Exploring Drivers for Small and Medium-Sized Sectors using a New Macroeconomic Model

Abstract

Why growth in final demands does not bring considerable implications on structural changes and economic growth in Malaysia? The current macroeconomic models are unable to provide explicit answer to this question because they ignore dualities in production technologies. The major limitation of the current macroeconomic models is production sectors are aggregative and thus homogeneity biases underlying in the models could not be avoided. In particular, one might get a false impression that development in some sector will “trickle down” equally to benefit all sectors. What is needed is a systematic methodological approach that links the different dualistic production structures. This paper has two objectives. First, it develops a new dataset for macroeconomic models that split the production sectors according to sizes—small, medium and large sectors. Second, using the new dataset, it analyzes the key sector for small and medium sized firms. Results indicate that growth linkages between small and medium, and large sized sectors are weak—with the growth stimuli mostly benefitted the large sized sector. For all of the production sectors regardless of their sizes, the palm-based sector (oils and fats) is one of the main key drivers.

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**1. Introduction**

Malaysia’s recent economic growth is considerably impressive, with the gross domestic product (GDP) expands at an average annual rate of 5.36% for the periods 2011-2015. The average monthly household income has increased by 8.8% from RM4,025 in 2009 to RM6,141 in 2014. A more fundamental concern is that Malaysia’s recent growth has not been accompanied by adequate structural changes. Between the periods 2011-2015, the share of GDP by main economic sectors only varies from the lowest -1.9% for the mining sector to the highest 2.3% for the services sector. Similarly, the gaps in the average income for the bottom 40% of households-to-middle 40% are marginally improve from an index of 2.521 in 2009 to 2.476 in 2012 (the last figure indicates for every *Ringgit* earned by the bottom 40% equal to 2.476 *Ringgit* earned by the middle 40%). The gaps in the average income for the bottom 40%-to-top 20% of households also marginally reduce from 6.935 in 2009 to 6.583 in 2012.

What are the factors that can be put forward to explain the lower impacts of economic growth? We are unable to provide explicit answer to this question because the current macroeconomic models are unable to deal with dualistic aspects of economic structures. In the Malaysian case, dualities exist in many aspects of the economy, ranging from the labor market to the product markets. For the product markets, there is a huge difference in structural characteristics between small, medium and large-sized firms. Although the small and medium-sized firms accounted for 97.3% of the total number of establishments in 2010, they only generated 30.2% of GDP while employing 52.7% of total workforce. Thus, there might be the case where the growth in final demands only benefits mostly the large firms. Since the large firms are essentially capital-intensive production, the impacts on income (and its distribution) are marginal.

The contribution of small and medium-sized firms (or SMEs for short) to GDP in Malaysia are relatively lower compared to other countries. For instance, SMEs comprise approximately 97% of all establishments in the OECD countries which contribute about 40-60% of GDP. The contribution of SMEs to GDP ranges from 60% in China, 57% in Germany, 55% in Japan to 50% in Korea (Bank Negara, 2003). The government has formulated several policies related to the economic growth such as emphasizing the national key economic areas (NKEA). This leads to the following questions: the extent to which these policies have affected the growth of SMEs. Do SMEs benefit the most from the designed growth policies? Similarly, number of policies has been designed for SMEs and the extent to which those policies affect the national economy. Can we neglect the contribution of SMEs? Little is known about the inter-connection between SMEs and non-SMEs, and the implication of macroeconomic policies on SMEs activities. The reason is that the industrial-linkages among SMEs and between SMEs and large firms are virtually ignored although data for SMEs production have been collected.

Failing to recognize the dualistic economic structures in the macroeconomic models implying that homogeneity assumption in the macroeconomic models cannot be avoided. Empirical evidences for other countries provide a clear indication that the homogeneity assumption underlying most macroeconomic models can lead to biases (see for example, Lee 1997; Biorn and Skjerpen, 2004; de Koning et al., 2015). If sectors serve different markets, but the production technologies adopted (which include the use of various labor types) are not identical across destinations, serious misrepresentations of reality could occur. In particular, one might get a false impression that development in some sector will “trickle down” equally to benefit all sectors. What is needed is a systematic methodological approach that links the different dualistic production structures.

This paper develops a new methodology for macroeconomic models that takes into account three different production technologies. The three different production technologies are developed and integrated in an expanded input-output table (let us termed as IO-TECH for short). We distinguish dualistic technologies on the basis of firm sizes—small, medium and large firms. Under an ideal condition, the choice of our technological criteria depends entirely upon the data availability and policy interest. Census for small and medium-sized firms is available and it can be used to support the higher disaggregation of multi-sectoral models. In relation to policy purposes, this has two main contributions. First, it develops a new dataset (IO-TECH) that improves the current macroeconomic models. This provides policy guidance for identifying and monitoring the key sectors for small, medium and large sized firms. Second, it can be used to examine the extent to which growth in final demands affects the generation of value added for small, medium and large-sized firms. This analysis is very important to evaluate spillover effects or backward linkages among difference firm sizes.

This paper is structured into five sections. Section 2 review cross-country studies on the macroeconomic impacts of different technologies and the importance to recognize the sectoral sizes in macroeconomic models. Section 3 discusses the methodologies for the construction of IO-TECH along with the data sources. Section 4 presents the main findings of our analysis. Section 5 provides concluding remarks.

**2. Literature Review**

This paper develops a new database that expands the current 2010 input-output table to include disaggregated information for small, medium and large firms. Although input-output provide the most detailed and comprehensive estimate of inter-industry flows, it is often not disaggregated enough for some analyses. This is especially true when policy maker request for the direct and indirect effects of changes in output technology that has been aggregated with other information. As such, further disaggregating the input-output table to provide useful information for policy analysis and implications remains a novelty area of research since disaggregation can be in different forms.

Literature review in this section highlights the main research gaps that support the need of this study. We divide the literature review into three main themes: (i) aggregation bias and dualistic economic structures, (ii) technological differences and implications, and (iii) small and medium-sized firm studies.

The issues of aggregation errors and biases have been documented in the past (see for example, Theil, 1957; Fisher, 1958, 1961). This led to pioneer works on the disaggregation of input-output model by Wolsky (1984) and emerging studies on input-output disaggregation (see Gretton 2005; Lindner, et al., 2012; Oosterhaven, 2014; Koning et al., 2015; Lenzen, 2011). For a more practical policy analysis and implication in recent times, see Barrera-Lozano and Vallés (2015).

In relation to the aggregation bias, both econometric and input-output studies provide a consistent finding that disaggregated macroeconomic models are superior to their aggregate counterparts in predicting economic variables. Applying econometric model, Lee (1997) confirms that analysis of output growth ideally should be carried out at the highest level of disaggregation. Biorn and Skjerpen (2004) also find that aggregation bias in output volumes, scale elasticity and total factor productivity is substantial in Translog estimation. In regional studies, Herrmann-Pillath et al. (2002) conclude that highest level of disaggregation of data is to be recommended for policy analysis.

Furthermore, a number of input-output studies highlighted the aggregation bias in measuring environmental indicators. For example, de Koning et al. (2015) show that low product categories to calculate the embodied material use will likely result in inaccurate estimations of the total embodied material for some product categories. Aggregation bias exists because the current macroeconomic models are unable to deal with dualistic economic structures. Aurangzeb and Stengos (2014) validate that foreign direct investment (FDI) inflows can have different implications on the local economy if economic sectors are differentiated between exports and non-exports.

What effects do different production technologies have on an economy? Literature has provided a clear indication that different technologies have different implications on the economy. James and Khan (1997) show that traditional technology (essentially labor-intensive) tends to be more egalitarian in their impact than the modern technology (essentially capital-intensive). At firm-level data study, Lee and Wie (2015) indicate that the diffusion of foreign technologies through imports and FDI causes demand to shift toward more skilled labor and increased wage inequality. Technological change also is found to be main driver for the increase in regional disparities in China (Liu et al., 2011). Other strands of literatures that emphasis on the importance of technological differences in production system includes Haggblade and Hazell (1989), Watanabe et al. (2004), Faber et al. (2007), Fleischer and Grunwald (2008), Hauknes and Knell (2009) and Wydra, (2011). For instance, Haggblade and Hazell (1989) show how different agricultural technologies promote different pattern of nonfarm linkages.

Representing production technologies by firm sizes (i.e. small, medium and large sized) is highly relevant for macroeconomic analysis. Small and medium firms are not only the backbone for developing and developed countries but also they are highly flexible in adapting technology and innovation (see for example, Qiao et al., 2014). Small and medium-sized firms are technically inefficient (Charoenrat et al., 2013) and thus disaggregating economic sectors by firm sizes provides an explanation of why growth policies less affected the whole economy. However, efforts to integrate small and medium-sized firms into a complete macroeconomic model are lacking. Most of the current literature emphasize only on small and medium-sized ‘ecosystem’ that moves toward environmental issues (e.g. Cagno and Trianni, 2013; Singh et al., 2015).

Specifically, studies that investigate small and medium enterprises (SMEs) in Malaysia include Onn (1990), Radam et al. (2008), Alam and Noor (2009), Muhammad et al. (2010), Husin and Ibrahim (2014), Jaharuddin et al. (2016), Wang and Yang (2016), Kasiran et al. (2016) and Maarof and Mahmud (2016). Radam et al. (2008) apply stochastic frontier analysis to examine the technical efficiency of SMEs in Malaysia. Muhammad et al. (2010) assess the competitiveness of Malaysia’s SMEs in a global environment. Alam and Noor (2009) evaluates information and communication technology adaption of SMEs in Malaysia while Wang and Yang (2016) investigate the success of knowledge management. Jaharuddin et al. (2016) focus on the supply chain and intelligence practices of SMEs in Malaysia among others. To the best of our knowledge, none of these studies in Malaysia have developed a complete SME economic “ecosystem” by integrating SMEs and non-SMEs in an inter-industrial framework.

As such, the literature review above provides a clear justification for Malaysia to have macroeconomic model that distinguishes between various technologies. In this research, we distinguish dualistic technologies on the basis of firm sizes—small, medium and large firms. Separation of a sector into small, medium and large firms can be justified based on the fact that small and medium-sized firms form 97% of total business establishments that contribute 30% and 53% of total value added and employment in 2010 respectively.

**3. Construction of IO-TECH**

In this section, we discuss first the structure of our IO-TECH, which is explained after the introduction to the standard input-output table. Next, we detail the estimation of our IO-TECH along with the data sources.

**3.1 Structure of IO-TECH**

Planning for an economy that characterized by a large size of SMEs requires a model that could capture not partial but general equilibrium analysis, taking into account the interdependencies among SMEs and non-SMEs sectors. Because economic working as a system of interactions, policies require models that capture interdependencies among all production sectors. Without such a model, it will be more difficult to carry out short and medium-term planning exercises in a systematic manner, thus affecting the quality of policies and strategies to be formulated. Indeed, this may have adverse implications on future growth and the attainment of the economic and social objectives of the country.

Development of dualistic general equilibrium models must start with the construction of an expanded input-output table that captures the dualistic economic flows. An input-output table provides a complete picture of flows of goods and services sold (demand) and bought (supply) in an economy for a given calendar year. It illustrates the interdependencies of production sectors and the relationship between producers and consumers. The formal properties for the simplified input-output accounting system are shown in Table 1.

**“Insert Table 1 here”**

The matrix $Z$ denotes the intermediate deliveries and each element of $z\_{ij}$ indicates the amount of commodity sector *i* used by sector *j*. The vector of $f$ represents final demand components (i.e. private consumption, **c**, investment, **i**. government consumption, **g** and export, **e**). Primary input components—the vector $m$ gives the sectoral imports, vector $v$ shows value added and vector $t$ is indirect tax for each sector.

In the current input-output table that constructed by the Department of Statistics Malaysia, there are 124 sectors have been included. However, the sectors are not separated between SMEs and non-SMEs. Sectors are defined as aggregated “homogenous” sectors—include SMEs and non-SMEs. For this reason, results of input-output analysis imply the impact of a grouped sector (e.g. electric and electronic) but not a specific SME (e.g. SME electric and electronic). To achieve this level of detail, the standard input-output table needs to be extended and Table 2 shows the structure of our IO-TECH.

**“Insert Table 2 here”**

In contrast to Table 1, we inter-link the intermediate demand within and between small, medium and large firms. Final demand, imports, indirect tax and value added components are also separated between small, medium and large firms. The inter-connection between Table 1 and Table 2 can be shown in the following accounting identities:

for intermediate demand,

$Z=Z^{S}+Z^{M}+Z^{L}$

$Z^{S}=Z^{SS}+Z^{SM}+Z^{SL}; Z^{M}=Z^{MS}+Z^{MM}+Z^{ML}; Z^{L}=Z^{LS}+Z^{LM}+Z^{LL}$

for imports,

$m=m^{S}+m^{M}+m^{L}$

for indirect tax,

$t=t^{S}+t^{M}+t^{L}$

for value added,

$v=v^{S}+v^{M}+v^{L}$

for output,

$x=x^{S}+x^{M}+x^{L}$

From analytical point of view, production sectors in our IO-TECH are distinguished according three different technologies whereas the ordinary input-output table implies the “average” production technology. To capture technological differences, the production sectors in the IO-TECH must be differentiated according to different production technologies. Technologies can be distinguished by using any or all of a number of criteria. Formally, we may define each element of a technology set $T,T=(t\_{1, }t\_{2, }…t\_{n) }$ where $t\_{1}$ = the *i*th characteristic of the technology $T$. Two technologies $T$ and $T'$ are distinct when there exist at least $t\_{i }$and $t'\_{i }$such that $t\_{i }\ne t'\_{i }$.

Among the technological indicators which have been utilized and proposed as admissible by previous studies are capital-labor ratio, output-capital ratio, value added per worker, ratio of skilled-to-unskilled workers, vintage and origin of capital stock, and firm size. Under an ideal condition, the choice of technological criteria depends entirely upon the data availability and policy interest. As the main concern of our investigation is focused on the macroeconomic effects of various production technologies, we distinguish dualistic technologies on the basis of firm sizes—small, medium and large firms. Census for small and medium-sized firms is available which at the later stage are integrated with other dataset. The Department of Statistics Malaysia (2005) defines the classification of small, medium and large-sized firms as follows.

**“Insert Table 3 here”**

Development of IO-TECH that separates sectors into small, medium and large firms is novel. It should be mentioned here that IO-TECH that we proposed in this project is the first attempt to construct such a comprehensive dataset that links small, medium and large sectors in literature. In the Malaysian context, there is no economic model at the Economic Planning Unit (EPU) and other institutions that is capable to address explicitly the economy-wide impacts of policy changes on production sectors that differentiated between different technologies.

**3.2 Data Sources and Harmonization**

There are three main datasets utilized for the development of IO-TECH for Malaysia. The first dataset is the latest national input-output table for 2010. Data from the input-output table are used as the control totals in the disaggregation process (see Department of Statistics Malaysia, 2014). This to ensure that the summation of the disaggregated values for small, medium and large sectors yields the control totals for each of the output, final demand and primary input components. Second dataset is micro data of Economic Census for 2010 that obtained from the Department of Statistics Malaysia. The micro data consist of 300,435 establishments and detailed for the indicators: revenue, expenditure, salary and wages, and number of establishments. These datasets provide the basis for the disaggregation of small, medium and large sectors in our IO-TECH. The third dataset are retrieved from the Profile of Small and Medium Enterprise (see Department of Statistics Malaysia, 2012). This report presents the detail information for the output and value added generated by the SMEs that was compiled based on the Economic Census for 2010.

Before we can proceed with the estimation process, the available micro datasets from the Economic Census and Profile of Small and Medium Enterprise need to be harmonized with the national input-output table. The reason is that the micro-data from the Economic Census are provided in three-digit levels of the Malaysia Standard Industrial Classification (MSIC) 2008, while the 2010 input-output table is classified based on five-digit levels. Thus, some of the sectors need to be aggregated. For instance, MSIC 01120, 01140 and 01191 respectively belongs to the paddy, food crops and flower plants sectors, but as the data are provided in three-digit levels of 011, aggregation for all these sectors are required. In addition to the aggregation constraint, the confidentiality policy prevented some of the MSIC that falls under the services sector such as defense and public order cannot be released by the Department of Statistics Malaysia. For this reason, we are not able to disaggregate the sectors into small, medium and large classifications, but instead we classify them as the rest of sectors (RoS). In the final stage of the harmonization process, we are able to identify 58 sectors with SMEs breakdown.

**3.3 Data Estimation**

The development process of IO-TECH is started with the estimation of the output for small and medium-sized sectors. The estimation involves two steps. First, output for broad SME sectors are compiled directly from the Profile of Small and Medium Enterprise. The next step is to disaggregate the broad sectors into individual sub-sectors, using the micro-data of Economic Census. The disaggregation is carried out by taking the weightage of revenue from the micro-data of Economic Census. The utilization of revenue as the weightage for the disaggregation is supported by the statistical correlation, which shows that revenue and output is 99.6% correlated[[1]](#footnote-1). For large-sized sectors, the output is estimated based on the differences between the output from the national input-output table and the estimated output for small and medium-sized sectors. Altogether, our IO-TECH captures 97% of SMEs total output and the rest of the 3% could not be estimated due to data constraints.

Data that are needed to estimate output that consumed by final demand components for SMEs is not available. For this reason, we assume that consumption of final demand components on SMEs output is derived based on the total output share of small, medium and large sectors-to-the total national output. This assumption implies that the output deliveries into final demand components are influenced by the sectoral sizes. This assumption is not seem unreasonable because Pagan (2003) found a positive and robust relationship between the level of output and the sector size. We use the output share to estimate exports, gross fixed capital formation (GFCF) and private consumption. For the change in inventory, this component is residually estimated from the total final demand (change in inventory is sub-sets of final demand). That is, the total final demand consumption (private consumption, government consumption, GFCF and export) are able to be estimated, thus the change in inventory can be residually obtained.

Next to the final demands, we need to estimate primary input components—value added, imports and indirect tax, for small and medium sectors. Procedures for the estimation of value added are similar to the estimation of output. The control totals for broad SME sectors are taken directly from the Profile of Small and Medium Enterprise. Then, the individual sub-sector within the broad sectors is estimated by taking share of revenue that obtained from the micro-data of Economic Census. Based on our estimation using the available information and provided the information from the input-output table, we are able to capture 96% of the total value added generated by the SMEs in our IO-TECH. The difference between the estimated value added and the one that reported in the SMEs report is mainly caused by the confidentiality issue as stressed in the previous sub-section. For imports and indirect tax, we generalize it from the “average” sector in the input-output table. For each sector, we calculate the import and indirect tax coefficients, and these coefficients are multiplied with the total output of small and medium-sized sectors. This implies that import requirement and indirect tax paid by small and medium-sized sectors is determined by the output sizes.

The final components to be estimated are the total intermediate demand and intermediate input for each small and medium sector. These two components are estimated residually. The total intermediate demand is residually estimated by taking differences between the total output and total final demand. The differences between total input and total primary input give the total intermediate input. Then, the intermediate matrix that shows the flows of input and output between the economic sectors are estimated using the RAS technique. Before this technique can be applied, the initial estimate of the intermediate matrix must be derived. We cannot apply the intermediate matrix from the national input-output table because it formed only one matrix whereas in our I-O TECH, the intermediate matrix has nine sub-matrices (see Table 1 and Table 2). To derive the initial estimates, we decompose the small, medium, and large sectors using the share of total intermediate demand and intermediate input. For example, sector *i* delivers output to sector *j* as intermediate demand for RM2 million in the national input-output table. To disaggregate sector *j* into small, medium and large sectors, the share of intermediate demand for small, medium and large sectors to the total intermediate demand is used. The similar procedures are applied for the disaggregation of intermediate input into small, medium and large sectors. Using the initial estimates for the intermediate matrix and provided the control totals for the intermediate demand and intermediate input, the nine sub-matrices are adjusted by using the RAS technique.

**4. Results and Discussion**

In total, our I-O TECH consists of 176 sectors, which 58 sectors are able to disaggregate into small, medium and large-sized sectors. For exposition, the simplified version of out I-O TECH is prepared and provided in Appendix 1 (in this simplified version, sectors are aggregated into five broad sectors). This section discusses the major findings that analyzed based on the I-O TECH. Discussion of the major findings can be divided into three sub-sections. First, we discuss the relative contribution of small, medium and large sectors to the total national output and value added. Second, we analyze the technological differences between small, medium and large sectors in the production of output. Third, we provide analysis of key drivers for the small, medium and large sectors by means of multiplier and linkage measures.

**4.1 Contribution of SMEs**

The contribution of small, medium and large sectors on output, value added and import is summarized in Table 4 for five broad economic sectors. The contribution of 58 sectors in each category of small, medium and large sectors are detailed in Appendix 2. In total, SMEs has contributed 23.7% (RM492.7 billion) of the total national output as compared to large-sized sectors with the contribution of 62.9% (RM1,304.6 billion). Disaggregating the contribution of SMEs into small and medium sectors, the former has contributed 13.5% (RM280.5 billion) and the latter has explained 10.2% (RM212.1 billion). Database in the Profile of Small and Medium Enterprise indicate that the total number of establishments for small, medium and large sectors is 625,245, 19,891 and 17,803. These database allowing us to correlate with the total output and so a simple index of ‘productivity’ can be measured. Taking a ratio total output-to-total number of establishments provides the productivity of the different sectoral sizes. On average, results show that there is positive association between sectoral sizes and productivity. Larger the sizes of the sector implies higher productivity. Specifically, the average production productivity for small, medium and large sectors are RM0.5 million, RM11.1 million and RM73.3 million, respectively.

**“Insert Table 4 here”**

Next, let us discuss the contribution of the five broad sectors to the specific group of small and medium sized sectors. For small-sized sector, the contribution is mainly driven by the services sector that contributes 10.0% (RM206.9 billion), followed by the manufacturing sector (3.1%, RM63.4 billion), construction sector (0.3%, RM7.2 billion), agriculture, forestry and logging and fishing sector (0.1%, RM2.6 billion), and mining and quarrying sector (0.0%, RM0.3 billion). The contribution of the small-sized services sector is generated partly by the wholesale and retail trade and motor vehicle sector with the amount of output of RM96.8 billion.

For the medium-sized sector, the contribution of the manufacturing sector is more dominant with the total contribution of 6.3% (RM130.6 billion). This value has surpassed the contribution of the services sector that only recorded the amount of output of 3.1% (RM65.3 billion). The construction sector, agriculture, forestry and logging and fishing sector, and mining and quarrying sector on the other hands, contribute 0.6% (RM12.9 billion), 0.1% (RM2.6 billion) and 0.0% (RM0.8 billion), respectively. Based on our analysis, oils and fats sector is found to be the major contributor for the output of medium-sized sectors with the amount of output produced RM39.8 billion.

In term of value added contribution, the group of SMEs generates 25.8%, the large sized sector dominates 50.4% and other sectors contribute 23.7%. Among the SMEs, the small sized sector generates more to the value added with the contribution of 17.8% compared to 8.0% by the medium sized sector. If we calculate value added-output ratio for each group, it provides an interesting observation regarding the value added intensity. It is not common to find that the small sized sector generates more value added for each unit of output produced. Specifically, the value added-output ratio for small, medium and large sized sectors is 0.506, 0.301 and 0.307, respectively (the first figure indicates that for every Ringgit of output generated by the small sector generates RM0.506 to the value added).

Additionally, we can observe in Table 5 that the value added per labor ratio or simply the productivity measure for small, medium and large sized sectors are RM54,668, RM77,241 and RM121,746 respectively. Although the small sized sector is confirmed to generate more value added for each unit of output produced, its productivity level is considerably low compared to the medium and large sized sectors. In this case, we can argue that the small sized sector is essentially labor-intensive sector. Among the broad small sized sector, mining and quarrying and services sector recorded the above average productivity level. Both of these sectors are capable of producing RM62,500 and RM60,805 of value added by each labor. For the medium sized sector, one labor in services sector produces RM98,300 of value added and RM82,677 in manufacturing sector. Meanwhile four sectors under the large sized cluster recorded the above average performance of RM235,502 (mining and quarrying), RM230,916 (agriculture, forestry and logging, and fishing), RM139,539 (services) and RM128,714 (manufacturing). Surprisingly, construction sector that is deemed to be the important sector performs below par in all sector sizes.

**“Insert Table 5 here”**

At the individual level of the small sized sector, services sector has the highest amount of value added generated by 15.4% (RM122.2 billion). The higher value added content in this sector is brought upon by the wholesale and retail trade sector with the contribution of 7.7% (RM61.4 billion). The manufacturing sector becomes the second largest value added generator by 2.0% (RM15.7 billion), then accompanied by construction sector 0.3% (RM2.8 billion), agriculture, forestry and logging and fishing sector 0.2% (RM1.3 billion), and mining and quarrying sector 0.0% (RM0.1 billion).

As previously mentioned, the medium-sized sector does not show a significance contribution to the total value added, which explains only 8.0% (RM63.9 billion). At the individual sectoral level, services sector has topped the contributor list with the total value added generated of 4.4% (RM35.1 billion). Out of this, RM19.0 billion is generated by wholesale and retail trade and motor vehicle sector. Other remaining sectors contribute 3.6% (RM28.8 billion) to the total value added with the manufacturing sector constitutes RM22.4 billion.

Analysis of import is also important to observe the extent to which the small, medium and large sized sectors are dependent on the foreign content. Results in Table 4 show that there is a positive association between sectoral sizes and import content. The smaller the sizes of the sector, the lower import content is required. Specifically, the small sized sector contributes 9.3% of total imports, medium sized sector 9.8% and large sized sector 74.8%. For small sized sector, the wholesale and retail trade and motor vehicle sector is still identified as the sector that consumes the most of the imports. For medium sized sector, the import consumption is mostly generated by the manufacturing sector with the percentage share of 7.4% (RM29.7 billion). Within the manufacturing sector, the chemical and fertilizers sector is found to contribute RM4.1 billion to the total imports of RM29.7 billion.

In summary, there are three most important points are observed in this discussion. First, the sizes of economic pie for output and value added are dominantly contributed by the large sized sector while SMEs only explains about one-thirds. Second, productivity that measured by a ratio of output-to-number of establishment, is positively correlated with the sectoral sizes. The larger of the sizes of the particular sector, the larger output will be produced. Third, the small sized sector has higher degree of value added intensity. For each Ringgit of output produced by this sector, generates RM0.506 of value added.

**4.2 Technological differences**

In Section 2, literature has provided a clear indication that different production technologies have different implications on the economy. One way to observe the production technologies is by examining the input-mix used in the production of output. For example, production of paddy that utilizes traditional technology may consume large amount of labor inputs compared to the modern technology that relying more on imported machinery equipment. In this example, production that using traditional technology would have greater value added share and the modern technology is likely to have lower value added share (due to greater import share). Input-output model allows users to analyze input-mix or ‘ingredients’ used in the production for each sector. In our case, the I-O TECH provides a better analysis because input-mix used in the small, medium and large sized can be studied extensively.

Figure 1 tabulates the percentage share of inputs used in the production of small, medium and large sized sectors, detailed into the consumption of intermediate input, imports, indirect tax and value added. For example, to produce the total output for the small sized sector, the following share of inputs is required: 35.1% from the intermediate inputs, 13.4% from imports, 0.8% from the government services (in the form of indirect) and 50.6% from value added (essentially labor and capital inputs). Of the total 35.1% consumption of intermediate inputs, 31.1% are supplied by the small sectors, 14.3% are provided by the medium sectors and 53.7% are provided by the large firm.

There are two major findings that can be observed in Figure 1. First, there is a clear weakest link between the SMEs and large sectors in the production linkages. It can be observed that small and medium sized sectors demands for 53.7% and 58.1% of the total intermediate inputs that produced by large sized sector. The large sized sector is also highly dependent on the large sector which demands 68.8% of total intermediate inputs. In other words, all the SMEs and large sector are highly connected to the large sector but the large sector less integrated with SMEs. Thus, if the government promotes investment either in SMEs or large sector, the large sector would definitely benefits the most. Second, the production of small sized sector associates with the higher value added intensity. Of the total output produced by the small sized sectors, 50.6% received by the value added, compared to 30.1% and 30.7% of value added created by the medium and large sized sectors. The main explanation behind the lower value added creation and lack of dependency of large sectors on SMEs is the imports. Imports are leakages to domestic the economy and large consumption of imports implies less value added. Usually, larger value added generation implies that small sized sector in specific contributes more to the labor income which also brings to conclusion that this sector is labor intensive.

**“Insert Figure 1 here”**

**4.3 Key drivers for small and medium-sized sectors**

The objective of this sub-section is to determine the abilities of small, medium and large-sized sectors in boosting growth of the domestic economy. Our discussion in this sub-section is derived from the multiplier and linkages analysis that take into consideration the relative sectoral sizes. This approach is important because different sectoral size will affect the economy distinctively. Appendix 5 provides the technical details for the derivation of the multipliers and linkages.

In identifying the drivers of the Malaysia economy, value added is one of the most relevant measures to be evaluated by the policy makers. It provides more useful information on the economic contribution of a sector as compared to the output measure in which it includes imports that contain foreign countries’ shares and involvement. Moreover, it is not necessarily sectors with high outputs will also have substantial value added returns (Oosterhaven, et al., 2002). With the recent government development strategies to promote high value added sectors in order to achieve the targeted economic growth, value added is chosen to be the main key measure emphasized in this report.

In measuring the potential impacts of a sector in boosting the domestic economy, value added multiplier is calculated. Value added multiplier measures the economy-wide impacts on value added for every Ringgit increases in final demand. The value added multiplier for broad small, medium and large sized sectors that decomposed into small, medium and large sized sectors are presented in Table 6 below. For example, for every Ringgit in final demand of Manufacturing sector generates RM0.2558 of value added to the entire economy. Of out the multiplier value, 6.8%, 13.7% and 79.5% are contributed by the small, medium and large sized sectors. The result for the 58 sectors is provided in Appendix 4. Appendix 4 shows that the value added multiplier is mostly driven by the large sized sector. This is given by the fact that the larger size of final demand for the particular sector, the larger multiplier effect is created. There are two sectors where the multiplier is comparable across the sectoral sizes, which are the Other Fabricated Metal and Business Services. For example, out of the total multiplier created by the Business Services sector, 39.4% are contributed by small, 23.9% by medium and 36.7% by large sized sectors.

**“Insert Table 6 here”**

For policy purposes, the most important information is to identify what are the sectors within the small and medium sized sectors can be promoted as new sources of growth. Is there any identical sector within the small and medium sized sectors can be found? Next, we are partitioning our analysis of value added multiplier by group of small and medium sectors. It is important to note here is that the multiplier does not inform the policy makers the level of economic integration of the particular sector with the rest of the sectors in the economy. To be labelled as a driver sector, besides having large impact on growth, the sector also needs to have large linkages to pass on the growth to other sectors. That is, key sectors should be the ones who acting as leaders with abilities in creating demand and spreading growth throughout the economy (Botrić, 2013; Temurshoev, and Oosterhaven, 2014). Thus, the backward and forward linkages are used as complement measures to the multiplier.

Figure 2 shows the multiplier impact for small-sized sector. The value added multiplier is plotted against output multiplier in the graph to show their respective impacts on the economy. Through our analysis, the Wholesale and Retail Trade is found to bring the largest multiplier impact. For every Ringgit increases in final demand indicates that this sector generates RM0.0376 of value added. The outstanding performance of this sector is explainable by it heterogeneous nature. Ranked in the second position, Restaurant sector also exhibits a remarkable achievement. It generates the value added multiplier of 0.0148. The observation on the four sectors with the largest multiplier impact reveals that this result is in line to the government initiative under the Economic Transformation Programme (ETP) to focus on Wholesale and Retail, Tourism, Financial Services, and Palm Oil and Rubber sectors. Woods and Paper products sector also shows a substantial impact despite its smaller size.

**“Insert Figure 2 here”**

In spite of being identified as the sector with the highest potential multiplier impact under small-sized sector cluster, Wholesale and Retail Trade fail to be labelled as the driver sector. This result is associated to the higher import content for Wholesale and Retail Trade sector if compared to the amount of inputs acquired from domestic sectors. Only Oils and Fats sector can be labelled as the driver sector due to its higher backward (5.06) and forward (1.17) linkages[[2]](#footnote-2). The amount of domestic inputs utilized by this sector is equivalent to RM9.7 billion compared to the amount of imported inputs by RM0.5 billion. Woods and Paper Products also has the potential to be promoted due to its above average backward (1.63) and forward (1.45) linkage indices. Finance and Insurance, and Restaurant sectors are the sectors that may bring substantial multiplier impacts but they do not have large growth spillover effect to pass on to other economic sectors, thus make them fail to be identified as the driver sectors.

The value added multiplier for medium-sized sector that portrayed in Figure 3 shows that Oils and Fats, and Wholesale and Retail Trade, and Motor Vehicle dominates the top ranking. However, only Oils and Fats sector brings the considerable impacts on value added (0.0145). In addition, the Chemical and Fertilizers, Food Products, and Residential and Non-residential sectors also listed as the sectors that would generate larger multiplier impacts. Furthermore, these sectors are the other potential sectors to be promoted as they assist and facilitate business activities of other segments in the economy through growth spillover effects. Compared to scenario shown in Figure 2, medium-sized sector is proven to be more diversified in terms of the economic activities as it includes manufacturing, construction and services.

**“Insert Figure 3 here”**

Recall that a sector with high multiplier impact does not necessarily have large linkages with other sectors. But in some cases, the sector may bring significant influence on both multiplier impact and linkages to other sectors and the economy as a whole. For the medium sized sector, Oils and Fats sector associated with high backward (5.33) and forward (1.10) linkages and it also exhibit higher multiplier impact. As discussed in the paragraph above, Wholesale and Retail Trade sector under medium-sized cluster also is not identified as the driver due to its low backward linkage (0.72). In addition to Oils and Fats sector, Chemical and Fertilizers, Food Products and Rubber Products sectors can be considered as drivers for the medium sized cluster. The backward and forward linkages for Chemical and Fertilizers sector are 1.76 and 1.50, Food Products 3.78 and 1.51, and Rubber Products 3.65 and 1.82.

Figure 4 presents the value added multiplier for the large sized sector and the multiplier is predominantly by the manufacturing sector except for Wholesale and Retail Trade sector. Oils and Fats sector marked an exceptional performance in the Malaysian economy as it is also identified as the driver for large-sized sector. Huge backward (45.58) and forward (7.33) linkages besides having high multiplier impact has crowned Oils and Fats sector as the backbone of the nation. The impressive performance of this sector specifically from the perspective of linkages is rooted from the increase in the production of palm oil in particular to support the demand for food and biodiesel (Johari et. al., 2015). Concurrently, Petroleum Refinery also shows decent linkages measure with backward and forward linkages are 2.86 and 1.55. Based on our discussion in the previous sub-section, semi-conductor devices and TV, radio and transmitters sector are failed to be classified as the driver sectors due to the low forward linkages. The main explanation for this situation is the sectors are primarily engaged in processing export activities, thus have lower integration with domestic sectors.

**“Insert Figure 4 here”**

**5.0 Concluding Remarks**

This paper develops a new dataset for macroeconomic models that takes into account three different production technologies. The three different production technologies are developed and integrated in an expanded input-output table (let us termed as IO-TECH for short). We distinguish dualistic technologies on the basis of firm sizes—small, medium and large firms. There are four major findings that can be summarized as follows:

1. The IO-TECH that developed in this paper is very useful for the policy makers. It does not only provide complete industrial networks among and between small, medium and large sized sectors but also can be used to assess and monitor the economic impacts of growth.
2. Our analysis that based on the IO-TECH indicates that the large sized sector contributes mostly to the output and value added generated in the economy. Decomposition of the multiplier effects clearly shows the large sized sector generates more than two-thirds of the output and multiplier for every Ringgit increases in final demand.
3. Results indicate that small and medium sized sectors are more connected to the large sector in acquiring intermediate inputs for their production of output. However, large sized sector is less dependent on small and medium sized sectors since most of the inputs are obtained within the large sized cluster and imports. The weaker industrial networks between small, medium and large sized sectors explain why growth in final demand does not bring “big” effects to the domestic economy.
4. Small sized sector provides opportunities for the Malaysian economy to find new sources of growth. For every unit of output produced, the value added created by the average small sized sector is 68% higher than the medium sized sector and 65% larger than the large sized sector.

In spite of the usefulness of analyses provided in this paper, results may be highly sensitive to the assumptions and estimation techniques used to construct the IO-TECH. Validation and sensitivity analyses to the assumptions are hardly to verify due to data availability. One way to improve the estimation is to include specific information of SMEs in the future Economic Census.

Alternatively, we have validated our estimation qualitatively through workshops and meetings with the SME Corporation Malaysia and our results are consistent with the actual observations.

**References**

Alam, S. S., and Noor, M. K. M. (2009). ICT adoption in small and medium enterprises: An empirical evidence of service sectors in Malaysia. *International Journal of Business and Management*, 4(2), 112.

Aurangzeb, Z. and Stengos, T. (2014). The role of foreign direct investment (FDI) in a dualistic growth framework: a smooth coefficient semi-parametric approach. *Borsa Istanbul Review*, 14, 133-144.

Barrera-Lozano, M., Mainar, A. J., and Vallés, J. (2015). Disaggregation of sectors in social accounting matrices using a customized Wolsky method. *Applied Economics Letters*, 22(13), 1020–1024.

Botrić, V. (2013). Identifying Key Sectors in Croatian Economy Based on Input-Output Tables. Ekonomski Institute Zaghreb.

Biorn, E. and Skjerpen, T. (2004). Aggregation biases in production functions: a panel data analysis of Translog models. *Research in Economics*, 58, 31-57.

Cagno, E. and Trianni, A. (2013). Exploring drivers for energy efficiency within small- and medium-sized enterprises: first evidences from Italian manufacturing enterprises. *Applied Energy*, 104, 276-285.

Charoerat, T., Harvie, C. and Amornkitvikai, Y. (2013). Thai manufacturing small and medium sized enterprise technical efficiency: evidence from firm-level industrial census data. *Journal of Asian Economics*, 27, 42-56.

Department of Statistics Malaysia (2012). Profile of Small and Medium Enterprise. Department of Statistics Malaysia: Putrajaya.

Faber, A., Idenburg, A. M., and Wilting, H. C. (2007). Exploring techno-economic scenarios in an input–output model. *Futures*, 39(1), 16-37.

Fleischer, T., and Grunwald, A. (2008). Making nanotechnology developments sustainable. A role for technology assessment?. *Journal of Cleaner Production*, 16(8), 889-898.

Gretton, P. (2005). Australian Input-Output Tables. *The Australian Economic Review*, 38(3), 319–332.

Haggblade, S., and Hazell, P. (1989). Agricultural technology and farm-nonfarm growth linkages. *Agricultural Economics*, 3(4), 345-364.

Hauknes, J., and Knell, M. (2009). Embodied knowledge and sectoral linkages: An input–output approach to the interaction of high-and low-tech industries. *Research Policy*, 38(3), 459-469.

Herrmann-Pillath, C., Kirchert, D. and Pan, J. (2002). Disparities in Chinese economic development: approaches on different levels of aggregation. *Economic Systems*, 26, 31-54.

Husin, M. A., and Ibrahim, M. D. (2014). The Role of Accounting Services and Impact on Small Medium Enterprises (SMEs) Performance in Manufacturing Sector from East Coast Region of Malaysia: A Conceptual Paper. *Procedia-Social and Behavioral Sciences*, 115, 54-67.

James, J. and Khan, H. (1997). Technology choice and income distribution. *World Development*, 25, 153-165.

Jaharuddin, N. S., Dato’Mansor, Z., and Yaakob, S. (2016). Assessing the Supply Chain Intelligence Practices of Small Medium Enterprises in Malaysia. *Procedia Economics and Finance*, 35, 515-521.

Johari, A., Nyakuma, B. B., Nor, S. H. M., Mat, R., Hashim, H., Ahmad, A. and Abdullah, T. A. T. (2015). The challenges and prospects of palm oil based biodiesel in Malaysia. *Energy*, 81, 255-261.

Kasiran, F. W., Mohamad, N. A., and Chin, O. (2016). Working Capital Management Efficiency: A Study on the Small Medium Enterprise in Malaysia. *Procedia Economics and Finance*, 35, 297-303.

de Koning, A., Bruckner, M., Lutter, S., Wood, R., Stadler, K. and Tukker, A. (2015). Effect of aggregation and disaggregation on embodied material use of products in input-output analysis. *Ecological Economics*, 116, 289-299.

Lee, K. (1997). Modelling economic growth in the UK: an econometric case for disaggregated sectoral analysis. *Economic Modelling*, 14, 369-394.

Lee, J-W. and Wie, D. (2015). Technological change, skill demand and wage inequality: evidence from Indonesia. *World Development*, 67, 238-250.

Lenzen, M. (2011). Aggregation versus Disaggregation in Input–Output Analysis of the Environment. *Economic Systems Research*, 23(1), 73–89.

Lindner, S., Legault, J., and Guan, D. (2012). Disaggregating Input–Output Models with Incomplete Information. *Economic Systems Research*, 24(4), 329–347.

Liu, X., Wang, X., Whalley, J. and Xin, X. (2011). Technological change and China’s regional disparities – a calibrated equilibrium analysis. *Economic Modelling*, 28, 582-588.

Loke, W. H., and Tham, S. Y. (2014). Vertical specialisation and backward linkages: Reconsidering Malaysian manufacturing development. *Malaysian Journal of Economic Studies*, 51, 57.

Maarof, M. G., and Mahmud, F. (2016). A Review of Contributing Factors and Challenges in Implementing Kaizen in Small and Medium Enterprises. *Procedia Economics and Finance*, 35, 522-531.

Miller, R.E. and Blair, P.D. (2009). *Input-output analysis: Foundations and extensions*. Cambridge University Press: Cambridge, UK.

Muhammad, M. Z., Char, A. K., bin Yasoa, M. R., and Hassan, Z. (2010). Small and medium enterprises (SMEs) competing in the global business environment: A case of Malaysia. *International Business Research*, 3(1), 66.

Oosterhaven, J. and Stelder, D. (2002). Net multipliers avoid exaggerating impacts: with a bi-regional illustration for the Dutch transportation sector. *Journal of Regional Science*, 42, 553-543.

Pagano, P. (2003). Firm size distribution and growth. *The Scandinavian Journal of Economics*, 105(2), 255-274.

Qiao, P-H., Ju, X-F. and Fung, H-G. (2014). Industry association networks, innovations, and firm performance in Chinese small and medium-sized enterprises. *China Economic Review*, 29, 213-228.

Radam, A., Abu, M. L., and Abdullah, A. M. (2008). Technical efficiency of small and medium enterprise in Malaysia: A stochastic frontier production model. *International Journal of Economics and Management*, 2(2), 395-408.

Singh, M., Brueckner, M. and Padhy, P.K. (2015). Environmental management system ISO 14001: effective waste minimization in small and medium enterprises in India. *Journal of Cleaner Production*, 102, 285-301.

Temurshoev, U. and Oosterhaven, J. (2014). Analytical and empirical comparison of policy-relevant key sector measures. *Spatial Economic Analysis*, 9, 284-308.

Wang, M. H., and Yang, T. Y. (2016). Investigating the success of knowledge management: An empirical study of small-and medium-sized enterprises. *Asia Pacific Management Review*.

Watanabe, C., Matsumoto, K., and Hur, J. Y. (2004). Technological diversification and assimilation of spillover technology: Canon's scenario for sustainable growth. *Technological Forecasting and Social Change*, 71(9), 941-959.

Wydra, S. (2011). Production and employment impacts of biotechnology—input–output analysis for Germany. *Technological Forecasting and Social Change*, 78(7), 1200-1209.

Wolsky, A. M. (1984). Disaggregating input-output models. *The Review of Economics and Statistics*, 283-291.

**Table 1**. Simplified input-output table

|  |  |  |  |
| --- | --- | --- | --- |
|   | Intermediate demand | Final demand | Total output |
| S1 | S2 | S3 | **.** | **.** | **.** | S*n* | **c** | **i** | **g** | **e** |
| Sector 1 (S1) | $Z$(intermediate demand required among production sectors) | $f$ (final demand) | $x$ (total output) |
| Sector 2 (S2) |
| Sector 3 (S3) |
| **.** |
| **.** |
| **.** |
| Sector *n* (S*n*) |
| Import | $m$(imported intermediate input) |  |  |  |  |  |
| Indirect tax | $t$(taxes paid) |  |  |  |  |  |
| Value added | $v$(value added) |  |  |  |  |  |
| Total input | $x'$ (total input) |  |  |  |  |  |

**Table 2**.Separation of SME and non-SME sectors in input-output table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   |  | Intermediate demand | Final demand $(f)$ | Total output $(x)$ |
| Small (S) | Medium (M) | Large (L) |
| Intermediate input $(Z)$ | Small (S) | Intermediate demand among small firms$$(Z^{SS})$$ | Intermediate demand from small firms$$(Z^{SM})$$ | Intermediate demand from small firms$$(Z^{SL})$$ | Final demand of small firms $$(f^{S})$$ | Total output of small firms$$(x^{S})$$ |
| Medium (M) | Intermediate demand from medium firms$$(Z^{MS})$$ | Intermediate demand among medium firms$$(Z^{MM})$$ | Intermediate demand from medium firms$$(Z^{ML})$$ | Final demand of medium firms$$(f^{M})$$ | Total output of medium firms$$(x^{M})$$ |
| Large (L) | Intermediate demand from large firms$$(Z^{LS})$$ | Intermediate demand from large firms$$(Z^{ML})$$ | Intermediate demand among large firms$$(Z^{LL})$$ | Final demand of large firms$$(f^{L})$$ | Total output of large firms$$(x^{L})$$ |
| Import $(m)$ | Imports of small firms $(m^{S})$ | Imports of medium firms $(m^{M})$ | Imports of large firms $(m^{L})$ |  |  |
| Taxes $(t)$ | Indirect tax paid by small firms $(t^{S})$ | Indirect tax paid by medium firms $(t^{M})$ | Indirect tax paid by large firms $(t^{L})$ |  |  |
| Value added $(v)$ | Value added of small firms $(v^{S})$ | Value added of medium firms $(v^{M})$ | Value added of large firms $(v^{L})$ |  |  |
| Total input $(X')$ | Total input of small firms $(x'^{S})$ | Total input of medium firms $(x'^{M})$ | Total input of large firms $(x'^{L})$ |  |  |

**Table 3**. Classification of small, medium and large firms in Malaysia

|  |  |
| --- | --- |
| Firm sizes  | Definition  |
| Manufacturing sector  |
| Small  | Between 5 and 50 full-time employees/Between RM250,000 and less than RM10 million annual sales turnover  |
| Medium  | Between 50 and 150 full-time employees/Between RM10 million and RM25 million annual sales turnover  |
| Large  | More than 150 full-time employees/more than RM25 million annual sales turnover  |
| The rest of the sectors (Agriculture, mining and quarrying, construction and services)  |
| Small  | Between 5 and 20 full-time employees/Between RM200,000 and less than RM1 million annual sales turnover  |
| Medium  | Between 20 and 50 full-time employees/Between RM1 million and RM5 million annual sales turnover  |
| Large  | More than 50 full-time employees/more than RM5 million annual sales turnover  |

Source: Department of Statistics Malaysia (2005)

**Table 4.** The contribution of small, medium and large sectors on output, value added and import

|  |  |  |  |
| --- | --- | --- | --- |
| Sector | Output | VA | Import |
| RM billion |  %  | RM billion |  %  | RM billion |  %  |
| **Small** | **280.5** | **13.5** | **142.1** | **17.8** | **37.6** | **9.3** |
| Agriculture, Forestry and Logging, and Fishing | 2.6 | 0.1 | 1.3 | 0.2 | 0.3 | 0.1 |
| Mining and Quarrying | 0.3 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| Manufacturing | 63.4 | 3.1 | 15.7 | 2.0 | 15.7 | 3.9 |
| Construction | 7.2 | 0.3 | 2.8 | 0.3 | 1.4 | 0.3 |
| Services | 206.9 | 10.0 | 122.2 | 15.4 | 20.2 | 5.0 |
| **Medium** | **212.1** | **10.2** | **63.9** | **8.0** | **39.6** | **9.8** |
| Agriculture, Forestry and Logging, and Fishing | 2.6 | 0.1 | 1.4 | 0.2 | 0.2 | 0.1 |
| Mining and Quarrying | 0.8 | 0.0 | 0.3 | 0.0 | 0.1 | 0.0 |
| Manufacturing | 130.6 | 6.3 | 22.4 | 2.8 | 29.7 | 7.4 |
| Construction | 12.9 | 0.6 | 4.8 | 0.6 | 2.4 | 0.6 |
| Services | 65.3 | 3.1 | 35.1 | 4.4 | 7.1 | 1.8 |
| **Large** | **1,304.6** | **62.9** | **401.1** | **50.4** | **301.4** | **74.8** |
| Agriculture, Forestry and Logging, and Fishing | 118.7 | 5.7 | 72.0 | 9.0 | 10.7 | 2.7 |
| Mining and Quarrying | 8.0 | 0.4 | 6.2 | 0.8 | 0.7 | 0.2 |
| Manufacturing | 707.1 | 34.1 | 143.3 | 18.0 | 233.5 | 57.9 |
| Construction | 70.7 | 3.4 | 19.9 | 2.5 | 12.0 | 3.0 |
| Services | 400.1 | 19.3 | 159.6 | 20.0 | 44.4 | 11.0 |
| **Rest of Sectors** | **276.9** | **13.4** | **189.0** | **23.7** | **24.5** | **6.1** |
| Crude Oil and Natural Gas | 98.0 | 4.7 | 81.9 | 10.3 | 5.5 | 1.4 |
| Others | 178.9 | 8.6 | 107.1 | 13.5 | 19.0 | 4.7 |
| **Total** | **2,074.2** | **100** | **796.1** | **100** | **403.1** | **100** |

**Table 5.** Productivity of broad small, medium and large sectors

|  |  |  |  |
| --- | --- | --- | --- |
| Sector |  Small (RM)  | Medium (RM) | Large (RM) |
| Agriculture, Forestry and Logging, and Fishing |  33,202  |  34,432  |  230,916  |
| Mining and Quarrying |  62,500  |  67,129  |  235,502  |
| Manufacturing |  36,643  |  82,677  |  128,714  |
| Construction |  23,051  |  30,661  |  28,486  |
| Services |  60,805  |  98,300  |  139,539  |
| **Total Sector** |  **54,668**  |  **77,241**  |  **121,746**  |

**Table 6.** Net Multiplier for broad small, medium and large sectors

|  |  |  |
| --- | --- | --- |
| Sector | Output | Value Added |
| Total | Small (%) | Medium (%) | Large (%) | Total | Small (%) | Medium (%) | Large (%) |
| Agriculture, Forestry and Logging, and Fishing | 0.0482 | 3.2 | 2.4 | 94.4 | 0.0233 | 2.6 | 2.0 | 95.4 |
| Mining and Quarrying | 0.0011 | 5.6 | 12.5 | 81.9 | 0.0007 | 3.4 | 7.3 | 89.3 |
| Manufacturing | 0.8542 | 6.3 | 15.5 | 78.2 | 0.2558 | 6.8 | 13.7 | 79.5 |
| Construction | 0.1156 | 6.5 | 12.4 | 81.0 | 0.0373 | 7.8 | 13.8 | 78.4 |
| Services | 0.4351 | 30.5 | 9.8 | 59.7 | 0.1930 | 36.1 | 10.5 | 53.4 |

Figure 1. Technological differences between small, medium and large sized sectors



Figure 2. Output and value added multipliers of small sized sectors



Figure 3. Output and value added multipliers of medium sized sectors



Figure 4. Output and value added multipliers of large sized sectors



**Appendix 1**. Simplified IO-TECH

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **IO-TECH (RM million)** | Commodity | Agriculture, Forestry and Logging, and Fishing | Mining and Quarrying | Manufacturing | Construction | Services | Agriculture, Forestry and Logging, and Fishing | Mining and Quarrying | Manufacturing | Construction | Services |
| **Commodity** |  | Small | Medium |
| Agriculture, Forestry and Logging, and Fishing | Small | 1 | - | 19 | 0 | 38 | 0 | - | 76 | 0 | 3 |
| Mining and Quarrying | 0 | 0 | 4 | 1 | 0 | 0 | 0 | 18 | 6 | 1 |
| Manufacturing | 28 | 2 | 1,755 | 166 | 1,632 | 38 | 11 | 5,421 | 468 | 860 |
| Construction | 2 | 0 | 32 | 27 | 44 | 8 | 0 | 110 | 48 | 70 |
| Services | 300 | 55 | 6,873 | 576 | 19,050 | 174 | 108 | 8,360 | 618 | 5,331 |
| Agriculture, Forestry and Logging, and Fishing | Medium | 0 | - | 52 | 0 | 18 | 1 | - | 111 | 0 | 3 |
| Mining and Quarrying | 0 | 0 | 42 | 10 | 3 | 0 | 2 | 122 | 37 | 5 |
| Manufacturing | 66 | 3 | 2,578 | 226 | 2,208 | 122 | 28 | 14,638 | 585 | 1,878 |
| Construction | 3 | 0 | 44 | 27 | 60 | 8 | 0 | 120 | 95 | 78 |
| Services | 101 | 26 | 2,545 | 212 | 5,865 | 48 | 36 | 2,134 | 152 | 1,672 |
| Agriculture, Forestry and Logging, and Fishing | Large | 25 | - | 2,472 | 0 | 986 | 29 | - | 5,202 | 1 | 162 |
| Mining and Quarrying | 0 | 3 | 439 | 104 | 27 | 2 | 16 | 1,282 | 387 | 48 |
| Manufacturing | 159 | 14 | 6,906 | 892 | 6,297 | 321 | 88 | 32,636 | 2,316 | 5,222 |
| Construction | 6 | 0 | 105 | 137 | 151 | 20 | 1 | 287 | 518 | 200 |
| Services | 402 | 98 | 7,555 | 633 | 25,482 | 150 | 132 | 6,193 | 436 | 6,694 |
| Crude Oil and Natural Gas | RoS | - | - | 134 | 0 | 63 | - | - | 1,144 | 0 | 13 |
| Others | 0 | - | 31 | 0 | 660 | 0 | - | 136 | 1 | 94 |
| **TOTAL INTERMEDIATE INPUT** |  | **1,093** | **201** | **31,587** | **3,011** | **62,584** | **922** | **422** | **77,989** | **5,668** | **22,334** |
| Imported Commodities |  | 255 | 30 | 15,715 | 1,409 | 20,193 | 229 | 68 | 29,707 | 2,414 | 7,137 |
| Taxes on Products |  | 10 | 2 | 403 | 29 | 1,930 | 19 | 4 | 578 | 51 | 672 |
| Value Added |  | 1,281 | 108 | 15,690 | 2,772 | 122,214 | 1,384 | 271 | 22,366 | 4,764 | 35,141 |
| **TOTAL OUTPUT** |  | **2,640** | **341** | **63,395** | **7,220** | **206,920** | **2,554** | **764** | **130,640** | **12,898** | **65,283** |

**Appendix 1**. Simplified IO-TECH (Continued)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **IO-TECH (RM million)** | Commodity | Agriculture, Forestry and Logging, and Fishing | Mining and Quarrying | Manufacturing | Construction | Services | Crude Oil and Natural Gas | Others | Total Intermediate Demand |
| **Commodity** |  | Large | RoS |  |
| Agriculture, Forestry and Logging, and Fishing | Small | 73 | - | 1,325 | 0 | 106 | - | 0 | 1,641 |
| Mining and Quarrying | 1 | 1 | 164 | 80 | 22 | 3 | 0 | 302 |
| Manufacturing | 697 | 18 | 10,536 | 2,459 | 2,394 | 543 | 1,376 | 28,406 |
| Construction | 89 | 0 | 450 | 321 | 238 | 109 | 524 | 2,072 |
| Services | 3,639 | 154 | 21,824 | 2,515 | 26,820 | 610 | 6,789 | 103,796 |
| Agriculture, Forestry and Logging, and Fishing | Medium | 186 | - | 1,323 | 1 | 78 | - | 3 | 1,775 |
| Mining and Quarrying | 2 | 2 | 260 | 127 | 35 | 32 | 0 | 678 |
| Manufacturing | 1,886 | 38 | 22,696 | 3,423 | 3,746 | 884 | 2,488 | 57,494 |
| Construction | 144 | 0 | 729 | 861 | 436 | 153 | 658 | 3,415 |
| Services | 1,110 | 61 | 7,938 | 828 | 7,988 | 349 | 2,821 | 33,888 |
| Agriculture, Forestry and Logging, and Fishing | Large | 8,932 | - | 62,363 | 49 | 4,018 | - | 133 | 84,373 |
| Mining and Quarrying | 23 | 17 | 2,733 | 1,334 | 371 | 336 | 4 | 7,124 |
| Manufacturing | 10,819 | 450 | 90,361 | 17,974 | 37,785 | 3,793 | 9,715 | 225,747 |
| Construction | 344 | 3 | 1,745 | 5,079 | 1,522 | 983 | 3,440 | 14,543 |
| Services | 7,057 | 311 | 46,566 | 3,434 | 105,130 | 2,338 | 22,065 | 234,677 |
| Crude Oil and Natural Gas | RoS | - | - | 54,500 | 0 | 27 | 267 | - | 56,147 |
| Others | 24 | - | 679 | 12 | 2,131 | - | 2,381 | 6,151 |
| **TOTAL INTERMEDIATE INPUT** |  | **35,026** | **1,056** | **326,193** | **38,498** | **192,847** | **10,400** | **52,398** | **862,229** |
| Imported Commodities |  | 10,696 | 710 | 233,523 | 12,025 | 44,418 | 5,542 | 18,987 | 403,056 |
| Taxes on Products |  | 919 | 38 | 4,015 | 297 | 3,190 | 198 | 429 | 12,784 |
| Value Added |  | 72,030 | 6,229 | 143,342 | 19,908 | 159,609 | 81,905 | 107,088 | 796,102 |
| **TOTAL OUTPUT** |  | **118,671** | **8,033** | **707,073** | **70,728** | **400,064** | **98,045** | **178,902** | **2,074,171** |

**Appendix 1**. Simplified IO-TECH (Continued)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **IO-TECH (RM million)** | Commodity | Private Consumption | Government Consumption | Gross Fixed Capital Formation | Change in Inventory | Total Export | Total Final Demand | Total Demand |
| **Commodity** |  |  |  |  |  |  |  |  |
| Agriculture, Forestry and Logging, and Fishing | Small | 636 | - | 108 | 7 | 247 | 999 | 2,640 |
| Mining and Quarrying | - | - | - | 2 | 37 | 39 | 341 |
| Manufacturing | 5,984 | - | 1,490 | 532 | 26,982 | 34,989 | 63,395 |
| Construction | 1,082 | - | 3,754 | (0) | 313 | 5,148 | 7,220 |
| Services | 63,757 | - | 4,605 | 1,078 | 33,685 | 103,124 | 206,920 |
| Agriculture, Forestry and Logging, and Fishing | Medium | 422 | - | 90 | 9 | 258 | 779 | 2,554 |
| Mining and Quarrying | - | - | - | 4 | 83 | 86 | 764 |
| Manufacturing | 13,514 | - | 1,830 | 2,532 | 55,269 | 73,146 | 130,640 |
| Construction | 1,622 | - | 7,227 | 0 | 635 | 9,483 | 12,898 |
| Services | 16,384 | - | 1,637 | 374 | 13,000 | 31,395 | 65,283 |
| Agriculture, Forestry and Logging, and Fishing | Large | 18,587 | - | 3,230 | 413 | 12,068 | 34,298 | 118,671 |
| Mining and Quarrying | - | - | - | 37 | 871 | 908 | 8,033 |
| Manufacturing | 64,801 | - | 17,081 | 4,611 | 394,832 | 481,326 | 707,073 |
| Construction | 4,132 | - | 47,680 | - | 4,373 | 56,185 | 70,728 |
| Services | 103,608 | - | 4,733 | 860 | 56,185 | 165,387 | 400,064 |
| Crude Oil and Natural Gas | RoS | 136 | - | - | (442) | 42,204 | 41,898 | 98,045 |
| Others | 61,906 | 101,380 | 6,132 | (157) | 3,489 | 172,750 | 178,902 |
| **TOTAL INTERMEDIATE INPUT** |  | **356,571** | **101,380** | **99,597** | **9,861** | **644,534** | **1,211,941** | **2,074,171** |
| Imported Commodities |  | 56,083 | 5,161 | 78,064 | 3,973 | 35,658 | 178,939 | 581,995 |
| Taxes on Products |  | 9,407 | 6 | 4,923 | - | 5,492 | 19,829 | 32,613 |
| Value Added |  | - | - | - | - | - | - | - |
| **TOTAL OUTPUT** |  |  |  |  |  |  |  |  |

**Appendix 2**. The contribution of small, medium and large sectors on output, value added and import

| Sector | Output | Value Added | Import |
| --- | --- | --- | --- |
| RM billion | % | RM billion | % | RM billion | % |
| **Small** |  **280.5**  |  **13.5**  |  **142.1**  |  **17.8**  |  **37.6**  |  **9.3**  |
| Crops |  1.7  |  0.1  |  1.0  |  0.1  |  0.1  |  0.0  |
| Poultry and Livestock |  0.4  |  0.0  |  0.1  |  0.0  |  0.1  |  0.0  |
| Forestry and Logging  |  0.1  |  0.0  |  0.0  |  0.0  |  0.0  |  0.0  |
| Fishing |  0.4  |  0.0  |  0.1  |  0.0  |  0.1  |  0.0  |
| Mining and Quarrying |  0.3  |  0.0  |  0.1  |  0.0  |  0.0  |  0.0  |
| Meat and Meat Production |  0.2  |  0.0  |  0.0  |  0.0  |  0.0  |  0.0  |
| Preservation of Seafood |  0.4  |  0.0  |  0.1  |  0.0  |  0.0  |  0.0  |
| Preservation of Fruits and Vegetables |  0.1  |  0.0  |  0.0  |  0.0  |  0.0  |  0.0  |
| Food Products |  3.4  |  0.2  |  0.5  |  0.1  |  1.0  |  0.2  |
| Oils and Fats  |  11.9  |  0.6  |  1.7  |  0.2  |  0.5  |  0.1  |
| Wine, Spirit and Soft Drink |  0.6  |  0.0  |  0.2  |  0.0  |  0.1  |  0.0  |
| Tobacco Products |  0.1  |  0.0  |  0.0  |  0.0  |  0.0  |  0.0  |
| Textile, Wearing Apparel and Leather Products |  2.5  |  0.1  |  1.0  |  0.1  |  0.6  |  0.2  |
| Wood Products, Paper and Paper Products and Furniture |  10.1  |  0.5  |  3.1  |  0.4  |  1.7  |  0.4  |
| Petroleum Refinery |  0.3  |  0.0  |  0.1  |  0.0  |  0.1  |  0.0  |
| Chemicals and Fertilizers |  4.7  |  0.2  |  1.1  |  0.1  |  1.2  |  0.3  |
| Pharmaceuticals, Chemicals & Botanical Product |  0.4  |  0.0  |  0.1  |  0.0  |  0.1  |  0.0  |
| Rubber Products |  2.8  |  0.1  |  0.6  |  0.1  |  0.7  |  0.2  |
| Plastics Products |  4.2  |  0.2  |  1.1  |  0.1  |  1.5  |  0.4  |
| Glass, Ceramic, Cement, Lime and Plaster and Other Non-Metallic Mineral Products |  3.3  |  0.2  |  0.9  |  0.1  |  0.6  |  0.2  |
| Iron and Steel Products |  2.2  |  0.1  |  0.4  |  0.1  |  0.7  |  0.2  |
| Basic Precious and Non-Ferrous Metals |  0.8  |  0.0  |  0.2  |  0.0  |  0.5  |  0.1  |
| Casting of Metals |  0.4  |  0.0  |  0.1  |  0.0  |  0.2  |  0.1  |
| Metal Products and Machineries |  3.2  |  0.2  |  1.0  |  0.1  |  1.5  |  0.4  |
| Other Fabricated Metal Products  |  4.3  |  0.2  |  1.4  |  0.2  |  1.5  |  0.4  |
| Domestic Appliances |  0.4  |  0.0  |  0.1  |  0.0  |  0.1  |  0.0  |
| Electrical Machineries |  0.6  |  0.0  |  0.2  |  0.0  |  0.3  |  0.1  |
| Insulated Wires and Cables & Electric Lamp and Lighting Equipment |  1.0  |  0.0  |  0.3  |  0.0  |  0.6  |  0.1  |
| Semi-Conductor Devices, Tubes and Circuit Boards |  0.9  |  0.0  |  0.3  |  0.0  |  0.5  |  0.1  |
| TV, Radio Receivers & Transmitters & Asso. Goods |  0.3  |  0.0  |  0.1  |  0.0  |  0.2  |  0.0  |
| Medical, Surgical and Orthopaedic Appliances |  0.0  |  0.0  |  0.0  |  0.0  |  0.0  |  0.0  |
| Instruments and Appliances for Measuring, Checking, Testing, Navigating and Other Purpose  |  0.1  |  0.0  |  0.0  |  0.0  |  0.1  |  0.0  |
| Optical Instruments and Photographic Equipment |  0.0  |  0.0  |  0.0  |  0.0  |  0.0  |  0.0  |
| Motor Vehicles  |  1.2  |  0.1  |  0.3  |  0.0  |  0.5  |  0.1  |
| Motorcycles, Ships and Boats, and Other Transport Equipment |  0.9  |  0.0  |  0.3  |  0.0  |  0.3  |  0.1  |
| Other Manufacturing |  1.2  |  0.1  |  0.3  |  0.0  |  0.3  |  0.1  |
| Repair & Maintenance |  0.9  |  0.0  |  0.3  |  0.0  |  0.1  |  0.0  |
| Electricity and Gas, and Waterworks |  0.7  |  0.0  |  0.2  |  0.0  |  0.1  |  0.0  |
| Sewerage, Waste Collection & Remediation Activities |  0.3  |  0.0  |  0.1  |  0.0  |  0.1  |  0.0  |
| Residential and Non-Residential |  2.8  |  0.1  |  1.1  |  0.1  |  0.4  |  0.1  |
| Civil Engineering |  1.4  |  0.1  |  0.5  |  0.1  |  0.3  |  0.1  |
| Special Trade Works |  3.0  |  0.1  |  1.1  |  0.1  |  0.8  |  0.2  |
| Accommodation |  0.8  |  0.0  |  0.4  |  0.1  |  0.0  |  0.0  |
| Restaurants |  29.3  |  1.4  |  13.2  |  1.7  |  3.1  |  0.8  |
| Land Transport |  6.0  |  0.3  |  2.7  |  0.3  |  1.0  |  0.3  |
| Water Transport |  1.2  |  0.1  |  0.5  |  0.1  |  0.1  |  0.0  |
| Other Transport Services, Port and Airport Operation Services, and Highway, Bridge and Tunnel Operation Services |  3.1  |  0.2  |  1.4  |  0.2  |  0.6  |  0.2  |
| Communications |  0.1  |  0.0  |  0.0  |  0.0  |  0.0  |  0.0  |
| Publishing Activity |  0.3  |  0.0  |  0.2  |  0.0  |  0.0  |  0.0  |
| Telecommunications |  0.3  |  0.0  |  0.1  |  0.0  |  0.0  |  0.0  |
| Cinema, Video and Television Activity |  0.7  |  0.0  |  0.4  |  0.0  |  0.0  |  0.0  |
| ICT & Computer Services |  1.1  |  0.1  |  0.5  |  0.1  |  0.1  |  0.0  |
| Real Estate |  10.8  |  0.5  |  6.6  |  0.8  |  0.5  |  0.1  |
| Rental and Leasing |  1.6  |  0.1  |  0.6  |  0.1  |  0.2  |  0.1  |
| Professional |  11.4  |  0.5  |  6.6  |  0.8  |  0.7  |  0.2  |
| Business Services |  5.9  |  0.3  |  2.2  |  0.3  |  0.5  |  0.1  |
| Wholesale & Retail Trade and Motor Vehicle |  96.8  |  4.7  |  61.4  |  7.7  |  11.8  |  2.9  |
| Finance and Insurance |  36.7  |  1.8  |  25.1  |  3.2  |  1.1  |  0.3  |

**Appendix 2**. The contribution of small, medium and large sectors on output, value added and import (continued)

| Sector | Output | Value Added | Import |
| --- | --- | --- | --- |
| RM billion | % | RM billion | % | RM billion | % |
| **Medium** |  **212.1**  |  **10.2**  |  **63.9**  |  **8.0**  |  **39.6**  |  **9.8**  |
| Crops |  1.6  |  0.1  |  1.0  |  0.1  |  0.1  |  0.0  |
| Poultry and Livestock |  0.4  |  0.0  |  0.1  |  0.0  |  0.0  |  0.0  |
| Forestry and Logging  |  0.4  |  0.0  |  0.2  |  0.0  |  0.0  |  0.0  |
| Fishing |  0.2  |  0.0  |  0.1  |  0.0  |  0.0  |  0.0  |
| Mining and Quarrying |  0.8  |  0.0  |  0.3  |  0.0  |  0.1  |  0.0  |
| Meat and Meat Production |  0.7  |  0.0  |  0.1  |  0.0  |  0.1  |  0.0  |
| Preservation of Seafood |  1.2  |  0.1  |  0.1  |  0.0  |  0.1  |  0.0  |
| Preservation of Fruits and Vegetables |  0.3  |  0.0  |  0.0  |  0.0  |  0.1  |  0.0  |
| Food Products |  11.4  |  0.6  |  1.3  |  0.2  |  3.3  |  0.8  |
| Oils and Fats  |  39.8  |  1.9  |  4.5  |  0.6  |  1.7  |  0.4  |
| Wine, Spirit and Soft Drink |  0.7  |  0.0  |  0.2  |  0.0  |  0.2  |  0.0  |
| Tobacco Products |  0.1  |  0.0  |  0.0  |  0.0  |  0.0  |  0.0  |
| Textile, Wearing Apparel and Leather Products |  1.1  |  0.1  |  0.3  |  0.0  |  0.3  |  0.1  |
| Wood Products, Paper and Paper Products and Furniture |  8.5  |  0.4  |  2.0  |  0.2  |  1.4  |  0.3  |
| Petroleum Refinery |  0.6  |  0.0  |  0.1  |  0.0  |  0.1  |  0.0  |
| Chemicals and Fertilizers |  15.7  |  0.8  |  3.8  |  0.5  |  4.1  |  1.0  |
| Pharmaceuticals, Chemicals & Botanical Product |  1.0  |  0.1  |  0.3  |  0.0  |  0.3  |  0.1  |
| Rubber Products |  9.8  |  0.5  |  0.9  |  0.1  |  2.5  |  0.6  |
| Plastics Products |  5.2  |  0.3  |  1.5  |  0.2  |  1.8  |  0.4  |
| Glass, Ceramic, Cement, Lime and Plaster and Other Non-Metallic Mineral Products |  4.7  |  0.2  |  1.2  |  0.2  |  0.9  |  0.2  |
| Iron and Steel Products |  4.0  |  0.2  |  0.6  |  0.1  |  1.4  |  0.3  |
| Basic Precious and Non-Ferrous Metals |  3.5  |  0.2  |  0.5  |  0.1  |  2.0  |  0.5  |
| Casting of Metals |  0.4  |  0.0  |  0.1  |  0.0  |  0.2  |  0.0  |
| Metal Products and Machineries |  2.1  |  0.1  |  0.5  |  0.1  |  1.0  |  0.2  |
| Other Fabricated Metal Products  |  6.7  |  0.3  |  1.5  |  0.2  |  2.3  |  0.6  |
| Domestic Appliances |  0.4  |  0.0  |  0.1  |  0.0  |  0.2  |  0.0  |
| Electrical Machineries |  1.1  |  0.1  |  0.2  |  0.0  |  0.5  |  0.1  |
| Insulated Wires and Cables & Electric Lamp and Lighting Equipment |  3.1  |  0.1  |  0.5  |  0.1  |  1.8  |  0.4  |
| Semi-Conductor Devices, Tubes and Circuit Boards |  0.7  |  0.0  |  0.2  |  0.0  |  0.4  |  0.1  |
| TV, Radio Receivers & Transmitters & Asso. Goods |  3.0  |  0.1  |  1.0  |  0.1  |  1.4  |  0.3  |
| Medical, Surgical and Orthopaedic Appliances |  0.0  |  0.0  |  0.0  |  0.0  |  0.0  |  0.0  |
| Instruments and Appliances for Measuring, Checking, Testing, Navigating and Other Purpose  |  0.1  |  0.0  |  0.0  |  0.0  |  0.0  |  0.0  |
| Optical Instruments and Photographic Equipment |  0.2  |  0.0  |  0.1  |  0.0  |  0.2  |  0.0  |
| Motor Vehicles  |  1.4  |  0.1  |  0.3  |  0.0  |  0.6  |  0.2  |
| Motorcycles, Ships and Boats, and Other Transport Equipment |  0.9  |  0.0  |  0.3  |  0.0  |  0.2  |  0.1  |
| Other Manufacturing |  1.9  |  0.1  |  0.2  |  0.0  |  0.5  |  0.1  |
| Repair & Maintenance |  0.2  |  0.0  |  0.1  |  0.0  |  0.0  |  0.0  |
| Electricity and Gas, and Waterworks |  0.7  |  0.0  |  0.3  |  0.0  |  0.1  |  0.0  |
| Sewerage, Waste Collection & Remediation Activities |  0.2  |  0.0  |  0.1  |  0.0  |  0.0  |  0.0  |
| Residential and Non-Residential |  6.0  |  0.3  |  2.2  |  0.3  |  0.8  |  0.2  |
| Civil Engineering |  2.5  |  0.1  |  1.0  |  0.1  |  0.5  |  0.1  |
| Special Trade Works |  4.4  |  0.2  |  1.6  |  0.2  |  1.1  |  0.3  |
| Accommodation |  1.0  |  0.1  |  0.5  |  0.1  |  0.1  |  0.0  |
| Restaurants |  2.6  |  0.1  |  1.1  |  0.1  |  0.3  |  0.1  |
| Land Transport |  3.8  |  0.2  |  1.5  |  0.2  |  0.6  |  0.2  |
| Water Transport |  1.9  |  0.1  |  0.8  |  0.1  |  0.2  |  0.1  |
| Other Transport Services, Port and Airport Operation Services, and Highway, Bridge and Tunnel Operation Services |  3.3  |  0.2  |  1.3  |  0.2  |  0.7  |  0.2  |
| Communications |  0.2  |  0.0  |  0.1  |  0.0  |  0.0  |  0.0  |
| Publishing Activity |  0.2  |  0.0  |  0.1  |  0.0  |  0.0  |  0.0  |
| Telecommunications |  0.2  |  0.0  |  0.1  |  0.0  |  0.0  |  0.0  |
| Cinema, Video and Television Activity |  0.4  |  0.0  |  0.2  |  0.0  |  0.0  |  0.0  |
| ICT & Computer Services |  1.2  |  0.1  |  0.6  |  0.1  |  0.1  |  0.0  |
| Real Estate |  2.6  |  0.1  |  1.6  |  0.2  |  0.1  |  0.0  |
| Rental and Leasing |  0.2  |  0.0  |  0.0  |  0.0  |  0.0  |  0.0  |
| Professional |  4.0  |  0.2  |  2.1  |  0.3  |  0.3  |  0.1  |
| Business Services |  3.7  |  0.2  |  1.1  |  0.1  |  0.3  |  0.1  |
| Wholesale & Retail Trade and Motor Vehicle |  32.4  |  1.6  |  19.0  |  2.4  |  4.0  |  1.0  |
| Finance and Insurance |  6.7  |  0.3  |  4.5  |  0.6  |  0.2  |  0.0  |

**Appendix 2**. The contribution of small, medium and large sectors on output, value added and import (continued)

| Sector | Output | Value Added | Import |
| --- | --- | --- | --- |
| RM billion | % | RM billion | % | RM billion | % |
| **Large** |  **1,304.6**  |  **62.9**  |  **401.1**  |  **50.4**  |  **301.4**  |  **74.8**  |
| Crops |  76.1  |  3.7  |  56.4  |  7.1  |  6.0  |  1.5  |
| Poultry and Livestock |  11.1  |  0.5  |  5.2  |  0.7  |  1.4  |  0.3  |
| Forestry and Logging  |  20.0  |  1.0  |  6.2  |  0.8  |  1.7  |  0.4  |
| Fishing |  11.5  |  0.6  |  4.3  |  0.5  |  1.7  |  0.4  |
| Mining and Quarrying |  8.0  |  0.4  |  6.2  |  0.8  |  0.7  |  0.2  |
| Meat and Meat Production |  1.4  |  0.1  |  0.3  |  0.0  |  0.2  |  0.1  |
| Preservation of Seafood |  2.4  |  0.1  |  0.5  |  0.1  |  0.2  |  0.0  |
| Preservation of Fruits and Vegetables |  0.5  |  0.0  |  0.1  |  0.0  |  0.1  |  0.0  |
| Food Products |  22.3  |  1.1  |  7.9  |  1.0  |  6.5  |  1.6  |
| Oils and Fats  |  77.7  |  3.7  |  1.2  |  0.2  |  3.4  |  0.8  |
| Wine, Spirit and Soft Drink |  5.0  |  0.2  |  1.5  |  0.2  |  1.3  |  0.3  |
| Tobacco Products |  1.9  |  0.1  |  1.3  |  0.2  |  0.3  |  0.1  |
| Textile, Wearing Apparel and Leather Products |  10.0  |  0.5  |  3.3  |  0.4  |  2.5  |  0.6  |
| Wood Products, Paper and Paper Products and Furniture |  30.2  |  1.5  |  6.0  |  0.7  |  5.0  |  1.2  |
| Petroleum Refinery |  103.4  |  5.0  |  22.6  |  2.8  |  21.8  |  5.4  |
| Chemicals and Fertilizers |  53.4  |  2.6  |  9.8  |  1.2  |  14.1  |  3.5  |
| Pharmaceuticals, Chemicals & Botanical Product |  2.4  |  0.1  |  1.2  |  0.2  |  0.8  |  0.2  |
| Rubber Products |  18.8  |  0.9  |  0.6  |  0.1  |  4.7  |  1.2  |
| Plastics Products |  13.4  |  0.6  |  1.0  |  0.1  |  4.7  |  1.2  |
| Glass, Ceramic, Cement, Lime and Plaster and Other Non-Metallic Mineral Products |  17.0  |  0.8  |  2.5  |  0.3  |  3.2  |  0.8  |
| Iron and Steel Products |  21.8  |  1.1  |  3.4  |  0.4  |  7.5  |  1.9  |
| Basic Precious and Non-Ferrous Metals |  7.7  |  0.4  |  0.8  |  0.1  |  4.4  |  1.1  |
| Casting of Metals |  4.2  |  0.2  |  0.7  |  0.1  |  2.0  |  0.5  |
| Metal Products and Machineries |  63.4  |  3.1  |  16.5  |  2.1  |  30.2  |  7.5  |
| Other Fabricated Metal Products  |  7.5  |  0.4  |  1.6  |  0.2  |  2.5  |  0.6  |
| Domestic Appliances |  2.5  |  0.1  |  0.6  |  0.1  |  1.0  |  0.3  |
| Electrical Machineries |  5.7  |  0.3  |  1.3  |  0.2  |  2.7  |  0.7  |
| Insulated Wires and Cables & Electric Lamp and Lighting Equipment |  6.5  |  0.3  |  0.5  |  0.1  |  3.8  |  1.0  |
| Semi-Conductor Devices, Tubes and Circuit Boards |  96.1  |  4.6  |  20.8  |  2.6  |  54.4  |  13.5  |
| TV, Radio Receivers & Transmitters & Asso. Goods |  66.2  |  3.2  |  24.6  |  3.1  |  31.2  |  7.7  |
| Medical, Surgical and Orthopaedic Appliances |  1.4  |  0.1  |  0.4  |  0.1  |  0.5  |  0.1  |
| Instruments and Appliances for Measuring, Checking, Testing, Navigating and Other Purpose  |  2.3  |  0.1  |  0.4  |  0.0  |  1.1  |  0.3  |
| Optical Instruments and Photographic Equipment |  3.8  |  0.2  |  0.4  |  0.0  |  2.5  |  0.6  |
| Motor Vehicles  |  30.3  |  1.5  |  3.2  |  0.4  |  14.0  |  3.5  |
| Motorcycles, Ships and Boats, and Other Transport Equipment |  13.8  |  0.7  |  1.8  |  0.2  |  3.7  |  0.9  |
| Other Manufacturing |  10.1  |  0.5  |  5.4  |  0.7  |  2.7  |  0.7  |
| Repair & Maintenance |  3.9  |  0.2  |  1.0  |  0.1  |  0.6  |  0.2  |
| Electricity and Gas, and Waterworks |  40.0  |  1.9  |  18.1  |  2.3  |  8.4  |  2.1  |
| Sewerage, Waste Collection & Remediation Activities |  2.6  |  0.1  |  0.9  |  0.1  |  0.5  |  0.1  |
| Residential and Non-Residential |  38.4  |  1.9  |  12.1  |  1.5  |  5.4  |  1.3  |
| Civil Engineering |  21.8  |  1.0  |  5.8  |  0.7  |  4.0  |  1.0  |
| Special Trade Works |  10.5  |  0.5  |  2.0  |  0.3  |  2.7  |  0.7  |
| Accommodation |  7.7  |  0.4  |  3.3  |  0.4  |  0.4  |  0.1  |
| Restaurants |  5.8  |  0.3  |  0.5  |  0.1  |  0.6  |  0.2  |
| Land Transport |  10.7  |  0.5  |  2.6  |  0.3  |  1.8  |  0.5  |
| Water Transport |  8.8  |  0.4  |  3.2  |  0.4  |  1.1  |  0.3  |
| Other Transport Services, Port and Airport Operation Services, and Highway, Bridge and Tunnel Operation Services |  35.9  |  1.7  |  8.8  |  1.1  |  7.5  |  1.9  |
| Communications |  2.5  |  0.1  |  0.9  |  0.1  |  0.5  |  0.1  |
| Publishing Activity |  1.4  |  0.1  |  0.9  |  0.1  |  0.1  |  0.0  |
| Telecommunications |  55.5  |  2.7  |  18.0  |  2.3  |  6.8  |  1.7  |
| Cinema, Video and Television Activity |  3.7  |  0.2  |  2.1  |  0.3  |  0.2  |  0.0  |
| ICT & Computer Services |  19.1  |  0.9  |  8.2  |  1.0  |  1.7  |  0.4  |
| Real Estate |  16.2  |  0.8  |  6.2  |  0.8  |  0.7  |  0.2  |
| Rental and Leasing |  3.6  |  0.2  |  1.7  |  0.2  |  0.5  |  0.1  |
| Professional |  29.6  |  1.4  |  19.5  |  2.4  |  1.9  |  0.5  |
| Business Services |  5.3  |  0.3  |  3.1  |  0.4  |  0.4  |  0.1  |
| Wholesale & Retail Trade and Motor Vehicle |  73.3  |  3.5  |  31.1  |  3.9  |  8.9  |  2.2  |
| Finance and Insurance |  78.4  |  3.8  |  30.4  |  3.8  |  2.3  |  0.6  |
| **Rest of Sectors** |  **276.9**  |  **13.4**  |  **189.0**  |  **23.7**  |  **24.5**  |  **6.1**  |
| Crude Oil and Natural Gas |  98.0  |  4.7  |  81.9  |  10.3  |  5.5  |  1.4  |
| Others |  178.9  |  8.6  |  107.1  |  13.5  |  19.0  |  4.7  |
| **Total** |  **2,074.2**  |  **100.0**  |  **796.1**  |  **100.0**  |  **403.1**  |  **100.0**  |

**Appendix 3**. Technological Difference

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sector | Small | Medium | Large | Rest of Sectors |
| RM million | % | RM million | % | RM million | % | RM million | % |
| **A. Small**  |  **30,604**  |  **10.9**  |  **21,730**  |  **10.2**  |  **73,928**  |  **5.7**  |  **9,955**  |  **3.6**  |
| Agriculture, Forestry and Logging, and Fishing |  58  |  0.0  |  79  |  0.0  |  1,504  |  0.1  |  0  |  0.0  |
| Mining and Quarrying |  5  |  0.0  |  25  |  0.0  |  269  |  0.0  |  3  |  0.0  |
| Manufacturing |  3,584  |  1.3  |  6,798  |  3.2  |  16,105  |  1.2  |  1,919  |  0.7  |
| Construction |  104  |  0.0  |  236  |  0.1  |  1,098  |  0.1  |  634  |  0.2  |
| Services |  26,853  |  9.6  |  14,592  |  6.9  |  54,952  |  4.2  |  7,399  |  2.7  |
| **B. Medium** |  **14,089**  |  **5.0**  |  **21,873**  |  **10.3**  |  **53,899**  |  **4.1**  |  **7,388**  |  **2.7**  |
| Agriculture, Forestry and Logging, and Fishing |  71  |  0.0  |  115  |  0.1  |  1,587  |  0.1  |  3  |  0.0  |
| Mining and Quarrying |  54  |  0.0  |  165  |  0.1  |  426  |  0.0  |  32  |  0.0  |
| Manufacturing |  5,082  |  1.8  |  17,250  |  8.1  |  31,790  |  2.4  |  3,372  |  1.2  |
| Construction |  133  |  0.0  |  301  |  0.1  |  2,170  |  0.2  |  810  |  0.3  |
| Services |  8,750  |  3.1  |  4,042  |  1.9  |  17,926  |  1.4  |  3,170  |  1.1  |
| **C. Large** |  **52,894**  |  **18.9**  |  **62,343**  |  **29.4**  |  **408,421**  |  **31.3**  |  **42,807**  |  **15.5**  |
| Agriculture, Forestry and Logging, and Fishing |  3,484  |  1.2  |  5,394  |  2.5  |  75,362  |  5.8  |  133  |  0.0  |
| Mining and Quarrying |  573  |  0.2  |  1,735  |  0.8  |  4,477  |  0.3  |  340  |  0.1  |
| Manufacturing |  14,268  |  5.1  |  40,582  |  19.1  |  157,389  |  12.1  |  13,508  |  4.9  |
| Construction |  399  |  0.1  |  1,026  |  0.5  |  8,694  |  0.7  |  4,423  |  1.6  |
| Services |  34,170  |  12.2  |  13,606  |  6.4  |  162,499  |  12.5  |  24,403  |  8.8  |
| **D. Rest of Sectors** |  **889**  |  **0.3**  |  **1,389**  |  **0.7**  |  **57,373**  |  **4.4**  |  **2,648**  |  **1.0**  |
| Crude Oil and Natural Gas |  197  |  0.1  |  1,157  |  0.5  |  54,526  |  4.2  |  267  |  0.1  |
| Others |  692  |  0.2  |  231  |  0.1  |  2,847  |  0.2  |  2,381  |  0.9  |
| **Total Intermediate Input** |  **98,476**  |  **35.1**  |  **107,335**  |  **50.6**  |  **593,620**  |  **45.5**  |  **62,798**  |  **22.7**  |
| Imported Commodities |  37,602  |  13.4  |  39,555  |  18.6  |  301,371  |  23.1  |  24,529  |  8.9  |
| Taxes on Products  |  2,373  |  0.8  |  1,324  |  0.6  |  8,459  |  0.6  |  628  |  0.2  |
| Value Added |  142,065  |  50.6  |  63,926  |  30.1  |  401,118  |  30.7  |  188,993  |  68.2  |
| **Total Output** |  **280,516**  |  **100**  |  **212,139**  |  **100**  |  **1,304,569**  |  **100**  |  **276,947**  |  **100**  |

**Appendix 4**. Output and value added multipliers adjusted for relative sizes

|  |  |  |
| --- | --- | --- |
| Sector | Output | Value Added |
| Total  | Small (%) | Medium (%) | Large (%) | Total  | Small (%) | Medium (%) | Large (%) |
| Crops | 0.0167 | 2.6 | 2.3 | 95.1 | 0.0109 | 2.1 | 1.9 | 96.0 |
| Poultry and Livestock | 0.0153 | 4.4 | 3.5 | 92.1 | 0.0064 | 3.4 | 2.6 | 94.0 |
| Forestry and Logging | 0.0045 | 0.2 | 1.7 | 98.1 | 0.0015 | 0.3 | 2.3 | 97.4 |
| Fishing | 0.0117 | 3.7 | 1.3 | 95.0 | 0.0045 | 3.5 | 1.3 | 95.2 |
| Mining and Quarrying | 0.0011 | 5.6 | 12.5 | 81.9 | 0.0007 | 3.4 | 7.3 | 89.3 |
| Meat and Meat Production | 0.0017 | 9.2 | 32.8 | 58.0 | 0.0005 | 9.4 | 28.9 | 61.7 |
| Preservation of Seafood | 0.0046 | 9.1 | 34.1 | 56.7 | 0.0013 | 9.3 | 29.6 | 61.0 |
| Preservation of Fruits and Vegetables | 0.0009 | 9.6 | 34.1 | 56.4 | 0.0003 | 9.0 | 28.0 | 63.0 |
| Food Products | 0.0377 | 10.2 | 36.3 | 53.5 | 0.0121 | 8.8 | 26.9 | 64.3 |
| Oils and Fats | 0.1588 | 8.6 | 33.3 | 58.0 | 0.0478 | 9.1 | 30.4 | 60.5 |
| Wine, Spirit and Soft Drink | 0.0081 | 9.1 | 12.3 | 78.6 | 0.0026 | 9.1 | 10.3 | 80.6 |
| Tobacco Products | 0.0021 | 3.1 | 4.2 | 92.6 | 0.0013 | 2.7 | 2.9 | 94.3 |
| Textile, Wearing Apparel and Leather Products | 0.0143 | 17.0 | 8.3 | 74.6 | 0.0051 | 19.1 | 7.8 | 73.1 |
| Wood Products, Paper and Paper Products, and Furniture | 0.0450 | 18.6 | 17.2 | 64.1 | 0.0132 | 21.9 | 17.2 | 61.0 |
| Petroleum Refinery | 0.0874 | 0.3 | 0.7 | 99.0 | 0.0370 | 0.2 | 0.5 | 99.2 |
| Chemicals and Fertilizers | 0.0596 | 6.0 | 20.9 | 73.2 | 0.0169 | 6.6 | 21.6 | 71.8 |
| Pharmaceuticals, Chemicals and Botanical Product | 0.0012 | 10.9 | 34.1 | 55.0 | 0.0005 | 9.9 | 24.3 | 65.9 |
| Rubber Products | 0.0315 | 7.3 | 31.9 | 60.9 | 0.0061 | 10.9 | 29.4 | 59.7 |
| Plastics Products | 0.0198 | 16.3 | 20.0 | 63.8 | 0.0047 | 20.7 | 25.1 | 54.2 |
| Glass, Ceramic, Cement, Lime and Plaster, and Other Non-Metallic Mineral Products | 0.0066 | 12.2 | 17.3 | 70.5 | 0.0020 | 14.0 | 19.4 | 66.6 |
| Iron and Steel Products | 0.0065 | 7.3 | 14.5 | 78.1 | 0.0015 | 8.8 | 13.8 | 77.4 |
| Basic Precious and Non-Ferrous Metals | 0.0126 | 6.4 | 28.5 | 65.1 | 0.0025 | 8.2 | 29.0 | 62.8 |
| Casting of Metals | 0.0004 | 8.3 | 8.6 | 83.2 | 0.0001 | 9.4 | 7.7 | 82.9 |
| Metal Products and Machineries | 0.0701 | 4.4 | 3.2 | 92.4 | 0.0203 | 5.2 | 3.0 | 91.8 |
| Other Fabricated Metal Products | 0.0127 | 21.4 | 36.9 | 41.7 | 0.0036 | 25.9 | 34.7 | 39.3 |
| Domestic Appliances | 0.0041 | 10.1 | 12.8 | 77.1 | 0.0012 | 12.2 | 12.3 | 75.5 |
| Electrical Machineries | 0.0084 | 7.5 | 15.7 | 76.7 | 0.0022 | 9.1 | 13.9 | 77.0 |
| Insulated Wires and Cables, and Electric Lamp and Lighting Equipment | 0.0117 | 7.3 | 27.3 | 65.3 | 0.0023 | 11.7 | 30.3 | 58.0 |
| Semi-Conductor Devices, Tubes and Circuit Boards | 0.1085 | 0.9 | 0.6 | 98.5 | 0.0281 | 1.1 | 0.8 | 98.1 |
| TV, Radio Receivers and Transmitters, and Asso. Goods | 0.0723 | 0.6 | 4.5 | 95.0 | 0.0271 | 0.5 | 4.1 | 95.4 |
| Medical, Surgical and Orthopaedic Appliances | 0.0019 | 2.2 | 1.6 | 96.2 | 0.0006 | 2.4 | 1.7 | 95.9 |
| Instruments and Appliances for Measuring, Checking, Testing, Navigating and Other Purpose | 0.0027 | 4.7 | 1.7 | 93.6 | 0.0007 | 6.2 | 2.4 | 91.4 |
| Optical Instruments and Photographic Equipment | 0.0041 | 0.8 | 4.5 | 94.7 | 0.0008 | 1.2 | 8.0 | 90.8 |
| Motor Vehicles | 0.0291 | 3.0 | 3.6 | 93.3 | 0.0050 | 5.4 | 5.7 | 88.9 |
| Motorcycles, Ships and Boats, and Other Transport Equipment | 0.0212 | 5.1 | 5.1 | 89.8 | 0.0050 | 7.2 | 6.5 | 86.3 |
| Other Manufacturing | 0.0083 | 10.9 | 21.3 | 67.8 | 0.0035 | 8.6 | 11.7 | 79.6 |
| Repair and Maintenance | 0.0004 | 15.8 | 4.0 | 80.2 | 0.0001 | 19.0 | 4.4 | 76.6 |
| Electricity and Gas, and Waterworks | 0.0137 | 1.7 | 1.6 | 96.7 | 0.0062 | 1.6 | 1.7 | 96.7 |
| Sewerage, Waste Collection and Remediation Activities | 0.0005 | 8.0 | 6.3 | 85.7 | 0.0002 | 8.8 | 7.0 | 84.2 |
| Residential and Non-Residential | 0.0663 | 5.6 | 12.1 | 82.3 | 0.0219 | 6.4 | 13.0 | 80.6 |

**Appendix 4**. Output and value added multipliers adjusted for relative sizes

|  |  |  |
| --- | --- | --- |
| Sector | Output | Value Added |
| Total (RM) | Small (%) | Medium (%) | Large (%) | Total (RM) | Small (%) | Medium (%) | Large (%) |
| Civil Engineering | 0.0346 | 5.0 | 9.0 | 86.0 | 0.0109 | 6.1 | 10.4 | 83.5 |
| Special Trade Works | 0.0147 | 14.5 | 22.1 | 63.5 | 0.0045 | 18.5 | 26.3 | 55.3 |
| Accommodation | 0.0098 | 7.9 | 10.9 | 81.2 | 0.0042 | 8.8 | 11.3 | 79.8 |
| Restaurants | 0.0480 | 72.8 | 7.1 | 20.1 | 0.0186 | 79.5 | 7.0 | 13.6 |
| Land Transport | 0.0102 | 26.2 | 17.5 | 56.4 | 0.0037 | 31.3 | 18.9 | 49.7 |
| Water Transport | 0.0147 | 9.3 | 16.0 | 74.7 | 0.0057 | 10.6 | 16.9 | 72.6 |
| Other Transport Services | 0.0305 | 6.1 | 6.8 | 87.0 | 0.0100 | 8.2 | 8.3 | 83.4 |
| Communications | 0.0031 | 2.2 | 6.1 | 91.7 | 0.0012 | 2.7 | 7.4 | 89.9 |
| Publishing Activity | 0.0021 | 17.3 | 12.2 | 70.5 | 0.0010 | 15.9 | 11.0 | 73.2 |
| Telecommunications | 0.0471 | 0.4 | 0.3 | 99.4 | 0.0172 | 0.5 | 0.3 | 99.2 |
| Cinema, Video and Television Activity | 0.0031 | 16.4 | 8.1 | 75.5 | 0.0016 | 15.5 | 7.7 | 76.8 |
| ICT and Computer Services | 0.0083 | 4.6 | 5.0 | 90.4 | 0.0035 | 5.3 | 5.6 | 89.2 |
| Rental and Leasing | 0.0017 | 32.1 | 3.4 | 64.5 | 0.0007 | 30.1 | 2.8 | 67.1 |
| Professional | 0.0181 | 26.6 | 10.0 | 63.4 | 0.0101 | 25.2 | 8.7 | 66.1 |
| Business Services | 0.0055 | 41.9 | 27.8 | 30.2 | 0.0024 | 39.4 | 23.9 | 36.7 |
| Wholesale and Retail Trade, and Motor Vehicle | 0.1528 | 43.0 | 15.7 | 41.3 | 0.0755 | 49.9 | 16.1 | 34.0 |
| Finance and Insurance | 0.0660 | 24.4 | 4.5 | 71.1 | 0.0313 | 31.3 | 5.6 | 63.1 |

**Appendix 5**. Linkages and multipliers adjusted for sectoral sizes

Temurshoev and Oosterhaven (2014) show that backward and forward linkages that adjusted for relative sectoral sizes can be summarized as follows,

$B\_{i}=\sum\_{i}^{}l\_{ij}(f\_{i}/x\_{i})$ for backward linkages (A1)

$F\_{i}=\sum\_{j}^{}b\_{ij}(d\_{i}/x\_{i})$ for forward linkages (A2)

where $l\_{ij}$ is element of Leontief inverse matrix and $b\_{ij}$ is element of Ghosh inverse matrix. The Leontief inverse matrix can be derived using the following well known expressions.

$x=(I-A)^{-1}f=Lf$ (A3)

where $x$isthevector for gross output, $ A$ $ (A=Z\hat{x}^{-1})$ is known as the technical coefficient or input-output coefficient, $I$is the identity matrix, $(I-A)^{-1}$ is known as the Leontief inverse matrix and $f$is the vector for final demand.

The Ghosh inverse matrix can be obtained using the following expressions.

$x'=d'\left(I-B\right)^{-1}=d'G$ (A4)

where $x'$is the row vector gross input, $B$ $ (B=\hat{x}^{-1}Z)$ represents the output coefficient matrix and $d'$ is the vector of primary inputs (i.e. value added and imports). Each element of the matrix output coefficient shows the delivery $z\_{ij}$ of commodity sector *i* to sector *j* per unit of the seller’s output.

This study employs the hypothetical extraction method (HEM) to measure the backward and forward linkages. The central idea of the HEM is that the hypothetical elimination of a complete sector in the economic system allows us to estimate the economy-wide contribution of the particular sector (for overview, see Temurshoev and Oosterhaven, 2014). Leaving the technical production process in a variant, it assumed that the inputs required for the production are no longer delivered by the sector within the system, but has its origin outside the system. For backward linkages, HEM nullifies the *i*-th column of the input coefficient matrix, denoted by $A^{-i}$, and nullifies the *i*-th element of the final demand vector, denoted by $f^{-i}$. As a consequence of this nullifying process, the vector of total output after extracting sector i is given by:

$x\_{l}^{-i}=L^{-i}f^{-i}$ with $L^{-i}=(I-A^{-i})^{-1}$ (A5)

For forward linkages, HEM nullifies the *i*-th row of the output coefficient matrix, denoted by $B^{-i}$, and nullifies the *i-*th element of the primary input vector, denoted by $d^{-i}$. Thus, the total input after extracting of sector *i* is given by:

$x\_{b}^{-i}=(d^{-i})'G^{-i}$ with $G^{-i}=(I-B^{-i})^{-1}$ (A6)

The *normalized* backward and forward linkages due to the complete extraction can be derived as follows:

$\acute{B}=\frac{i^{'}x-i'x\_{l}^{-i}}{x\_{i}}$ and $\acute{F\_{j}}=\frac{x'i-(x\_{b}^{-i})'i}{x\_{i}}$(A7)

where $i^{'}x-i'x\_{l}^{-i}$and $x'i-(x\_{b}^{-i})'i$ represent the total output and total input after extraction of the sector *i*.

For a more policy-oriented analysis, equations (A5) to (A7) can be further extended in a generalized form, taking into account specific variables, such as value added, tax and employment. To illustrate, let us consider the value added-linkages, given 𝜋 as the value added-coefficient (indicating the value added use per unit of output). In matrix form, the value added coefficient can be expressed as $\hat{π}=\hat{v}\hat{x}^{-1}$, where value added is formed in a diagonal matrix. We can simply derive the backward and forward linkage measures for value added as follows;

$\acute{B\_{i}}=\frac{i^{'}v-i'v\_{l}^{-i}}{v\_{i}}$ and $\acute{F\_{i}}=\frac{v'i-(v\_{b}^{-i})'i}{v\_{i}}$(A8)

where $v\_{i}=π\_{i}x\_{i}$, $v\_{l}^{-i}=\hat{π}L^{-i}f^{-i}$and$v\_{b}^{-i}=(d^{-i})'G^{-i}\hat{π}$.

Next, we detail the derivation of multipliers that adjusted for sectoral relative shares. Following Miller and Blair (2009), the output multipliers that are adjusted for sectoral sizes can be derived as follows,

$\tilde{L}=L\left⟨f\right.\left⟨i'\right.\left.\left.f\right⟩^{-1}\right⟩i$(A9)

where $\left⟨f\right.\left⟨i'\right.\left.\left.f\right⟩^{-1}\right⟩i$is a diagonal matrix showing each sector’s final demand as a proportion of the total final demand, $f\_{i}/\sum\_{i}^{}f\_{i}$; that is, a measure of relative sectoral sizes. Therefore, equation (A9) shows the effect on a sector’s output due to a $1 increase in final demand, which is distributed across sectors according to their proportion to total final demand. This type of multiplier is also called ‘growth equalized’ multiplier in Miller and Blair (2009).

To measure the multiplier for primary input components such as value added, we can extend equation (A9) as follows,

$v^{'}=π^{'}L\left⟨f\right.\left⟨i^{'}\right.\left.\left.f\right⟩^{-1}\right⟩i=π'L\hat{f}$ (A10)

It is also important to note that the final demand vector,$ f$ consists of private consumption, government consumption, investment and exports. Therefore, the equation (A10) has a unique feature that can be further extended to account for the multiplier impact of a specific final demand component on the value added. We are able to determine the sectors with the highest multiplier impact on value added for each $1 increase in exports, private consumption and so on.

1. We run correlation between revenue and output using the micro-data for the manufacturing sector, which obtained from the Malaysia Productivity Corporation (MPC). We could not run the correlation for other sectors due to data unavailability. [↑](#footnote-ref-1)
2. If the values of both forward and backward linkages are greater than one for a particular sector, this implies that the sector plays a significant role in the domestic economic growth by boosting value added of other sectors (backward linkages) and supporting value added of other sectors (forward linkages). [↑](#footnote-ref-2)