Projecting Malaysia Input-Output Table using EURO Method

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Abstract - Input-Output (I-O) tables provide a detailed account of the flow of production and consumption of goods and services from producers to consumers. It serves as a dataset for I-O analysis which provide the tools to perform economic modeling. The construction of the I-O tables based on detailed census or surveys is a complex procedure that requires substantial financial expenditures, large human capital and time. The work involved to prepare an input-output table is enormous and therefore, has led to the emergence of non-survey updating techniques. The availability of updated input-output table has become a major concern in the analysis of the country's economy for an effective assessment of the contribution of industries to the economy. In view of its significant importance in providing up-to-date inputs for applications in a wide range of economic analysis and decision making activities, this study projected the Malaysia Input-Output Table (MIOT) for the year 2015 using Euro Method. The basic idea of using the Euro method is to generate estimates of the I-O tables which are consistent with official macroeconomic data. The actual MIOT 2010 was used as the base year for the iteration procedure to construct a projected MIOT 2015. The sectors in the MIOT 2010 were aggregated from 124 sectors to 12 main sectors (industries). The projection of MIOT involved an intensive iterative procedure using MS-Excel Visual Basic programming. The initial values for value added by sectors, total final demand by use category and total value added for the iteration process were obtained from Malaysia Gross Domestic Product for 2015. Next, using the projected MIOT 2015, we analyzed the inter-industrial linkages of the industries sector in Malaysia based on the forward and backward linkages using Hypothetical Extraction Method (HEM). HEM was applied to quantify explicitly the important sectors to the economy. The HEM results show that the manufacturing sector has strong backward and forward linkages and this is the most important contributing sector to the Malaysian economy.

Keywords-component; projecting input-output table, Euro method, hypothetical extraction method

I. INTRODUCTION

Input-Output tables provide a detailed account of the flow of production and consumption of goods and services from producers to consumers. It serves as a dataset for input-output analysis which provide the tools to perform economic modeling. Input-output analysis is one of the important tools used in economics analysis and is widely applied by researchers and analysts at regional, national and international levels. It provides valuable information about the structure of a country's economy which can be used for policy development and decision making purposes.

The compilation of Malaysia Input-Output Table (MIOT) is a massive undertaking, involving the collection, evaluation, consolidation and reconciliation of a wide range of data and information from census, survey and administrative sources. Due to the intricate estimation procedure, coupled with the incorporation of multitude of massive data sources, input-output tables are usually not the latest or the most current of the economic statistics available for stakeholders and other users. The preparation of the input-output tables faces the problem of time lag of several years between the reference year and the actual publication of the input-output tables. The MIOT was produced and published on average of every five years. The construction of the input-output tables based on detailed census or surveys is a complex procedure that requires substantial financial expenditures, large human capital and time. The work involved to prepare an input-output table is enormous and therefore, has led

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to the emergence of non-survey projection techniques. However, the availability of projected input-output table has become a major concern in the analysis of the country's economy for an effective assessment of the contribution of industries to the economy. In view of the significant importance in providing up-to-date input-output table for applications in a wide range of economic analysis and decision making activities, the aim of this study is to project the MIOT for the year 2015 using Euro Method which was proposed by Beutel (2002). The basic idea of using the Euro method is to generate estimates of the input-output tables which are consistent with official macroeconomic data, that is, Gross Domestic Product for the iterative procedure.

The projected MIOT 2015 was then applied to quantify how much the total output of 12-sectors of the economy would change if one sector was removed from the economy using Hypothetical Extraction Method (HEM). The HEM has been used to measure backward and forward linkages. The results of backward and forward linkages of 2015 were then compared with 2010 based on MIOT 2010. This paper is organized as follows. Section II provides a review on projection of input-output tables. The methodology is explained in Section III. The results are presented in Section IV. Finally the conclusion is given in Section V.

II. LITERATURE REVIEW

The projection approach is known as non-survey or partial-survey method which tries to minimize the difference between the estimated and the original survey-based input-output tables. It has been the subject of long discussions and as a result the alternative of non-survey method has been proposed and extensively used (Oosterhaven *et al*., 1986). An early study, Leontief (1941) used biproportional techniques to identify the sources of intertemporal change in the cells of a given nation's input-output tables. A year later, based on the idea of Deming and Stephen (1940) and Stephen (1942), Stone *et al*. (1942) introduced a method of iterative proportions to make the adjustments more effective and convenient. This method can converge to the values given by the least squares adjustment and is self-correcting. It can be used with any set of data and weights for which a least squares solution exists. In 1962, Stone and Brown developed a particular biproportional procedure and known as ***RAS***. There are many non-survey method introduced, such as, Kuroda's method (Kuroda & Wilcoxen, 1988), Generalised RAS (Junius & Oosterhaven, 2003; Lenzen, *et al*., 2007; Temurshoev, *et al*., 2013), Cross Entropy methods (Good, 1963; Golan, *et al*., 1994; Robinson, *et al*., 2001), and Euro method (Beutel, 2002; Eurostat, 2008). The Euro method uses scale factors for rows and columns of the input-output table to derive the unknown growth rates for output from the projected sectoral growth rates for value added. The Euro approach has some correspondence to the procedure of Almon (Almon 2000) to estimate product-to-product input-output tables with no negative flows from supply and use tables by applying the product-technology assumption.

Temurshoev et al. (2011) presented eight methods for projecting or updating Supply and Use Tables (SUTs) and assessed the relative performance of these methods using Dutch and Spanish SUTs. The eight methods of projecting or updating SUTs are: (i) EUKLEMS method, (ii) Euro method, (iii) Generalised RAS (GRAS), (iv) Improved Normalized Squared Differences (INSD), (v) Improved Squared Differences (ISD), (vi) Improved Weighted Squared Differences (IWSD), (vii) Harthoorn and Van Dalen's method and (viii) Kuroda's method. Each projecting method produces a different estimate and to assess their relative performance, several measures are used. The measures are: (i) Mean Absolute Percentage Error, (ii) Weighted Absolute Percentage Error, (iii) Standardized Weighted Absolute Difference, (iv) The Psi Statistic, (v) RSQ (or coefficient of determination and (vi) $N0$ – number of zero elements in the estimated matrix X, whose corresponding elements are nonzero in the actual matrix X^{true}. The empirical applications to the Dutch and Spanish SUTs projections suggest that GRAS and the methods proposed by Harthoon and Van Dalen (1987) and Kuroda (1988) give the best performance.

III. METHODOLOGY

The comparison study on projection method (Norhayati, *et al*., 2015) reported that Euro method performed better than RAS procedure. The MIOT 2005 and MIOT 2010 were projected and evaluated based on statistical measures and input-output analysis. The three statistical measures used were Mean Absolute Deviation (MAD), Root Mean Squared Error (RMSE) and Dissimilarity Index (DI). The criterion used is the closeness of the estimates to the actual data. Their results show that the Euro method has smaller value of MAD, RMSE and D1.

In this study, we used the Euro method to project the MIOT 2015. The MIOT 2010 at basic prices was used as the base year of the iteration procedure to project MIOT 2015 with the 124 industries aggregated to 12 industries. The projection of the MIOT involved an iterative process using Microsoft Excel Visual Basic Programming. The simulation program was developed for this study. The data requirement for the year *t* was obtained from the Annual National Accounts - Gross Domestic Product, 2010-2015 (Department of Statistics, Malaysia, 2016).

Finally, the projected MIOT 2015 was applied to quantify how much the total output of 12-sectors of the economy would change if one sector was removed from the economy. This method is known as Hypothetical Extraction Method (HEM). The HEM has been used to measure backward and forward linkages. The results of backward and forward linkages of 2015 were then compared with 2010 based on MIOT 2010.

A. Euro Method

The Euro method is an approach of projecting all quadrants of an input-output table in a simultaneous way, which was developed by Joerg Beutel (Beutel, 2002; Eurostat, 2008). It corresponds to the basic idea of RAS approach. The fundamental idea drawn up is to develop a series of reliable and consistent input-output tables, which is dependent on official macroeconomic, that is, the Gross Domestic Product. However, to ensure a consistent data, any arbitrary adjustments of input coefficients are avoided. For this study, it only focuses on domestic input-output tables. The beginning point of the iteration procedure is an input-output table consisting of value added by industry and total final demand by category. The iteration procedure commences with the assumption that, in the first iteration, the given growth rates for value added by industry, final demand by category and total value added as the starting point for the input and output sectors. These growth rates are then marginally adjusted until the projected exogenous variables are reproduced. In the iteration, the growth rates for output and input are marginally changed until the projected growth rates for value added and final demand correspond with the given projected figures. The projected growth rates for value added and final demand components are compared with the macroeconomic data. If substantial deviations are observed, then the growth rates for input and output levels are adjusted in an appropriate manner for the next iteration. A convex adjustment function is used to adjust the growth rates during the iteration. The adjustment elasticity was set from 0.1-0.9. The best selection of coefficient is used for the adjustment. In order to identify the best adjustment elasticity or coefficient, a simulation study was done for 2010 using nine values, which increased progressively by 0.1, starting from 0.1 till 0.9. The projection is completed if the model results in values which correspond to the projected macroeconomic variables at a margin of one percent deviation or less.

The requirement data for Euro is the projected year t, that is, vectors of value added by sectors, v_j, totals of final demand by use category, Xf_k , and total value added, vX. Thus, the original base year input-output table at basic prices consist of intermediate input ($x_{11},\dots,x_{nm}$), final demand ($f_{11},\dots,f_{n5}$) and value added ($v_1,\dots,v_m$). As shown in Table 1, the required data is shaded in green colour.

The growth rates is defined as, $p = \dfrac{v(1)_j}{v(0)_j}$ (1)

where, $v(0)_j$ is actual value j for base year, $j=1,\dots,m$

$v(1)_j$ is macroeconomic statistics j for projected year t, $j=1,\dots,m$

The basis to update the intermediate input, $x_{11},\dots,x_{nm}$, and final demand, $f_{11},\dots,f_{n5}$. The growth rates for input are W0 and for output is W1. The growth rates for the activity levels of the corresponding input and output sector for each element in the input-output table is weighted in an iterative procedure. On completion of weighting the transactions, the resulting input-output table might not be expected to be consistent. Therefore, a traditional input-output model with projected input-output table is adjusted to guarantee the consistency of the system in terms of supply and demand.

Table 1: The Data Requirement for Euro Method

Use Matrix of Domestic Production at Basic Prices (Industry by Industry)		Intermediate Demand					Total Intermediate Demand (d)	Final Demand (f)					Total Output (X)
		Industry	Agriculture	Mining	…	Services	$d_i = \sum_{j=1}^{m} x_{ij}$	Private Consumption	Government Consumption	Gross Fixed Capital Formation	Changes Inventory	Exports	$X_i = d_i + \sum_{k=1}^{5} f_k$
	Industry		$j=1$	$j=2$	…	$j=m$		$k=1$	$k=2$	$k=3$	$k=4$	$k=5$	
Intermediate Input	Agriculture	$i=1$	x_{11}	x_{12}	…	x_{1m}	d_1	f_{11}	f_{12}	f_{13}	f_{14}	f_{15}	X_1
	Mining	$i=2$	x_{21}	x_{22}	…	x_{2m}	d_2	f_{21}	f_{22}	f_{23}	f_{24}	f_{25}	X_2
	…	…	…	…	…	…	…	…	…	…	…	…	…
	Services	$i=n$	x_{n1}	x_{n2}	…	x_{nm}	d_n	f_{n1}	f_{n2}	f_{n3}	f_{n4}	f_{n5}	X_n
Total Intermediate Input (u)	$u_j = \sum_{i=1}^{n} x_{ij}$		u_1	u_2	…	u_m	ud	f_1	f_2	f_3	f_4	f_5	uX
Imported Commodities (m)			m_1	m_2	…	m_m	md	mf_1	mf_2	mf_3	mf_4	mf_5	mX
Taxes (t)			t_1	t_2	…	t_m	td	tf_1	tf_2	tf_3	tf_4	tf_5	tX
Value Added (v)			v_1	v_2	…	v_m	vd	vf_1	vf_2	vf_3	vf_4	vf_5	vX
Total Input (X) $X_j = u_j + m_j + t_j + v_j$			X_1	X_2	…	X_m	Xd	Xf_1	Xf_2	Xf_3	Xf_4	Xf_5	XX

T1 is the base year of the input-output table. The weighted input-output matrix with row multipliers, T2, is obtained by multiplying the row multipliers for input, W0, with T1, (T2=W0*T1). T1 is then multiplied with column multipliers for outputs, W1 to obtain T3, (T3=T1*W1). T3 is the input-output table weighted with column multipliers. By calculating the average input-output matrix weighted with row multipliers, T2, and column multipliers, T3, we obtain inconsistent input-output table,T4, where, T4=(T2+T3)/2.

Based on T4 ,the input coefficient and Leontief inverse were calculated.

$$a_{ij} = x_{ij} / X_j \quad (2)$$

Leontief inverse = $(I - A)^{-1}$

The Leontief inverse was then multiplied with vector of final demand to derive total output,

$$Y = (I - A)^{-1} f \quad (3)$$

where, Y is total output of goods and services

f is column vector of final demand.

The consistent input-output table is established through several adjustments of row multiplier and column multiplier in n iterations. The rates used are then adjusted in an iterative procedure in which the difference between the actual and the projected rates is minimal (less than one percent).

The deviation, d, between macroeconomic variables of projected year and base year is defined as,

$$d = \frac{p_0}{p_1} \quad (4)$$

where, d is deviation

P_0 is growth rates between projected year (before iteration) and base year

P_1 is growth rates between projected year (after iteration) and base year

The observed deviations are then used to correct the rates of W0 and W1 during the iteration process. Hence, a convex adjustment function is recommended to adjust the rates. If the model underestimates or overestimates the projected macroeconomic variables, the corresponding rates, W0 and W1 respectively are increased or decreased according to the convex adjustment function. The adjustment function is defined as,

$$af = 1 - \frac{[(1-d)100]c}{100} \quad \text{if } d < 0 \quad (5)$$

$$af = 1 + \frac{[(d-1)100]c}{100} \quad \text{if } d > 0 \quad (6)$$

where, af is adjustment function

d is deviation

c is adjustment elasticity (for this study, c=0.9 is used based on simulation results)

Based on the adjustment function, the revised row multipliers for input, W0(2)=W0**af* and revised column multipliers for output, W1(2)=W1**af* are then calculated. With revised row and column multipliers, the consistent revised input-output matrix is obtained. The rates for input and output are marginally changed during the iteration until the projected rates for value added and final demand correspond with macroeconomic data. Each iteration begins with computing new correction factors, which is then multiplied by the row and column adjustment multipliers from the previous iteration. The iteration is completed if the deviation of projected and macroeconomic variables is at one percent margin or less. This will result in the final outcome of the Euro projection.

B. Hypothetical Extraction Method

The Hypothetical Extraction Method (HEM) was introduced by Paelinck *et al*. (1965) and later by Strassert (1968). It was further developed by Schultx (1976), Cella (1984) and further formalized by Dietzenbacher et al. (1993) and Dietzenbacher & van der Linden

(1997), Miller & Lahr (2001). The Hypothetical Extraction Method (HEM) was used to quantify how much an economy's total output would change if one sector was extracted. Thus, by comparing the output levels for each of the remaining sectors before and after the hypothetical extraction, the impact of the extracted sector can be assessed. The difference between the output in the reduced case and in the original situation reflects the linkages between the extracted sector and all other sectors in the economy. The advantages of HEM are (i) the linkages between sectors can be measured properly and (ii) determination of which sector has the largest impact on the economy. The HEM takes into account the relative magnitude of each sector's final demand in the economy and the relative effect of a sector on overall output, therefore, it is more suitable to analyse the linkages than the conventional method (Andreosso-O'Callaghan & Yue, 2004). Dietzenbacher and van der Linden (1997) also used HEM to measure backward and forward linkage components separately.

i. Backward Linkages (Miller & Lahr's Approach, 2001)

It is assumed that the *n*-sector direct input coefficient matrix A has been partitioned into two groups:
sector 1 - is a sector that is to be extracted from the economy
(e.g. Manufacturing)
sector 2- consists of all the remaining sectors of the economy

Then the Leontief model can be expressed as:

$$\begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} \times \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} Y_1 \\ Y_2 \end{bmatrix} \quad (7)$$

where, X_1 and X_2 are the outputs of sector 1 and sector 2 respectively
Y_1 and Y_2 are the final demand of sector 1 and sector 2 respectively

Consider the standard representation of an n-sector input-output technical coefficients matrix that has been partitioned so that k sectors (k<n) are shown in the upper left square submatrix, as A_{11}. That is,

$$A = \left[\begin{array}{c|c} A_{11} & A_{12} \\ \hline A_{21} & A_{22} \end{array}\right] \quad (8)$$

The Leontief inverse of the partitioned matrix can be expressed as,

$$L = (I - A)^{-1} = \left[\begin{array}{c|c} H & HA\alpha \\ \hline \alpha_{22}A_{21}H & \alpha_{22}(I + A_{21}HA_{12}\alpha_{22}) \end{array}\right] \quad (9)$$

where $H = (I - A_{11} - A_{12}\alpha_{22}A_{21})^{-1}$ and $\alpha_{22} = (I - A_{22})^{-1}$. Final demands and gross outputs can be partitioned similarly,

$$y = \left[\begin{array}{c} y_1 \\ \hline y_2 \end{array}\right] \text{ and } x = \left[\begin{array}{c} x_1 \\ \hline x_2 \end{array}\right] \quad (10)$$

and

$$x = \left[\begin{array}{c} x_1 \\ \hline x_2 \end{array}\right] = \left[\begin{array}{c|c} H & HA_{12}\alpha_{22} \\ \hline \alpha_{22}A_{21}H & \alpha_{22}(I + A_{21}HA_{12}\alpha_{22}) \end{array}\right] \left[\begin{array}{c} y_1 \\ \hline y_2 \end{array}\right] \quad (11)$$

Now, sector 1 is hypothetically extracted from the economy.

Set $A_{11} = A_{12} = A_{21} = 0$, therefore,

$A^1 = \left[\begin{array}{c:c} 0 & 0 \\ \hdashline 0 & A_{22} \end{array}\right]$ then the Leontief inverse is (12)

$$L^1 = \left[\begin{array}{c:c} I & 0 \\ \hdashline 0 & \alpha_{22} \end{array}\right] \tag{13}$$

The pre-extraction total output vector is given in (3.5). Hence the extraction total output is

$$x^1 = \begin{bmatrix} x_1^1 \\ \hdashline x_2^1 \end{bmatrix} = \left[\begin{array}{c:c} I & 0 \\ \hdashline 0 & \alpha_{22} \end{array}\right] \begin{bmatrix} y_1 \\ \hdashline y_2 \end{bmatrix} \tag{14}$$

Then from (11) and (14),

$$\Delta x^1 = \begin{bmatrix} x_1 - x_1^1 \\ \hdashline x_2 - x_2^1 \end{bmatrix} = \begin{bmatrix} \Delta x_1^1 \\ \hdashline \Delta x_2^1 \end{bmatrix} = \left[\begin{array}{c:c} H - I & HA_{12}\alpha_{22} \\ \hdashline \alpha_{22}A_{21}H & \alpha_{22}A_{21}HA_{12}\alpha_{22} \end{array}\right] \begin{bmatrix} y_1 \\ \hdashline y_2 \end{bmatrix} = \left[\begin{array}{c:c} \Delta_{11}^{1L} & \Delta_{12}^{1L} \\ \hdashline \Delta_{21}^{1L} & \Delta_{22}^{1L} \end{array}\right] \begin{bmatrix} y_1 \\ \hdashline y_2 \end{bmatrix} \tag{15}$$

where L denotes extraction from the Leontief model.

ii. Forward Linkages

The elements from the Ghosh model (often called the supply-driven or supply-side model) would be more appropriate as forward linkage measures (Beyers, 1976; Jones, 1976). The partitioned is similar as Leontief model,

$$\hat{x} = \left[\begin{array}{c:c} \hat{x}_1 & 0 \\ \hdashline 0 & \hat{x}_2 \end{array}\right] \quad \text{and} \quad (\hat{x})^{-1} = \left[\begin{array}{c:c} (\hat{x}_1)^{-1} & 0 \\ \hdashline 0 & (\hat{x}_2)^{-1} \end{array}\right] \tag{16}$$

Then,

$$B = \left[\begin{array}{c:c} B_{11} & B_{12} \\ \hdashline B_{21} & B_{22} \end{array}\right] = (\hat{x})^{-1}A(\hat{x}) = \left[\begin{array}{c:c} (\hat{x}_1)^{-1}A_{11}(\hat{x}_1) & (\hat{x}_1)^{-1}A_{11}(\hat{x}_2) \\ \hdashline (\hat{x}_2)^{-1}A_{21}(\hat{x}_2) & (\hat{x}_2)^{-1}A_{22}(\hat{x}_2) \end{array}\right] \tag{17}$$

The associated partitioned inverse is

$$G = (I - B)^{-1} = (\hat{x})^{-1}(I - A)^{-1}(\hat{x}) = \left[\begin{array}{c:c} K & KB_{12}\beta_{22} \\ \hdashline \beta_{22}B_{21}K & \beta_{22}(I + B_{21}KB_{12}\beta_{22}) \end{array}\right] \tag{18}$$

where $K = (I - B_{11} - B_{12}\beta_{22}B_{21})^{-1} = (\hat{x}_1)^{-1}H(\hat{x}_1)$ and $\beta_{22} = (I - B_{22})^{-1} = (\hat{x}_2)^{-1}\alpha_{22}(\hat{x}_2)$

Sector 1 is extracted from the economy, then

$$B^1 = \left[\begin{array}{c:c} 0 & 0 \\ \hdashline 0 & B_{22} \end{array}\right] \tag{19}$$

and the Ghosh inverse is

$$G^1 = \left[\begin{array}{c:c} I & 0 \\ \hdashline 0 & \beta_{22} \end{array}\right] \tag{20}$$

Therefore, Δx^1 generated by Ghosh model extraction is

$$\Delta x^1 = [\Delta x_1^1 \quad \Delta x_2^1] = [w_1' \;\vdots\; w_2'] \left|\begin{array}{c:c} K - I & KB\beta \\ \hdashline \beta_{22}B_{21}K & \beta_{22}B_{21}KB_{12}\beta_{22} \end{array}\right| = [w_1' \;\vdots\; w_2'] \left[\begin{array}{c:c} \Delta_{11}^{1G} & \Delta_{12}^{1G} \\ \hdashline \Delta_{21}^{1G} & \Delta_{22}^{1G} \end{array}\right] \tag{21}$$

IV. RESULTS

The application of the Euro method was done using Excel Visual Basic Programming. The data requirement for the Euro method is shown in Appendix 1 and the projected MIOT 2015 is shown in Appendix 2. The projected MIOT 2015 was analysed using Hypothetical Extraction Method (HEM) to measure the backward and forward linkages. The backward and forward linkage is the index with the ratio to output of extracted sector. The HEM results for the twelve sectors are shown in Table 1.2. The HEM results for projected MIOT 2015 were compared with MIOT 2010. The ranking of the backward and forward linkages between the MIOT 2010 and projected MIOT 2015 are quite similar across these hypothetical extraction measures. For example, manufacturing sector was ranked number one based on backward and forward linkages for MIOT 2010 and projected MIOT 2015. Similarly, the ranks are same for sector Wholesale & Retail Trade; Transport & Communication; Agriculture, Fishery & Forestry; and Finance & Insurance.

Table 1.2: Backward and Forward Linkage

	Sector	BACKWARD LINKAGE				FORWARD LINKAGE			
		MIOT 2010		PROJECTED MIOT 2015		MIOT 2010		PROJECTED MIOT 2015	
		backward linkage	rank	backward linkage	rank	forward linkage	rank	forward linkage	rank
1	Agriculture, Fishery & Forestry	1.10	4	1.12	4	1.27	4	1.30	4
2	Mining & Quarrying	0.66	7	0.65	7	0.87	6	0.86	6
3	Manufacturing	5.03	1	5.37	1	4.79	1	5.17	1
4	Electricity, Gas & Water	0.40	10	0.43	11	0.49	9	0.53	9
5	Construction	0.71	6	0.93	6	0.54	8	0.71	7
6	Wholesale & Retail Trade	1.39	2	1.58	2	1.43	2	1.66	2
7	Hotel & Restaurants	0.37	11	0.45	10	0.32	10	0.39	10
8	Transport & Communication	1.26	3	1.52	3	1.27	3	1.56	3
9	Finance & Insurance	1.08	5	1.04	5	1.25	5	1.18	5
10	Real Estate & Ownership of Dwellings	0.27	12	0.30	12	0.27	11	0.31	11
11	Business & Private Services	0.54	8	0.58	8	0.56	7	0.61	8
12	Government Services	0.46	9	0.52	9	0.26	12	0.30	12

By combining the backward and forward linkages, a typological presentation is shown in Figure 1. Five sectors are in quadrant 1 and were identified as “key sectors” to the economy with backward and forward linkages are greater than one (1). The position on the chart can reveal characteristics of the industrial sector. Sectors in quadrant (I) are of above-average importance in the economy. The sectors are Manufacturing; Wholesale & Retail Trade; Transport & Communication; Agriculture, Fishery & Forestry; and Finance & Insurance. The sectors in quadrant (III) are below average importance in the economy. Figure 1 also shows that Manufacturing sector is the most important contributing sector to the Malaysian economy.

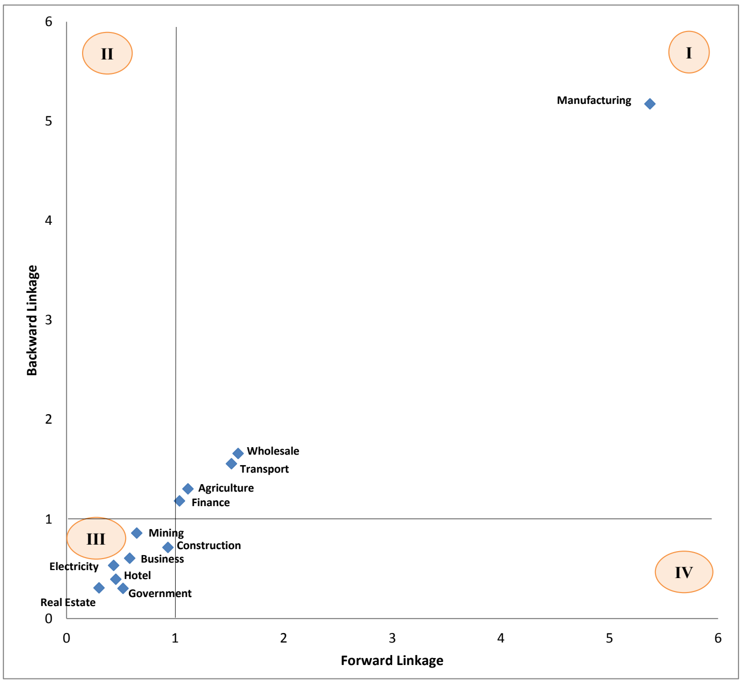

Figure 1: Backward and Forward Linkages, 2015

V. CONCLUSION

The application of Euro method shows that projected MIOT for 2015 could be produced with a minimal data based on macroeconomic official statistics. The benefits of the EURO projection method are that the data requirement is minimal, time lag is short, cost is low and involves no arbitrary changes of input coefficients. Based on HEM method, the five-sectors; Manufacturing; Wholesale & Retail Trade; Transport & Communication; Agriculture, Fishery & Forestry; and Finance & Insurance were identified as *key sectors*. The Manufacturing sector is the most important contributing sector to the Malaysian economy. Future work will involve more projection methods and a larger size of sectors.

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Appendix 1: Data Requirement to Project MIOT 2015

REQUIRED DATA TO PROJECT USE MATRIX OF DOMESTIC PRODUCTION AT BASIC PRICES **USING EURO METHOD** 12 INDUSTRY x 12 INDUSTRY 2015 (RM Million)	Industry	Agriculture, Fishery & Forestry	Mining & Quarrying	Manufacturing	Electricity, Gas & Water	Construction	Wholesale & Retail Trade	Hotel & Restaurants	Transport & Communication	Finance & Insurance	Real Estate & Ownership of Dwellings	Business & Private Services	Government Services	**TOTAL INTERMEDIATE DEMAND**	Private Consumption	Government Consumption	Gross Fixed Capital Formation	Change in Inventories	Exports	**TOTAL FINAL DEMAND**	**TOTAL OUTPUT**
Industry		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Agriculture, Fishery & Forestry	1																				
Mining & Quarrying	2																				
Manufacturing	3																				
Electricity, Gas & Water	4																				
Construction	5																				
Wholesale & Retail Trade	6																				
Hotel & Restaurants	7																				
Transport & Communication	8																				
Finance & Insurance	9																				
Real Estate & Ownership of Dwellings	10																				
Business & Private Services	11																				
Government Services	12																				
TOTAL INTERMEDIATE INPUT	13																				
Imported Products	14																				731,895
Taxes	15																				34,319
Value Added	16	97,805	103,693	263,717	31,236	54,138	182,072	34,666	101,930	76,149	36,579	61,992	97,310								1,142,451
TOTAL INPUT															626,239	151,989	302,948	(12,601)	820,459		

Appendix 2: Projected MIOT 2015

PROJECTED USE MATRIX OF DOMESTIC PRODUCTION AT BASIC PRICES **USING EURO METHOD** 12 INDUSTRY x 12 INDUSTRY 2015 (RM Million)	Industry	Agriculture, Fishery & Forestry	Mining & Quarrying	Manufacturing	Electricity, Gas & Water	Construction	Wholesale & Retail Trade	Hotel & Restaurants	Transport & Communication	Finance & Insurance	Real Estate & Ownership of Dwellings	Business & Private Services	Government Services	**TOTAL INTERMEDIATE DEMAND**	Private Consumption	Government Consumption	Gross Fixed Capital Formation	Change in Inventories	Exports	**TOTAL FINAL DEMAND**	**TOTAL OUTPUT**
Industry		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Agriculture, Fishery & Forestry	1	10,536	6	96,240	10	90	4,116	3,861	148	89	273	84	712	116,165	27,648	0	5,103	316	15,598	48,664	164,829
Mining & Quarrying	2	58	1,121	74,788	763	3,559	16	4	19	1	2	4	14	80,348	209	-	20	(271)	48,922	48,880	129,228
Manufacturing	3	20,051	7,259	256,124	5,563	48,610	45,938	15,311	27,552	4,282	688	12,251	7,120	450,750	125,569	-	32,830	6,409	615,703	780,511	1,231,261
Electricity, Gas & Water	4	1,387	195	19,314	9,670	730	1,434	4,106	2,059	4,179	329	1,703	4,311	49,415	16,469	-	522	13	1,111	18,115	67,530
Construction	5	1,369	1,303	6,458	36	12,591	89	493	2,845	781	1,766	861	7,401	35,994	11,981	-	105,719	5	8,355	126,060	162,054
Wholesale & Retail Trade	6	6,311	2,041	83,866	1,570	9,802	11,304	3,314	6,293	1,162	240	1,273	1,247	128,422	82,423	-	13,501	1,990	74,859	172,772	301,194
Hotel & Restaurants	7	362	15	674	19	196	2,963	5,262	1,635	5,890	128	496	2,292	19,932	58,389	0	24	(0)	65	58,477	78,409
Transport & Communication	8	3,202	2,100	28,155	987	1,821	8,316	3,089	69,556	12,007	1,231	7,119	9,740	147,322	72,952	-	1,629	151	43,837	118,569	265,891
Finance & Insurance	9	6,685	1,507	18,112	1,634	1,667	8,293	757	14,510	48,285	5,833	3,237	3,601	114,122	45,016	-	814	(0)	10,845	56,676	170,797
Real Estate & Ownership of Dwellings	10	144	-	2,504	-	1,656	3,119	219	2,803	2,152	6,988	998	7,613	28,196	28,560	-	-	-	-	28,560	56,756
Business & Private Services	11	1,257	757	9,079	2,662	1,108	4,900	1,170	4,606	3,984	1,088	12,057	3,696	46,362	42,372	12,181	4,227	(115)	11,677	70,344	116,706
Government Services	12	2	0	27	0	9	20	2	16	12	39	101	1,533	1,760	24,047	130,808	6,505	0	373	161,733	163,492
TOTAL INTERMEDIATE INPUT	13	51,365	16,304	595,340	22,915	81,839	90,508	37,590	132,043	82,822	18,604	40,182	49,277	1,218,788	535,637	142,989	170,893	8,497	831,344	1,689,361	2,908,149
Imported Products	14	15,288	8,259	377,174	13,659	26,261	34,232	6,905	35,883	5,475	1,246	13,462	16,337	554,182	80,746	7,286	119,668	3,144	44,447	255,291	809,472
Taxes less Subsidies on Products	15	(106)	(240)	2,774	(261)	(0)	1,641	(64)	(255)	822	59	604	119	5,092	8,824	9	7,570	-	13,811	30,213	35,306
Gross Value Added	16	98,282	104,906	255,973	31,217	53,954	174,813	33,979	98,221	81,679	36,847	62,458	97,759	1,130,087	-	-	-	-	-	-	1,130,087
TOTAL INPUT	17	164,829	129,228	1,231,261	67,530	162,054	301,194	78,409	265,891	170,797	56,756	116,706	163,492	2,908,149	625,206	150,284	298,132	11,641	889,601	1,974,864	4,883,013