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# Intersectoral Linkages in Oil Palm Industry between Malaysia and Indonesia

*(Rantaian Hubungan Industri Minyak Sawit Malaysia dan Indonesia)*

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*ABSTRACT*

*Malaysia and Indonesia are both major producers of palm oil. The palm oil industry in both countries has contributed immensely to rural income and development. The purpose of this paper is to empirically contrast the similarities and differences in linkages between the Malaysian and Indonesian palm oil industry.The assessment is carried out using the hypothetical extraction method. Data used in this study were from Malaysian and Indonesian 2005 Input-Output Table. Empirical findings of this study revealed several similarities and differences of Malaysian and Indonesian palm oil industry. The linkage analyses in this paper indicated that for both Malaysia and Indonesia, the oil palm cultivation sector is economically more linked to the manufacturing sector than to the agriculture or service sectors. In other words, the cultivation sector not only has a strong economic pull on the manufacturing sector, but also strong economic push as well. The processing sector was found to be more backwardly linked to the agriculture sector and more forwardly linked to the manufacturing sector. Comparing the Malaysian palm oil industry to the Indonesian palm oil industry, the empirical findings indicated that the palm oil industry in Malaysia is more interconnected to the rest of the production sectors than it is in Indonesia. The overall implication of this is that the the Malaysian palm oil industry has greater influence on its economy than the industry does on the overall economy of Indonesia.*

*Keywords: Palm oil industry; hypothetical extraction method; forward and backward linkages*

*ABSTRAK*

*Malaysia dan Indonesia adalah pengeluar utama minyak sawit. Industri minyak sawit dalam kedua-dua negara ini telah menyumbang kepada Keluaran Dalam Negara Kasar (KDNK) dan eksport. Tujuan kertas ini adalah membanding secara empirik hubungan rantaian industri minyak sawit Malaysia dan Indonesia. Kajian ini menggunakan kaedah pengekstrakan hipotetikal. Data yang digunakan dalam kajian ini adalah Jadual Input-Output 2005 bagi Malaysia dan Indonesia. Penemuan kajian menunjukkan persamaan dan perbezaan industri minyak sawit Malaysia dengan Indonesia. Analisis rantaian menunjukkan sektor penanaman kelapa sawit Malaysia dan Indonesia mempunyai rantaian ekonomi yang lebih tinggi dengan sektor pembuatan berbanding sektor pertanian dan perkhidmatan. Dengan erti kata lain, sektor penanaman kelapa sawit bukan sahaja mempunyai hubungan ekonomi yang kuat dengan sektor pembuatan tetapi juga tolakan ekonomi yang kukuh. Sektor pemprosesan didapati mempunyai kaitan rantaian ke belakang dengan sektor pertanian dan mempunyai kaitan rantaian ke hadapan yang kukuh dengan sektor pembuatan. Selanjutnya, penemuan menunjukkan industri minyak sawit Malaysia mempunyai rantaian yang lebih tinggi dengan sektor pengeluaran lain berbanding Indonesia. Secara keseluruhan, industri minyak sawit Malaysia mempunyai pengaruh yang lebih besar ke atas ekonomi keseluruhan berbanding Indonesia.*

*Kata kunci: Industri minyak sawit; kaedah pengekstrakan hipotetikal; rantaian ke hadapan dan rantaian ke belakang*

## INTRODUCTION

Palm oil is a versatile vegetable oil with a variety uses in food and non-food industries. In the early 1960's, major palm oil producers and exporters were located in the African continent with Nigeria being the largest, followed by the Republic of Congo and Cameroon. However, since oil palm can be grown in tropical climate with abundant rain, Malaysia and Indonesia adopted the crop as a means to diversify their economic base. The two countries began investing heavily in oil palm cultivation and palm oil production. Beginning 1970, Malaysia became the largest producer of palm oil, with Nigeria second and Indonesia third. With further expansion of oil palm cultivation area, Indonesia overtook Nigeria as the second largest producer of palm oil in the mid-70's. By 2000, Malaysia and Indonesia become the world major producers and exporters of palm oil, with combined productions and

exports comprising more than 80% of the world total. With further expansion of cultivation area, Indonesia became the world's largest producer and exporter of palm oil beginning 2008.Table 1 shows palm oil production by major producers in selected years.

The palm oil industry is comprised of an upstream cultivation sector and downstream processing sector. As such this industry plays many strategic roles in the economy of both Malaysia and Indonesia. While the upstream cultivation sector provides rural employments and earnings, and stimulate rural development, output from downstream processing activities provide intermediate inputs in food and non-food industries; thus indirectly create even more employments in a variety of food processing and manufacturing industries, in trades and export services.

The economic importance of palm oil industry in Malaysia and Indonesia are very significant. Oil palm is Indonesia's second largest agricultural output after rice. With the cultivation sector being very labour intensive and with over 50% of its population situated in the rural area, the palm oil industry in Indonesia is a major contributor to rural employment. It is estimated that the oil palm sector provides direct and indirect employment to some six million people in rural regions of Indonesia and is thus a significant contributor in the alleviation of rural poverty (World Growth 2011). In Malaysia, although manual labourers in oil palm estates are almost exclusively comprised of foreign laborers, the palm oil industry is the fourth contributor to the national economy after oil and gas, tourism and manufacturing sectors. The Malaysian Government has targeted the palm oil industry to be a major contributor of growth in its Economic Transformation Program launched in 2010.[1] This sector is targeted to raise its contribution to gross national income from US$17.6 billion to US$59.3 billion in 2020 through programs that improve its upstream productivity and sustainability, and downstream expansion and sustainability.[2]

In spite of the enormous significance of the oil palm industry in the Malaysian and Indonesian economies, they are not quite in the same stage of industrial development. Indonesia is a late comer in terms of large scale oil palm cultivation and downstream refinery processing. As such, it is highly probable that the oil palm industry in Malaysia will exhibit different linkage structure versus that of Indonesia. Therefore, understanding the similarities and diffreences of linkage structure of oil palm industry in the two countries will provide greater insight into their relative importance to other sectors of the economy, and how policy implemented in one sector can affect other sectors of the economy. With this in mind, the purpose of this paper is to empirically contrast the similarities and differences in linkages structure between the Malaysian and Indonesian palm oil industry. The linkage structure is evaluated from the point of view of the backward and forward linkages.

A sector with large linkages imply that it has a large spill over effect to other sectors of the economy. As such, the elimination of the sector would greatly decrease outputs of sectors that are directly or indirectly linked to it. For this purpose, the hypothetical extraction method is applied. The advantage of this method over the more traditional method of linkage assessment is that the hypothetical method takes into account the magnitude of final demand in its estimation; that is, it gives due consideration to external impacts in determining sectoral linkages (Hoen 2002). In addition, we also examined the relative size of internal linkages of the palm oil industry in the two countries.

With greater understanding of the sector's linkages to other sectors of the economy, policy makers would not only have a better idea about the ability of the palm oil sector to stimulate other sectors of the economy, but also gauge the severity of policy impacts implemented in the palm oil sector on other sectors of the economy.

The remainder of this paper is structured in the following manner. In the next section, a survey of relevant literatures on the hypothetical extraction method are presented. Section III provides an overview of palm oil industry in Malaysia and Indonesia. This is followed by section IV, elaborateson methodology used in this paper. Section V presents the empirical resultsand discussions. The final section concludes the paper.

## LITERATURE REVIEW

For Indonesia, Amzul (2011) calcualted forward, backward and total linkages of the oil palm cultivation and

TABLE 1. Palm Oil Production of Major Producers
(thousand metric tonnes)

| Year | Indonesia | Malaysia | Thailand | Colombia | Nigeria | Papua New Guinea |
|---|---|---|---|---|---|---|
| 1991 | 2,750 | 6,222 | 220 | 291 | 530 | 180 |
| 2001 | 9,200 | 11,858 | 780 | 548 | 760 | 329 |
| 2011 | 26,200 | 18,202 | 1,892 | 941 | 850 | 582 |

*Source*: IndexMundi. Online: http://www.indexmundi.com/agriculture/

vegetable oil processing sectors using 2003 Indonesian Social Accounting Matrix. He found that the oil palm cultivation sector has highest backward linkage among all agriculture sectors while the palm oil processing sector has the highest backward linkage among all sectors in the economy. For forward linkages, he found that the processing sectors has a higher linkage than its cultivation sector. On the other hand, we found no study on linkages structure of Malaysian oil palm industry.

Production activity of a particular sector generally generates two types of linkages to other sectors of the economy. One is backward linkage; the other is forward linkage. Backward linkage is the interconnection of the sector to upstream sectors for inputs. Forward linkage is the interconnection of the sector to downstream sectors as markets for its output (Miller and Blair 2009). The combined forward and backward linkage is total linkage. Total linkage measures the importance of the sector to the rest of the sectors in the economy. The larger the inter-connectedness in terms of production activities, or employment or value added, the larger is the spill over effect of the sector to other sectors of the economy. There are many methods to measure the degree of inter-connectedness. However, they can generally be classified into two categories. One category is the classical Rassmussen-Hirschman and Chenery-Watanabe type linkage measures, including their subsequent variants such as those in Jones (1976) and Hazari (1970). For this category of linkages, the backward linkage is based on a sector's demand for input while the forward linkage is based on its output supply to other production sectors. The other category is based on the hypothetical extraction method (Miller & Blair 2009; Miller & Lahr 2001).

The idea underlying the hypothetical extraction method (HEM) is to quantify the magnitude of reduction in total output, or other performance measure such as value added or employment, when a particular sector or a group of sector is removed from the economy (Miller & Blair 2009; Miller & Lahr 2001). The magnitude of reduction reflects the strength of interdependence between the extracted sector with the rest of the economy. The larger the magnitude, the stronger is the degree of interdependence; thus implying that the extracted sector has significant influence on the overall economy. In times of recession, this also implies that the sector with high interdependence deserve priority in fiscal stimulus to avoid further contraction of the economy (Luo 2013). As such, it follows that the applications of HEM have been in the realm of key sectors determination; for example see Dietzenbacher & van der Linden (1997) and O'Callaghan & Yue (2004). Based on the same concept, there are also numerous studies that focus on the assessment of a particular sector such as in Song et al. (2006) and Song & Liu (2007) on the construction sector, and Duarte (2002) on the water sector.

## OVERVIEW OF PALM OIL INDUSTRY IN MALAYSIA AND INDONESIA

Malaysia is a small country with total land area of 329,847 square kilometers and a population size of 29 million in 2013. GDP in 2012 is approximately US$303.5 billion with agricultural sector contribution of about 11.4%. Total agriculture land in Malaysia is about 7.87 million hectares while total labour force is estimated to be about 12.9 million with 11.1% in agriculture.[3] On the other hand, Indonesia is a fairly large country, made up of thousands of islands. Its total land area is 1,904,569 sq km and population totalling 250 million. GDP in 2012 is estimated to be US$878.2 billion with 14.4% coming from the agricultural sector. Total agriculture land is about 54.5 million hectares. Of its 118.1 million labor force, 38.9% are in agriculture.[4] Oil palms were introduced to Java by the Dutch in 1848, and to Malaysia by the British as ornamental trees in 1870. Subsequently, the first plantation was established in Indonesia in 1911 and Malaysia in 1917 (Jalani et al. 2002). Thus, both countries have had over 100 years of experience in the cultivation and milling of the crop. Malaysian crude palm oil yield averages 4 tonnes per hectare while Indonesia at slightly lower at about 3.7 tonnes per hectare in 2013 (GAIN Report 2013).

Oil palm hectarage in Malaysia and Indonesia in 2010 are approximately 4.5 and 8.6 million hactares respectively. Ownership categorizations in Malaysia and Indonesia are approximately the same with Malaysia having larger proportion of private plantation ownership. In 2011, Malaysia had a large private plantation companies hold 60.7% of the plantation land, 14.0% by independent smallholders, 18.9% by organized smallholders, and 6.4% by government owned agencies.[5] In Indonesia, 51% of land holdings are owned by large private companies, 40% by organized smallholders while the rest is state owned plantations.[6]

In 2010, Malaysia and Indonesia produce about 17 and 23 million tonnes of crude palm oil respectively (Table 2). Crude palm oil is either exported or sent for further processing into palm olein and stearin. Depending on their use, these processed palm oil can be further blended with other oil or fractioned in additional downstream processing.

Palm oil in Malaysia and Indonesia are export oriented commodities with over 70% of total palm oil supply exported each year. Domestic palm oil food use in Malaysia is only about four percent of total supply while domestic non-food consumption is about 11% to 12% of total supply. Indonesia has a higher percentage in food consumption, averaging about 20% of total supply. In spite of the higher consumption proportion, Indonesian non-food consumption doubled in percentage from about 4 percent of total supply in 2005 to about 8% in 2010 (Table 2).

TABLE 2. Brief Statistics on Palm Oil, 2005 and 2010

| | Malaysia | | Indonesia | |
|---|---|---|---|---|
| | 2005 | 2010 | 2005 | 2010 |
| Land (mill. ha.) | 4.1* | 4.9* | 6.9**(2007) | 8.6** |
| Crude Palm Oil production (mill tonnes) | - | 17.0* | - | 22.5** |
| Palm Oil Beginning Stock (mill tonnes)*** | 1.54 | 1.87 | 0.85 | 0.04 |
| Palm Oil Production (mill tonnes)*** | 15.49 | 18.21 | 15.56 | 23.6 |
| Palm Oil Imports (mill tonnes)*** | 0.75 | 1.59 | 0.04 | 0.02 |
| Palm Oil Total Supply (mill tonnes)*** | 17.77 | 21.67 | 16.45 | 23.66 |
| Exports (mill tonnes)*** | 12.9 | 16.60 | 11.70 | 16.42 |
| Domestic Food Use (mill tonnes)*** | 0.70 | 0.82 | 3.58 | 4.48 |
| Domestic non-food (mill tonnes)*** | 2.21 | 2.40 | 0.64 | 1.94 |
| Ending Stock (mill tonnes)*** | 1.93 | 1.86 | 0.54 | 0.83 |
| Export (USD billion) | - | 19.0 | - | 16.4 |
| Percentage GDP contribution | - | 8.0% | - | 2.3% |

*Sources*:
* Department of Statistics Malaysia. Online: http://www.statistics.gov.my/
** Statistics Indonesia. Online: http://www.bps.go.id/hasil_publikasi/stat_kelapa_sawit_2012
*** IndexMundi. Online: http://www.indexmundi.com/agriculture/

## METHODOLOGY

The analytical approach to linkage measure is based on the hypothetical extraction method (HEM) derived from the Leontief input-output framework (Millar & Blair 2009).The advantage of this approach over other linkage approach is that the derived linkage values can be translated in terms of monetary value lost by a specific setor if the sector being examined is extracted from the economy; thus giving a better picture on the significance of a particular sector in the overall economy.

Consider an *n*-sector economy with intersectoral transaction matrix Z and sectoral total output vector X, the direct input requirement coefficient matrix, A, is given by

$$A = Z(\hat{X})^{-1} \quad (1)$$

where $\hat{X}$ is the diagonalized matrix of X and elements in the direct input requirement matrix indicate the intermediate purchase of sector *j* from sector *i*. The supply-demand Leontief balance equation is given by

$$X = (1 - A)^{-1}y \quad (2)$$

where y is a vector of final demand.

Backward and forward linkages

Following Miller and Blair (2009), backward linkage is measured by hypothetically eliminating all of sector *j*'s purchases from all other production sectors in the economy while retaining the intra-sectoral transactions. Adopting Case 3b of Miller and Lahr (2001), it is assumed that sector *j* utilize imports rather than domestic intermediate inputs to meet final demand for producing sector *j*'s outputs.

Using $\bar{A}_{(cj)}$ to denote the direct requirement matrix of the economy without sector *j*'s backward purchases, then the output of the reduced economy is given by

$$X_{(cj)} = (1 - \bar{A}_{(cj)})^{-1}y \quad (3)$$

It follows that the normalized backward linkage of sector *j*, $X_{Bj}$, in percentage term is[7]

$$X_{Bj} = (i'X - i'\bar{X}_{(cj)}) \cdot 100/i'X \quad (4)$$

The forward linkage deals with downstream output supply; thus the linkage measure is based on Ghosh supply-side model (Miller & Blair 2009). The supply-side direct output coefficient matrix, B, is given by

$$B = (\hat{X})^{-1}Z \quad (5)$$

Elements in the direct output requirement coefficient matrix indicate the output deliveries from sector *j* to other sectors in the economy. The associated balance equation is

$$X' = V'(1 - B)^{-1} \quad (6)$$

where V' is a row vector of total payments to primary inputs (imports, compensation to employees and gross operating surplus).

Following Case 3a of Miller and Lahr (2001), forward linkage is measured by hypothetically eliminating all of sector *j*'s deliveries to all other production sectors in the economy while retaining the intra-sectoral transactions. In this version, it is assumed that sector *j* exports all output that would have been delivered to the domestic economy as intermediate inputs. The output associated with the reduced economy due the elimination of row *j*, i.e., sector *j*'s forward deliveries to other production sectors in the economy is

$$\bar{X}'_{(rj)} = V'(1 - \bar{B}_{(rj)})^{-1} \quad (7)$$

It follows that the normalized forward linkage of sector *j*, $X_{Fj}$, in percentage term is

$$X_{Fj} = (X'i - X'_{(rj)}i) \cdot 100/X'i \quad (8)$$

## TOTAL AND INTERNAL LINKAGES

Following Miller and Blair (2009), total linkage is measured by hypothetically eliminating sector *j* completely. This measure indicates the overall stimulative capacity of the sector. Using $\bar{A}_{(j)}$ to denote the direct requirement matrix of the economy eliminating sector *j*'s inter- and intra-sectoral transaction. Further, let $\bar{y}$ denote the final demand vector without sector *j* final demand. The output of the reduced economy is given by

$$\bar{X}_{(j)} = (1 - \bar{A}_{(j)})^{-1}\bar{y} \quad (9)$$

It follows that the normalized total linkage of sector *j*, $X_{Tj}$, in percentage term is

$$X_{Tj} = (i'X - i'\bar{X}_{(j)}) \cdot 100/i'X \quad (10)$$

Internal linkage measure the intra-transaction between sectors in an economy. This linkage is an important indicator of transaction within the sector which would not be explicit from just examining the backward and forward linkages. The Internal linkage is calculated by eliminating only the intra-trade of sector *j* from the direct requirement matrix. Using $\bar{A}_{(ij)}$ to denote the direct requirement matrix of the economy with intra-sectoral transaction eliminated, the output of the reduced economy is given by

$$\bar{X}_{(ij)} = (1 - \bar{A}_{(ij)})^{-1}y \quad (11)$$

It follows that the normalized internal linkage of sector *j*, $X_{ij}$, in percentage term is

$$X_{Ij} = (i'X - i'\bar{X}_{(ij)}) \cdot 100/i'X \quad (12)$$

## DATA SOURCES AND AGGREGATION

This study utilize the Malaysian 2005 Input-Output Table published by the Department of Statistic, Malaysia (DOSM) and the Indonesian 2005 Input-Output Table published by Biro Pusat Statistik of Indonesia (BPS). Both tables are aggregated into 31 comparable production activities of both countries. The 31 sectors are presented in Appendix A. In the tables, the oil palm cultivation sector is labelled as "oil palm" while the palm oil processing sector is labelled "oils and fats".

For the purpose of discussion, the 31 production sectors are further aggregated into agricultural, manufacturing or service sectors. As noted in the appendix, sectors 1 through 6 are categorized as agricultural, sectors 7 through 24 as manufacturing, and sectors 25 through 31 as the service sector(please refer Appendix A).

## EMPIRICAL RESULTS AND DISCUSSION

Using the aggregated Malaysia and Indonesia 31-sector input-output tables, the hypothetical extraction method is applied to the oil palm cultivation sector and the palm oil processing sector.Table 3 presents summary of empirical results of calculations based on equation (4), equation (8), equation (10), and equation (12). Table 4 shows the hypothetical reduction in monetary terms.

## BACKWARD AND FORWARD LINKAGES OF OIL PALM CULTIVATION SECTOR

As indicated in Table 3, if purchases of oil palm cultivation sector from all other sector in the economy were hypothetically eliminated, aggregate output would decrease by 0.53% in Malaysia and 0.17% in Indonesia. In monetary terms, the reduction is about US$2.25 billion and US$0.92 billion lower than the actual value of total output, respectively (Table 4). Of the total reduction due to backward extraction in Malaysia, approximately 33% is in agriculture, 45% in manufacturing, while approximately 22% is in the service sector (Table 5). Reduction in output due to backward extraction in Indonesia is less evenly distributed with 90% occuring in the manufacturing and service sectors. Figures in Table 5 show that the oil palm cultivation sectors of both countries are about equally backward-linked to the manufacturing sector through their demand for inputs. Apart from the similarity of being backwardly linked to the manufacturing sector, due to difference in intermediate input requirement, the cultivation sector in Malaysia is more linked to its agricultural sector while the oil palm cultivation sector in Indonesia is more to its service sector.

The elimination of forward supply by the cultivation sector would result in 1.39% or US$3.66 billion reduction

TABLE 3. Aggregate reduction in output due to hypothetical extraction

| | Malaysia | | Indonesia | |
|---|---|---|---|---|
| | Cultivation sector | Processing sector | Cultivation sector | Processing sector |
| Backward linkage | 0.53 | 2.39 | 0.17 | 0.81 |
| Forward linkage | 1.39 | 1.26 | 0.60 | 0.26 |
| Total linkage | 1.89 | 5.74 | 0.51 | 2.43 |
| Internal linkage | 0.31 | 4.75 | 0.02 | 2.19 |

TABLE 4. Hypothetical reduction in monetary terms (US$ billion)

| | Malaysia | | Indonesia | |
|---|---|---|---|---|
| | Cultivation sector | Processing sector | Cultivation sector | Processing sector |
| Backward linkage | 2.25 | 10.10 | 0.92 | 4.45 |
| Forward linkage | 3.66 | 3.36 | 2.75 | 1.21 |
| Total linkage | 7.96 | 24.23 | 2.82 | 13.36 |

TABLE 5. Disaggregation of backward extraction

| | Malaysia | | Indonesia | |
|---|---|---|---|---|
| | Cultivation sector | Processing sector | Cultivation sector | Processing sector |
| Agriculture | 33.05% | 77.75% | 9.94% | 90.20% |
| Manufacturing | 45.34% | 15.05% | 47.06% | 3.85% |
| Service | 21.62% | 7.20% | 43.00% | 5.95% |

TABLE 6. Disaggregation of forward extraction

| | Malaysia | | Indonesia | |
|---|---|---|---|---|
| | Cultivation sector | Processing sector | Cultivation sector | Processing sector |
| Agriculture | 11.22% | 11.76% | 1.51% | 8.12% |
| Manufacturing | 76.91% | 75.84% | 96.58% | 70.22% |
| Service | 11.87% | 12.4%0 | 1.91% | 21.66% |

in total output in Malaysia. Aggregate output reduction is much smaller in Indonesia where output decreased by 0.60% or US$2.75 billion (Table 3 and Table 4, row 2). Distribution of reduction in Malaysia and Indonesia, as expected, are largely concentrated in the manufacturing sector (Table 6) where the reduction is about 77% in Malaysia and 97% in Indonesia. The relatively smaller concentration of Malaysian forward linkage in manufacturing imply that its downstream activities, compared to Indonesia, is more diversified.

The foward linkage of Malaysian and Indonesian cultivation sector are larger than their respective backward linakges. This means that a variety of downstream milling and processing activities use the output from the cultivation sector as intermediate input to produce higher value products. As such, the elimination of forward deliveries from the cultivation sector would substantially reduce the output of the associated direct and indirect activities in downstream sectors. This result is consistent with those implied in Holland et al (2001) where the linkage structure of a successful agricultural commodity is where its output is more demanded by its downstream activities compared to its dependence on other sectors.

## BACKWARD AND FORWARD LINKAGES OF PALM OIL PROCESSING SECTOR

Backward linkage of palm oil processing sector is 2.39 (or US$10.10 billion) for Malaysia and 0.81 (US$4.45 billion) for Indonesia (Table 3). Extraction of backward purchases

by the processing sector in Malaysia result in almost 78% reduction in agricultural output, 15% in manufacturing output and about 7% reduction in service sector output (Table 5). In Indonesia, substantial reduction also occur in the agricultureal sector while the rest are distributed in the manufacturing and service sectors (Table 5).

Forward linkage of the processing sector is 1.26 in Malaysia and 0.26 in Indonesia. In monetary terms, the reduction represent US$3.36 billion and US$1.21 billion reduction in total output in Malaysia and Indonesia respectively (Table 3). Table 4 shows the distribution of reduction. As shown, for both Malaysia and Indonesia, the distribution of reduction is 70 to 75% concentrated in the manufacturing sector. The rest are distributed in the manufacturing and service sectors.

Contrary to the cultivation sector, the backward linkage of the palm oil processing sector of Malaysia and Indonesia is larger than its forwardward linkage; implying that, relative to downstream activities, there are greater dependence of upstream activites on the palm oil processing sector, i.e., denoted as the oils and fats sector in Appendix A. One of the factor that contribute to the larger backward linkage relative to forward linkage is that some proportion of output from the palm oil processing sector leaks out as deliveries to final demand for domestic consumption and exports rather than as intermediate inputs to other sectors of the economy. These results are consistent with findings by Resosudarmo & Nurdianto (2007) where they found that the backward linkages of regional palm oil processing sector in Indonesia is larger than their forward linkages.

## TOTAL AND INTERNAL LINKAGES

Figures in Table 3 show that if the cultivation sector is hypothetically totally eliminated from the economy, total output in the Malaysian and Indonesian economies would decrease by 1.89% (US$7.96 billion) and 0.51% (US$2.82 billion) respectively. Total linkage in the processing sector is much larger than in the cultivation sector, indicating larger reduction in total output upon elimination of the processing sector; i.e. about 5.74% (US$24.23 billion) in Malaysia and 2.43% (US$ 13.36 billion) in Indonesia. Larger total linkages in the cultivation and processing sectors in Malaysia than Indonesia indicate that its cultivation and processing sectors have stronger interdependence to the rest of its economy. This in turn implies that the Malaysian cultivation and processing sectors have larger stimulative capability on the overall economy than the sectors do in Indonesia. However, these also reflect that in the event of downturn in the palm oil industry, the overall economy of Indonesia would less likely be affected as it does in Malaysia.

As shown in the last row of Table3, internal linkage in the cultivation sector is only a small proportion of total linkage in both Malaysia and Indonesia. This implies very small intra-sectoral transactions within the cultivation sector. In terms of relative size of internal to total linkage, the internal linkage of Malaysian oil palm cultivation sector is approximately 16% of total linkage while the figure is about 4% in Indonesia. It is highly plausible that the higher internal linkage in Malaysia is due to the existance of a more developed oil-palm-seed industry within the Malaysian cultivation sector in 2005.

Internal linkage in the processing sector of both countries is larger than internal linkage in the cultivation sector. This indicates that there is significant intra-transactions within the processing sector. The reason for the larger intra-sectoral transactions is that the processing sector is comprised of many sub-sectors; *i.e.*, the fresh fruit milling and palm kernal crushing sub-sectors, and the palm oil and palm kernal oil processing sub-sectors. The tight association between these sub-sectors result in large intra-transactions and thus the high internal linkage within the palm oil processing sector.

## CONCLUSION

Malaysia and Indonesia are two of the largest producers of palm oil. While oil palm plantation was established earlier in Indonesia than in Malaysia, oil palm plantation expansion occur much earlier in Malaysia. Dramatic increases in the Indonesian cultivated area came after the mid-1990s, which turned Indonesia into the world largest producer and exporter of palm oil. After over 100 years of oil palm cultivation, how has the industry integrate itself into the rest of the production sectors is the subject of this paper.

Using the Malaysian and Indonesian 2005 Input-Output Table, this study has applied the hypothetical extraction method on the oil palm cultivation sector and palm oil processing sector to assess the importance of these sectors on other production sectors of the Malaysian and Indonesian economies. The empirical findings of this study make explicit several similarities and differences in sectoral linkages between palm oil industry in Malaysia and Indonesia.

The linkage analyses in this paper indicate that for both Malaysia and Indonesia, the oil palm cultivation sector, in spite of being in the agricultural sector, is both highly forward and backward linked to the manufacturing sector. The implication of this is that any backward and forward removal of oil palm cultivation sector results in greater reduction in manufacturing output than the outputs of agricultural and service sectors. In other words, the cultivation sector not only has a strong economic pull on the manufacturing sector, but also strong economic push on the manufacturing sector as well.

The Malaysian and Indonesian processing sectors on the other hand, are more backward linked to the agriculture sector, but more to the manufacturing sector in terms of forward linkage. From their purchases of intermediate

inputs, the Malaysian and Indonesian processing sectors create strong economic pull on the their respective agricultural sector. At the opposite end, their intermediate input deliveries to other production sectors create strong economic push on their manufacturing sector.

Our results indicate that the palm oil industry in Malaysia is more interconnected to the rest of the production sectors than in Indonesia. The overall implication of this is that the palm oil economy plays a more significant role in the total economy of Malaysia than it does in Indonesia. However, this does not imply that the palm oil industry is not important to the total economy of Indonesia. The total extraction of this industry from the Indonesian production sector seems small because, one, Indonesia has a larger economy than Malaysia. As such its share in the total economy is smaller. The other is that the oil palm cultivation sector in Indonesia is still low in terms of securing domestic intermediate inputs from its upstream sectors, thus resulting in small direct and indirect economic pull. At the same time, the output from the processing sector is also weak in being used as intermediate inputs in other production sectors for further processing. Much of the output from the processing sector leaked into final demand as domestic food use and exports. As much of the Indonesian agricultural land is still available for oil palm expansion and with increasing domestic non-food use of palm oil, future palm oil linkage scenarion for Indonesia would probably be similar to, if not greater than that of Malaysia.

As a final note, while it is true that the Malaysian palm oil industry is more interconnected in terms of output to the rest of the economy than the palm oil industry in Indonesia, the situation may not be the same if linkages were measured using alternative performance indicator such as value-added or employment. This is especially so since oil palm estates in Malaysia employ almost entirely foreign labor for field work and this could serve as a base for future studies.

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### END NOTES

1. The Malaysian Economic Transformation Programme (ETP) is an initiative brought about by the Malaysian Government to turn Malaysia into an industrilized nation by 2020.
2. Calculated at 1US$ = RM3 exchage rate. Source: http://etp.pemandu.gov.my/
3. The World Factbook. Online: https://www.cia.gov/library/publications/the-world-factbook/geos/my.html and The World Bank. Online: http://www.worldbank.org/en/country/.
4. The World Factbook. Online: https://www.cia.gov/library/publications/the-world-factbook/geos/id.html
5. MPOB (Malaysian Palm Oil Board). Online: http://econ.mpob.gov.my/economy/
6. BPS (Statistics Indonesia). Online: http://www.bps.go.id/hasil_publikasi/stat_kelapa_sawit_2012
7. Note that while linkage measure is in percentage term, the figure could also be treated as an index for strength linkage.

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APPENDIX A

Production Sectors

| Sector number | Sectors | |
|---|---|---|
| 1 | Agriculture | Agriculture sectors |
| 2 | Rubber | |
| 3 | Oil palm | |
| 4 | Livestock | |
| 5 | Forestry, logging and forest products | |
| 6 | Fishery | |
| 7 | Crude Oil and Natural Gas | Mining and quarying sectors |
| 8 | Mining & quarrying | |
| 9 | Food preservation | Manufacturing sectors |
| 10 | Oil and fats | |
| 11 | Grain, confectionary, and beverage | |
| 12 | Tobacco products | |
| 13 | Textiles, apparel and leather | |
| 14 | Wood and rattan products | |
| 15 | Paper and publishing | |
| 16 | Petroleum refinery | |
| 17 | Chemicals and chemical products | |
| 18 | Plastics and rubber products | |
| 19 | Concrete and non-metallic mineral products | |
| 20 | Metallic producys | |
| 21 | Industrial machinery and electrical equiptments | |
| 22 | Transport equiptments and repairs | |
| 23 | Electricity, gas and waterworks | Services sectors |
| 24 | Residential | |
| 25 | Wholesale and retail | |
| 26 | Accomodation and restaurants | |
| 27 | Transport services | |
| 28 | Communication | |
| 29 | Financial institution | |
| 30 | Building services | |
| 31 | Public and professional services | |

Production Sectors: Aggregated and Original IO sectors

| Sector number | Aggregated Sectors | Indonesia (66 sector table) | Malaysia (120 sector table) |
|---|---|---|---|
| 1 | Agriculture | 1 – 6, 8 – 9, 11 – 17 | 1 – 7 |
| 2 | Rubber | 7 | 5 |
| 3 | Oil palm | 10 | 6 |
| 4 | Livestock | 18 – 20 | 9 – 10 |
| 5 | Forestry, logging and forest products | 21 – 22 | 11 |
| 6 | Fishery | 23 | 12 |
| 7 | Crude Oil and Natural Gas | 25 | 13 |
| 8 | Mining & quarrying | 24, 26 | 14 – 16 |
| 9 | Food preservation | 27 | 17 – 20 |
| 10 | Oil and fats* | 28 | 21 |
| 11 | Grain, confectionary, and beverage | 29 – 33 | 22 – 28 |
| 12 | Tobacco products | 34 | 29 |
| 13 | Textiles, apparel and leather | 35 – 36 | 30 – 35 |
| 14 | Wood and rattan products | 37 | 36 – 40 |
| 15 | Paper and publishing | 38 | 41 – 43 |
| 16 | Petroleum refinery | 41 | 44 |
| 17 | Chemicals and chemical products | 39 – 40 | 45 – 50 |
| 18 | Plastics and rubber products | 42 | 51 – 55 |
| 19 | Concrete and non-metallic mineral products | 43 – 46 | 56 – 59 |
| 20 | Metallic producys | 47 | 60 – 64 |
| 21 | Industrial machinery and electrical equiptments | 48 | 65 – 79 |
| 22 | Transport equiptments and repairs | 49 – 50 | 80 – 85 |
| 23 | Electricity, gas and waterworlks | 51 | 86 – 87 |
| 24 | Residential | 52 | 88 – 90 |
| 25 | Wholesale and retail | 53 | 91 – 92 |
| 26 | Accomodation and restaurants | 54 | 93 – 94 |
| 27 | Transport services | 55 – 59 | 95 – 100 |
| 28 | Communication | 60 | 101 |
| 29 | Financial institution | 61 | 102 – 106 |
| 30 | Building services | 62 | 107 – 108 |
| 31 | Public and professional services | 63 – 66 | 109 – 116 |

*Note*:
Sector 1 through sector 6 are also defined as the agricultural sector. Sector 7 through sector 24, as the manufacturing sector, and sector 25 through 31 as service sector.
*In Malaysian Input-Output Table the oils and fats processing industry is also assume as palm oil processing (milling and refineries) since the other oils and fats are very limited, less than 1%.
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*Source:* IndexMundi. Online: http://www.indexmundi.com/agriculture/