LIS is performed on the 5 major economic sector, as well as at a more granular levels on various manufacturing sub-sectors and services sub-sectors. Change in own account workers LIS is added to the shift-share analysis of the unadjusted LIS to adjust for own account workers' LIS change for the overall economy. The methodology of the shift-share analysis on unadjusted LIS is found in Appendix 2.

Figure 5: Shift-Share Analysis, 2005 to 2016

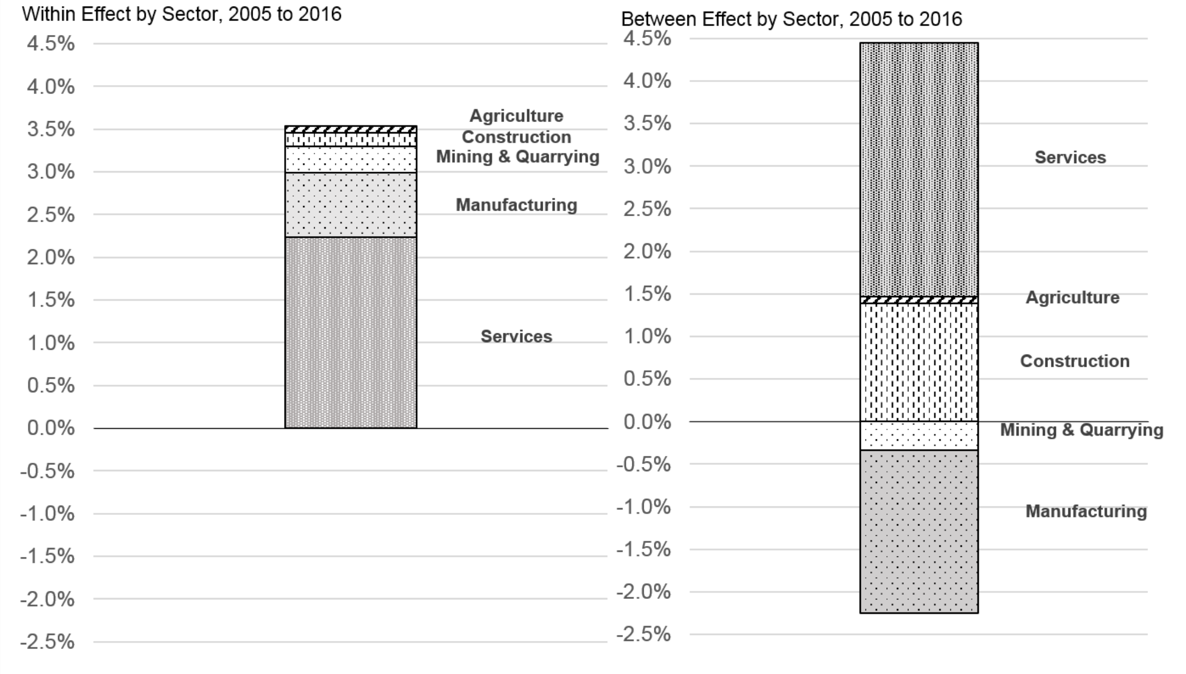


Source: DOSM (Various Years)

The combined shift-share analysis (Figure 5) shows that nearly half of the change in LIS is due to change from within effect, while another 29.4 percent is due to between effect. Changes in own account worker LIS contributes 23.3 percent to the overall change in LIS.

Decomposing within effect by the 5 major sectors, all 5 sectors contributed positively to the overall within effect (Figure 6), cumulatively contributing to a total of 3.54 percentage points. The services sector contributed the most to the within effect at 2.24 percentage points. This is followed by the manufacturing sector, contributing 0.75 percentage points. Decomposing between effect by sector, the services sector again contributed the most at 2.98 percentage points. For the between effect, both the manufacturing and the mining & quarrying sectors contributed negatively to the overall change in LIS as the shares of GDP of these sectors declined between 2005 and 2016.

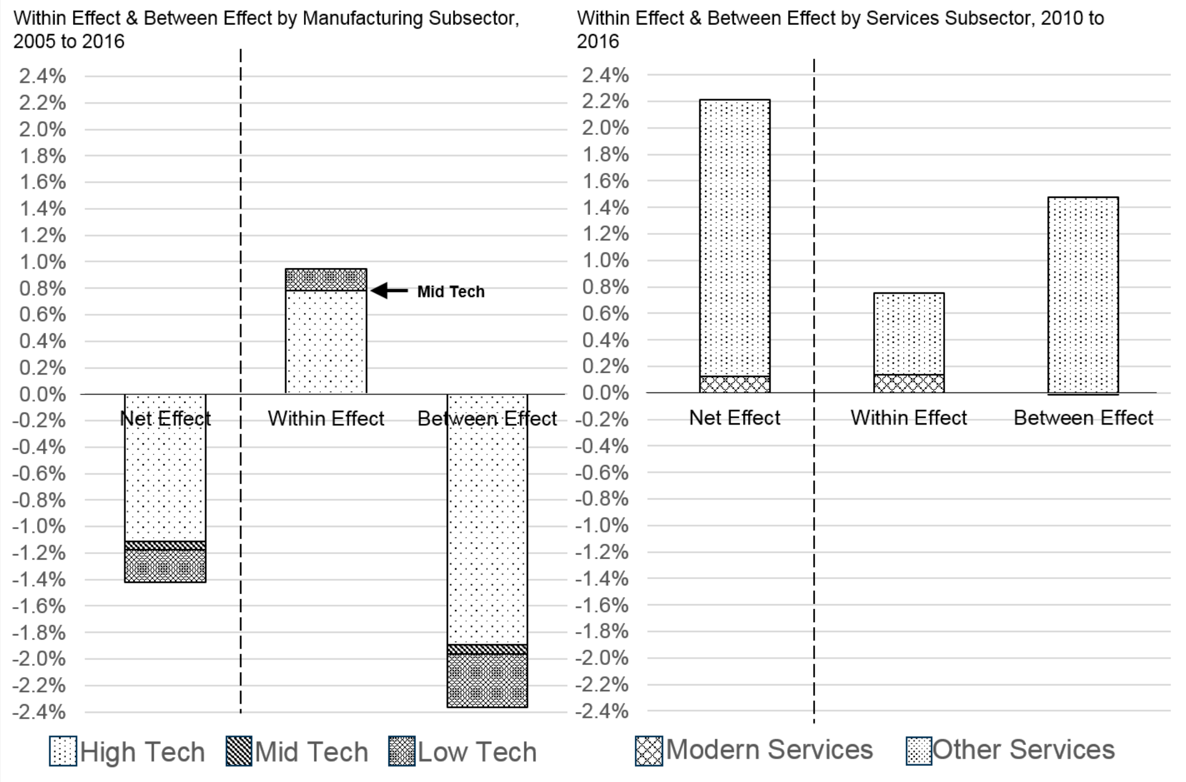
Figure 6: Labour Income Share Shift-Share Analysis by Sector, 2005 to 2016



Source: DOSM (Various Years), Authors' Calculations

Shift-share analysis is also done on the manufacturing and services sectors divided into smaller sub-sectors (Figure 7). Unlike the previous analysis, due to data limitation, this analysis is done for the period 2010 and 2016. The manufacturing sector is divided into high-tech, mid-tech and low-tech sub-sectors based on R&D intensity of the sub-sectors relative to value-added and gross production. Similarly, services sector is also divided into modern services and other services, based on labour productivity. Details of these sub-sectors are found in Appendix 3.

Figure 7: Labour Income Share Shift-Share Analysis by Manufacturing & Services Subsector



Source: DOSM (Various Years), Authors' Calculations

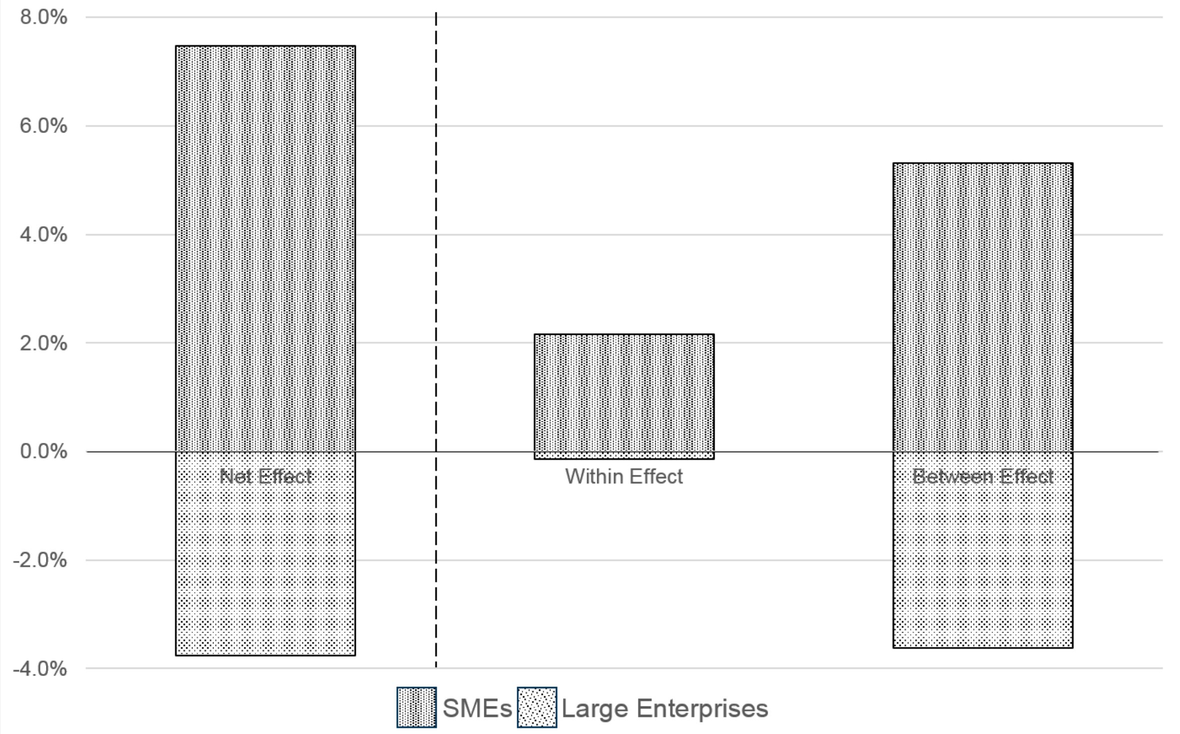
All three manufacturing sub-sectors contributed positively to the manufacturing sector within effect but contributed negatively to the between effect from 2005 to 2016. All three sub-sectors cumulatively contributed to 0.94 percentage points for within effect and -2.37 percentage points to between effect. High-tech manufacturing subsector contributed the most to the within effect at 0.78 percentage points, however also contributed most negatively to the between effect at -1.8 percentage points. Like other economic sectors, high-tech manufacturing experienced increase in LIS, but is offset by its shrinking importance in the Malaysian economy.

For the services sub-sectors, both modern services and other services contributed positively to services sector within effect, while only other services contributed positively to the between effect. Both services sub-sectors cumulatively contributed 0.75 percentage points to within effect and 1.46 percentage points to between effect. Other services contributed 0.6 percentage points to the within effect and 1.48 percentage points to the between effect.

3.2 By firm sizes

Shift-share analysis is also done for LIS by firm sizes between 2010 and 2015, categorised by SMEs and large enterprises[5]. SMEs contributed an overall positive net within and between effect, at 7.47 percentage points, while large enterprises gave a net negative contribution at -3.76 percentage points (Figure 8). SMEs contributed positively to the within effect at 2.16 percentage points, while large enterprises contributed a small negative effect. SMEs also positively contributed to the between effect at 5.31 percentage points while large enterprises contributed to a negative effect of -3.62 percentage points.

Figure 8: Labour Income Share Shift-Share Analysis by Firm Size, 2010 to 2015



Source: DOSM (Various Years), Authors' Calculations

[5] The analysis in this part should be read with caution, arising from change in the definition of SMEs by DOSM. The definition of enterprises in the SME category has changed in 2013. SME data derived from the 2011 census categorises SMEs in manufacturing sector as enterprises with either less than 150 employees or less than RM25 million annual sales turnover. For the other sectors, enterprises with less than 50 employees or less than RM 5 million annual sales turnover are categorised as SMEs. For 2015, SME data derived from the 2015 census categorises SMEs in manufacturing sector as enterprises with less than 200 employees or less than RM50 million annual turnover. For other sectors, enterprises with less than 75 employees or less than RM20 million annual turnover are categorised as SMEs.

3.3 Summary findings of shift-share analysis

Overall, the shift-share analysis shows that the increase of LIS in Malaysia has been broad-based across economic sectors, and is not driven exclusively by changes in the relative shares of the different economic sectors in the overall GDP. All major economic sectors, including some other finer sub-sectors in manufacturing and services sectors, experienced increase in LIS.

Most notably, the services sector is the main contributor to the increase in LIS – with the combined within and between effects of more than 5.2 percentage points for the period 2005 to 2016, or more than 90 percent of the entire increase in overall LIS unadjusted for own account workers for Malaysia during the period. Within the services sector, this change in turn can be attributed to the increased importance of the more traditional services sub-sectors with lower labour productivity. This could also be reflected in the shift-share analysis on firm sizes in which the entire change in LIS can be attributed to both the within and between effects of SMEs, with large enterprises contributing negatively to the overall LIS. It is telling that almost 90 percent of all SMEs in Malaysia are in the services sectors, mainly in the more traditional sub-sectors.

4. Factors affecting of labour income share in Malaysia

The findings in the shift-share analysis suggests that the increase in LIS could have been, in large, driven by broad-based underlying macro-economic factors, rather than sector-specific factors. Surveying the potential factors for the change in LIS, the current literature has identified various important determinants. Among them, two determinants are commonly recognised as key:

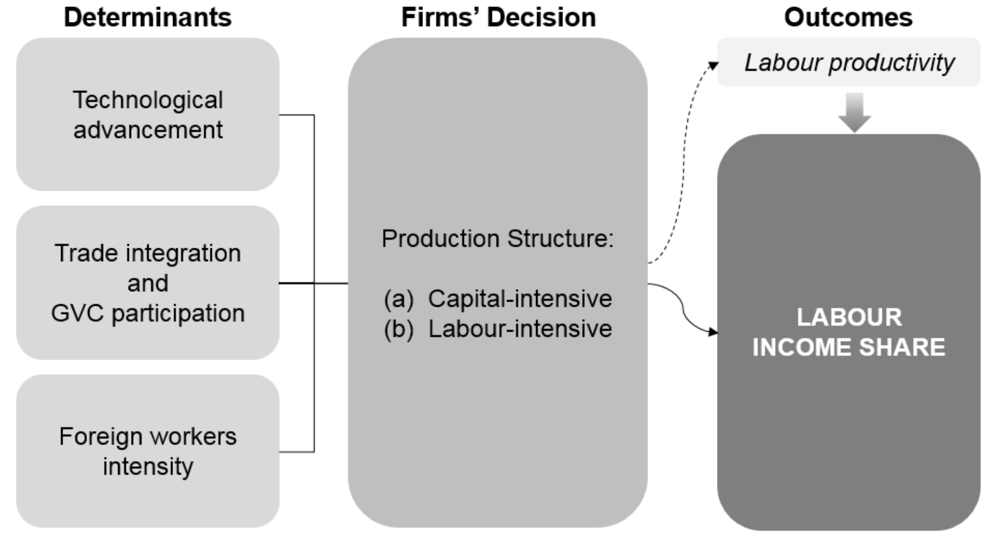
a) *Technological advancement* has affected LIS by reducing the relative cost of capital, thereby incentivising firms to substitute capital for labour in their production structure. The displacement of labour in this context is more pronounced where existing jobs are more exposed to routinisation. Empirically, these mechanisms are the major contributor to the decline in LIS in advanced economies, given their significant reliance on capital goods and a higher initial exposure to routinisation[6].

[6] See, among other, Krusell (1998) for the link between information and communications technology and price of investment goods; Autor and Dorn (2013) and Goos et al. (2014) for the role of technology in the displacement of labour.

b) *Trade and financial integration,* and particularly participation in global value chains (GVCs), have increased LIS in both advanced as well as emerging and developing economies as a whole. In capital-intensive advanced economies, global integration enables more labour-intensive tasks to be offshored to labour-intensive emerging economies, hence lowering LIS in their production. Whereas in the recipient emerging economies, these tasks are nonetheless relatively more capital-intensive than their existing tasks. Increased GVCs participation therefore induces an increase in capital intensity—and a corresponding decrease in LIS—in the receiving economies.[7]

Essentially, the mechanisms at play reflect the channels through which firms' choice of production structure is influenced in different economies, contributing to their respective LIS trend. In Malaysia, we argue that another important force could also play a role in influencing this mechanism—the reliance on foreign workers in the workforce. *The availability of low-cost foreign workers* in the country could reduce the relative cost of labour, and encourages firms to employ a labour-intensive production structure, thus increasing LIS[8].

Figure 9: The mechanism through different factors affect labour income share



[7] See, among others, IMF (2017), Elsby et al. (2013), and Feenstra and Hanson (1997), for a detailed explanation of the mechanism at play in emerging and developing economies.
[8] Implicit in the discussion throughout this section is the assumption that the elasticity of substitution between capital and labour is larger than one, except for the case of tasks offshored from advanced to emerging and developing economies. For more in-depth discussion on this, refer to IMF (2017).

4.1 Model Specification

A panel regression estimation is performed to identify the key determinants of LIS in Malaysia, using GDPI statistics and other information across 18 sectors[9] (N=18) over the course of seven years (2010-2016; T=7).

The dependent variable in our estimation model is the change in LIS, whilst the explanatory variables consist of measures of the potential determinants—changes in capital intensity, machines and equipment intensity (as proxy for technological adoption), and foreign workers intensity[10]. Given data limitation, there are no measures relating directly to trade or GVC participation in the model. However, the effects of trade intensity could be implicitly accounted for in two ways: first, the capital intensity variable would have partially captured said effects, since the impact of GVCs participation is mainly reflected through the variation in capital intensity across sectors; second, the inclusion of sector fixed effect—which accounts for time-invariant sector-specific heterogeneity—could potentially control for the factor to the extent that sectors' GVC participation remains stable across time. Besides, changes in GDP and labour productivity are included as additional controls. Further details of the estimation, including model specification, specification tests, and robustness measures are outlined in Appendix 4.

Figure 10 provides a cursory overview of the trends in the determinants used in model across the different sectors. From 2010 to 2016, capital intensity, and machines and equipment intensity have generally declined. Foreign workers intensity on the other hand has shown an apparent increase within the same period of time. The combination of these trends suggest that the overall production structure have become more labour intensive. This in turn could partly explain the slower growth in labour productivity in most sectors over the same years (Figure 11).

[9] Detailed information of the full list of 21 sectors according to Malaysia Standard Industrial Classification (MSIC) 2008 version 1.0 can be found in Appendix 3. For the purpose of econometric analysis, three sectors are excluded, namely *Mining & Quarrying, Electricity, Gas, Steam, and Air Conditioning Supply*, and *Fishing* sectors due to their outlying capital intensity and labour productivity statistics, attributed to the resource-based nature of the sectors.

[10] Detailed explanations of these various intensities are in Appendix 1.

Figure 10: Trends in potential determinants of labour income share in Malaysia, 2010-2016

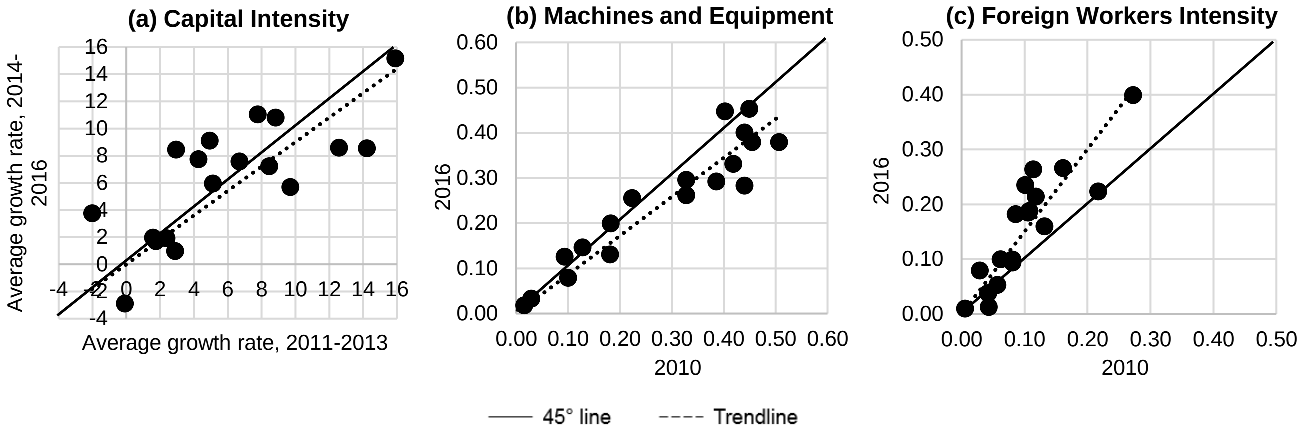
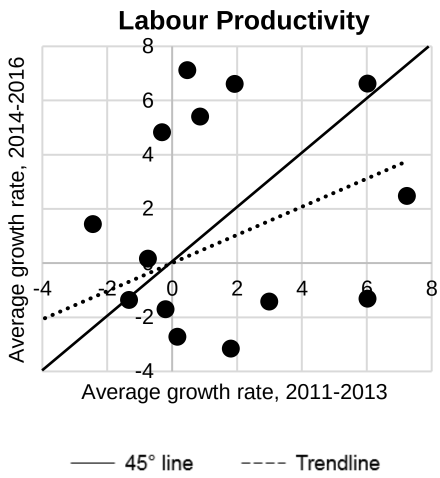


Figure 11: Trend in labour productivity in Malaysia, 2010-2016



4.2 Results

Table 1 presents the results of our baseline regressions, with Panel A being our main focus, whilst Panel B serves as a robustness check. In particular, we find the following:

- *The change in capital as well as machines and equipment intensities are strongly negatively correlated with LIS change in almost all model specifications*. Sectors which had a steeper decline in capital and machines intensities experienced a higher increase in LIS. The implications of this is two-fold: first, the downward trend in technological adoption observed plays a significant role in explaining Malaysia's upward LIS trend; second, it is also consistent with the explanation that the decline in Malaysia's participation in GVCs since 2000[11] could have contributed to the increase in LIS by reducing capital intensity across the relevant economic sectors.

[11] See KRI (2017).

- *As expected, the change in foreign workers intensity positively correlates with LIS change*. Specification (1) shows that, sectors which displayed a higher increase in foreign workers intensity experienced a more pronounced increase in LIS. By way of explanation, this is consistent with the findings in World Bank (2015) in which foreign workers are found to have benefited semi-skilled Malaysians the most in the labour market. As elaborated in section 2.1, the biggest increase in LIS can be traced to the increase to those who are in the semi-skilled category.

In summary, the results from the panel estimation suggest that the lower technological adoption and higher reliance on foreign workers employment have contributed to the increase in LIS across the various economic sectors in Malaysia between 2010 and 2016. Though not explicitly accounted for in the model, we posit that this could also have been compounded by Malaysia’s reduced participation in GVCs over the years and the overall declining importance of high-tech manufacturing in the economy. Notably, whilst our findings yield broadly similar qualitative results with other studies in terms of the direction of relations between the determinants and LIS, it is the reverse trend in these determinants in Malaysia in the recent period that have led to our opposite experience in the direction of change in LIS.

Table 1: Regression results

Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Exclude Mining, Electricity, and Fishing sectors					
Log Foreign Workers Intensity	0.007** (0.003)	0.002 (0.004)	0.004 (0.004)	0.003 (0.004)	0.003 (0.003)	0.004 (0.004)
Log Capital Intensity		-0.124** (0.058)	-0.135** (0.056)	-0.122** (0.056)		-0.011 (0.087)
Machines & Equipment Intensity			-0.445** (0.210)	-0.346* (0.173)		-0.287* (0.143)
Log GDP				-0.152*** (0.049)		0.048 (0.099)
Log Labour Productivity					-0.141** (0.052)	-0.118 (0.091)
Constant	0.019*** (0.006)	0.016** (0.006)	0.018** (0.007)	0.023*** (0.008)	0.015** (0.006)	0.018** (0.009)
Sector Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	108	108	108	108	108	108
Overall R^2	0.008	0.140	0.139	0.206	0.257	0.232
	Panel B: Exclude Mining and Electricity sectors					
Log Foreign Workers Intensity	0.006** (0.003)	0.004 (0.003)	0.006 (0.004)	0.004 (0.004)	0.005 (0.003)	0.006 (0.003)
Log Capital Intensity		-0.113** (0.051)	-0.119** (0.050)	-0.109** (0.049)		-0.001 (0.085)
Machines & Equipment Intensity			-0.405* (0.195)	-0.312* (0.156)		-0.254* (0.128)
Log GDP				-0.157*** (0.050)		0.055 (0.100)
Log Labour Productivity					-0.133** (0.048)	-0.116 (0.092)
Constant	0.018*** (0.006)	0.018*** (0.006)	0.022** (0.008)	0.025*** (0.007)	0.017*** (0.006)	0.021** (0.008)
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	114	114	114	114	114	114
Overall R^2	0.007	0.111	0.115	0.179	0.214	0.199

Note:
1. Standard errors are shown in parenthesis. They are heteroskedasticity-robust and clustered by sector.
2. All variables, including the dependent variable, i.e. labour income share, are first-differenced.
3. *denotes statistical significance at 10% level, ** 5%, and *** 1%.

5. Conclusion

To recap, we found that the increase in LIS in Malaysia since 2005 has been broad-based with all major economic sectors experiencing increases in LIS to various degrees. The services sector is the main contributor to the overall increase in LIS, due to both the increase in LIS within the services sector itself, and the growing share of the services sector in the overall economy. Within the services sector, this in turn is due to the growing share of the more traditional services sub-sectors rather than modern services sub-sectors. Relatedly, in terms of firm sizes, the increase in LIS is due entirely to the SMEs experiencing increasing LIS as well as the growing share of SMEs in the economy. Most SMEs in the Malaysian economy are in the more traditional services sub-sectors. In terms of underlying factors, the increase in LIS in Malaysia is explained by the lower adoption of technology and the higher reliance of low-skilled foreign workers in the period investigated. We also posit that this can be explained by the reduced participation of Malaysia in GVCs and the declining importance of high-tech manufacturing. More broadly, it is in fact not inconsistent to associate the overall increase in LIS as an outcome of the deindustrialisation of the Malaysian economy which has begun since the early 2000s[12].

From the increase in LIS and the improving income inequality, it appears that over the last decade, the growth of the Malaysian economy has become more inclusive in nature. Structurally, however, this has been accompanied by a transition away from a more capital-intensive to a more labour-intensive model—a structure that is skewed towards mid- and low-skilled workers rather than technology, more traditional services sub-sectors rather than high-tech manufacturing, and smaller firms rather than larger enterprises. This raises a number of important policy implications. For example, looking specifically at the SMEs, they create significant job opportunities–-65 percent of all workers in Malaysia are employed by SMEs in 2016. At the same time, SMEs are also significantly behind large enterprises in terms of productivity and investment in technology (Figure 12). As such, policies to raise the importance of SMEs in the economy, without significant effort to modernise them, could have an adverse impact on aggregate productivity and future growth potential of the overall economy. Similarly, policy efforts to drive technological adoption and productivity growth, without

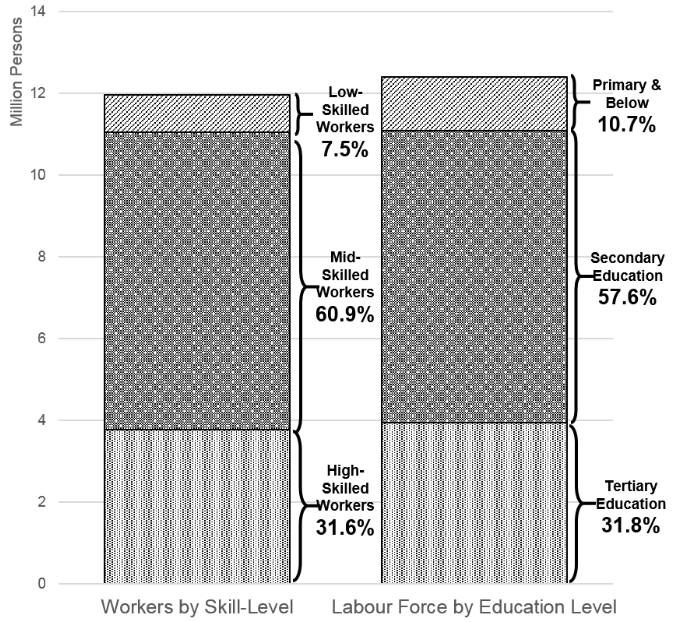
[12] As discussed in KRI (2017).

Figure 12: Labour Productivity & Capital Intensity by Firm Size, 2010 & 2015

Source: DOSM (Various Years), Authors' Calculations

significant consideration on the impacts to jobs, could have negative implications on the inclusiveness of economic growth. This is particularly crucial since close to 70 percent of all Malaysians in the workforce only have secondary education and below, and are working in low- and semi-skilled occupations (Figure 13). They are at risk of being left behind without significant upskilling. Similar policy trade-off is also present in relation to our dependence on low-skilled foreign workers. Transitioning away from a labour intensive economic structure that is facilitated by the easy

Figure 13: Employment by Skill & Labour Force by Education Level of Malaysians, 2016



Source: DOSM

availability of low-skilled foreign workers could work against most Malaysians who are semi-skilled and benefit from the current economic structure.

This paper highlights that the policies for Malaysia in moving towards an economy that is simultaneously productivity-driven and inclusive are wrought with multiple inter-linked trade-offs that could be self-defeating. The challenge is to understand why these trade-offs exist and how policies can be designed such that they are compatible with the various factors affecting the economy.

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Appendix 1: Data Sources

Data used for calculating the various indicators are taken from various publications from the DOSM. The 21 economic sub-sectors chosen are limited by the level of granularity of the different data sources.

Labour Income Share

$$Labour\ Income\ Share = \frac{Compensation\ of\ Employees}{Nominal\ GDP}$$

<table>
<tr><th colspan="2">Labour Income Share</th><th>Compensation of Employees</th><th>Nominal GDP</th><th>Year</th></tr>
<tr><td colspan="2">Overall</td><td>Gross Domestic Product by Income (GDPI) Approach</td><td>Gross Domestic Product by Income (GDPI) Approach</td><td>2005 - 2016</td></tr>
<tr><td colspan="2" rowspan="2">Own Account Worker</td><td>Gross Domestic Product by Income (GDPI) Approach</td><td rowspan="2">Gross Domestic Product by Income (GDPI) Approach</td><td rowspan="2">2005 - 2016</td></tr>
<tr><td>Labour Force Survey</td></tr>
<tr><td colspan="2">5 Major Economic Sectors</td><td>Gross Domestic Product by Income (GDPI) Approach</td><td>Gross Domestic Product by Income (GDPI) Approach</td><td>2005 - 2016</td></tr>
<tr><td rowspan="4">21 Economic Sub-sectors</td><td>Agriculture, Mining & Quarrying, Construction, Manufacturing</td><td>Gross Domestic Product by Income (GDPI) Approach</td><td>Gross Domestic Product by Income (GDPI) Approach</td><td>2005 - 2016</td></tr>
<tr><td rowspan="3">Services</td><td>Gross Domestic Product by Income (GDPI) Approach</td><td rowspan="3">Gross Domestic Product by Income (GDPI) Approach</td><td rowspan="3">2010 - 2016</td></tr>
<tr><td>Labour Force Survey (Ratio)</td></tr>
<tr><td>Salaries & Wages Survey Report (Ratio)</td></tr>
<tr><td colspan="2" rowspan="3">Workers by Skill-Level</td><td>Gross Domestic Product by Income (GDPI) Approach</td><td rowspan="3">Gross Domestic Product by Income (GDPI) Approach</td><td rowspan="3">2010 - 2015</td></tr>
<tr><td>Salaries & Wages Survey Report (Ratio)</td></tr>
<tr><td>Labour Force Survey (Ratio)</td></tr>
<tr><td colspan="2" rowspan="2">Firm Size</td><td>Gross Domestic Product by Income (GDPI) Approach</td><td rowspan="2">Gross Domestic Product by Income (GDPI) Approach</td><td>2010 - 2015</td></tr>
<tr><td>Economic Census Profile of Small and Medium Enterprises (Ratio)</td><td>2010, 2015</td></tr>
</table>

Real Wages & Productivity

$$Real\ Wage = \frac{Nominal\ Wage * 100}{GDP\ Deflator}$$

<table>
<tr><th>Real Wage</th><th>Nominal Wage</th><th>GDP Deflator</th><th></th></tr>
<tr><td rowspan="2">Overall, 5 Major Economic Sectors</td><td>Gross Domestic Product by Income (GDPI) Approach</td><td rowspan="2">Annual National Accounts Gross Domestic Product</td><td rowspan="2">2005 - 2016</td></tr>
<tr><td>Labour Force Survey</td></tr>
</table>

$$Productivity = \frac{Real\ GDP}{Employment}$$

<table>
<tr><th>Productivity</th><th>Real GDP (2010 base)</th><th>Employment</th><th></th></tr>
<tr><td>Overall & 5 Major Economic Sectors</td><td>Annual National Accounts Gross Domestic Product</td><td>Labour Force Survey</td><td>2005 - 2016</td></tr>
<tr><td rowspan="2">Firm Size</td><td>Annual National Accounts Gross Domestic Product</td><td>Labour Force Survey</td><td rowspan="2">2010, 2015</td></tr>
<tr><td>Economic Census (Ratio)</td><td>Economic Census (Ratio)</td></tr>
</table>

Gini Coefficient

Overall Gini Coefficient	Household Income Survey	2005 - 2016

GDP Share

$$GDP\ Share = \frac{Nominal\ GDP\ by\ Sector}{Nominal\ national\ GDP}$$

Overall, 5 Major Economic Sectors, 21 Economic Sub-sectors	Annual National Accounts Gross Domestic Product	2005 - 2016

Foreign Workers Intensity by Sector

$$Foreign\ Workers\ Intensity = \frac{Number\ of\ Foreign\ Worker}{Employment}$$

Foreign Workers Intensity by Sector	Number of Foreign Workers	Employment
21 Economic Sub-sectors	Labour Force Survey	Labour Force Survey

Capital Intensity

$$Capital\ Intensity = \frac{Net\ Capital\ Stock}{Employment}$$

Capital Intensity	Net Capital Stock	Employment	
Firm Size	National Accounts Capital Stock Statistics	Labour Force Survey	2010, 2015
	Economic Census (Ratio)	Economic Census (Ratio)	2010, 2015
21 Economic Sub-sectors	National Accounts Capital Stock Statistics	Labour Force Survey	2010 - 2016
	Economic Census (Ratio)		2010, 2015

Machines & Equipment Intensity

$$Machines\ \&\ Equipment\ Intensity = \frac{Machine\ \&\ Equipment}{Net\ Capital\ Stock}$$

Machines & Equipment Intensity	Machines & Equipment	Net Capital Stock	
21 Economic Sub-sectors	National Accounts Capital Stock Statistics	National Accounts Capital Stock Statistics	2010 - 2016
	Economic Census (Ratio)	Economic Census (Ratio)	2010, 2015

Appendix 2: Shift-Share Analysis

$$\underbrace{LS_T - LS_0}_{\text{Total}} \approx \underbrace{\sum\nolimits_i (LS_T - LS_0) \times W_{iT}}_{\text{Within Effect}} + \underbrace{\sum\nolimits_i (W_{iT} - W_{i0}) \times L_{iT}}_{\text{Between Effect}}$$

LS = Labour Income Share

W = GDP Share

i = sector

T = Final year (2016)

0 = Starting year (2005 or 2010)

Adapted from Abdih & Danninger (2017)

Appendix 3: 21 Economic Sub-sectors, Category of Workers by skill level, Manufacturing and Services Sub-sectors

21 Economic Sub-sectors

Adapted from Malaysia Standard Industrial Classification (MSIC) 2008 version 1.0

1. Rubber, oil palm, livestock and other agriculture
2. Forestry and logging
3. Fishing
4. Mining & quarrying
5. Food, beverages and tobacco
6. Textiles, wearing apparel and leather products
7. Wood products, furniture, paper products and printing
8. Petroleum, chemical, rubber and plastic products
9. Non-metallic mineral products, basic metal and fabricated metal products
10. Electrical, electronic and optical products
11. Transport equipment, other manufacturing and repair
12. Construction
13. Electricity, gas, steam and air conditioning supply
14. Water supply, sewerage, waste management and remediation activities
15. Wholesale and retail trade, repair of motor vehicles and motorcycles
16. Transportation and Storage
17. Accommodation and food and beverage services
18. Information and communication
19. Financial and insurance/takaful activities
20. Real estate activities
21. Professional, scientific and technical activities

High, Mid- and Low-Skilled Workers

Skill categorisation is based on DOSM and MASCO 2013

High-Skilled Worker

1. Managers
2. Professionals
3. Technicians and associate professionals

Mid-Skilled Worker

1. Clerical support workers
2. Services and sales workers
3. Skilled agricultural, forestry and fishery workers
4. Craft and related trades workers
5. Plant and machine-operators and assemblers

Low-Skilled Worker

1. Elementary occupations

Low-, Medium (Mid-) and High-Tech Manufacturing

Modified as per UNIDO's classification, following OECD technology classification based on R&D intensity relative to value-added and gross production (ISIC categorisation).

High-Tech

1. Electrical, electronic and optical products
2. Transport equipment, other manufacturing and repair

Medium (Mid-) Tech

1. Petroleum, chemical, rubber and plastic products
2. Non-metallic mineral products, basic metal and fabricated metal products

Low-Tech

1. Food, Beverages and Tobacco
2. Textiles, wearing apparel and leather products
3. Wood products, furniture, paper products and printing.

Modern Services

As per ADB (2013), adapted from Eichengreen and Gupta (2009) based on labour productivity (ISIC categorisation).

1. Information and communication
2. Financial and insurance activities
3. Real estate activities
4. Professional, scientific and technical activities

Appendix 4

This section explains in detail the econometric analysis employed in this study. The baseline estimation equation of the regression is as below:

$$Y_{it} = \alpha_i + \delta_t + \beta_1 X'_{it} + \beta_2 C'_{it} + \varepsilon_{it}$$

where

(i) i denotes the sector, t denotes the year;

(ii) Y_{it} is the dependent variable, i.e. labour income share;

(iii) X'_{it} is the vector of explanatory variables of interest, including foreign workers intensity, capital intensity, and machines and equipment intensity;

(iv) C'_{it} is the vector of all other control variables, namely sectoral GDP and labour productivity;

(v) α_i and δ_t are sector and year fixed effects, respectively; and

(vi) ε_{it} is the error term.

The main coefficients of interest are β_1, which capture the extent to which the variation in labour income share can be explained by the corresponding variation in the potential determinants. The sector and year fixed effects essentially capture industry and year-specific economic and social confounding factors.

Specification Tests

Because the time dimension, T, of the dataset is small, Harris-Tzavalis test[13] is used to test for unit roots in the panel. For most of the variables, the hypothesis of the presence of unit roots cannot be rejected at level, thus first-differencing is applied to obtain stationary series. The model is also estimated using standard errors clustered by industry to address serial correlation concern in the panel. Besides, in order to detect the presence of random effect, the model is tested for overidentifying restrictions—a Hausman-type test that is robust to heteroskedasticity and within-group correlation. The test found no random effects in all specifications of the model. The joint significance of year-specific effects is also tested using F-test. For all specifications, the hypothesis that the year-specific effects are jointly statistically

[13] Harris-Tzavalis test derives a unit root test that assumes that T is fixed.

insignificant cannot be rejected, therefore year-specific effects are not included in any of them.

Robustness Measure

Our dataset suffers from very minor missing variables problem, arising from the log transformation of *foreign workers intensity* which take the value of zero[14]. These "zero" observations are from two sectors, namely *electricity, gas, steam and air conditioning supply* and *financial and insurance/takaful activities*, in years 2011 and 2012, when DOS only reported foreign workers in each sector as a percentage of the total foreign workers population, up to one decimal place[15]. Given that the number of employed foreign workers in other years for these two sectors are significantly higher than zero, we could reasonably argue that the "zero" figures reported are highly likely due to rounding down errors, rather than a true absence of foreign workers.

To deal with this, the "zero" figures are imputed with half the smallest value of the variable within the respective sector[16]. Essentially, we are adding a small value to avoid taking the log of zero, without significantly distorting the distribution of the variable. Reverse calculations are done using the imputed figures to confirm that the percentage values implied are indeed zero when rounded down to one decimal place.

[14] There are three observations from the variable *foreign workers intensity* which take the value of zero. Stata recognizes the log transformation of such observations as "missing variable". First differencing of the variable then results in a total of five missing observations eventually.

[15] In order to obtain the absolute number of employed foreign workers for those years, the percentage figures reported in the respective LFS reports are multiplied with the total number of employed foreign workers disclosed in the later LFS reports.

[16] Refer to advice from Statalist: http://www.stata.com/statalist/archive/2014-02/msg00829.html