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Projecting Input-Output Table for Malaysia: A Comparison of RAS and EURO Method

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ABSTRACT

Input-Output analysis provides important information about the structure of a country's economy. The construction of input-output tables based on detailed census or surveys is a complex procedure requiring substantial financial outlay, human capital, and time. This is the main reason why Malaysia Input-Output (MIO) Table is produced and published on average once every five years. For policy makers past data is not seen as suitable for planning economic policies. The aim of this study is to compare RAS and Euro methods to project input-output tables for Malaysia. The data for the study are MIO table and Gross Domestic Product for the years 2000, 2005 and 2010. The RAS and Euro method were used to project the MIO table 2005 using MIO table 2000 and also projection of MIO table 2010 using MIO table 2005. The projection of I-O tables involved an intensive iterative procedure using Excel Visual Basic programming. The projection performance of RAS and Euro methods were assessed based on Mean Absolute Deviation (MAD), Root Mean Squared Error (RMSE) and Dissimilarity Index (DI). The results show that Euro method performed better than the RAS method in the projection of MIO table.

Keywords: Euro method, projecting input-output table, RAS method

INTRODUCTION

Input-output (I-O) table is an important tool in economic analysis. I-O table provides information about the structure of the economy useful for policy development and decision making. Currently, producing a benchmark I-O table is expensive and time consuming. This is the main reason why

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Malaysia Input-Output (MIO) Table is produced and published on average every five years. Generally, the latest I-O tables available would reflect data of a previous year. For example, MIO table for 2010 was released in 2014 (Department of Statistics Malaysia, 2014) making its application to be inaccurate.

This study will focus on projecting the MIO table using past I-O table to project the I-O table of the current year. The projection methods used are the bivariate method, namely the RAS technique and the EURO procedure which is a stochastic method. The RAS method was selected for this study because this technique is simple and widely used (Bacharah, 1970) whilst Euro method is a robust procedure and data requirement is minimal. It involves no arbitrary changes of input coefficients (Beutel, 2002; Eurostat, 2008). This paper is structured as follows. Reviews on projection of input-output tables are provided in Section 2, followed by the methodology in Section 3. Section 4 presents the results and findings. Finally, the conclusion is given in Section 5.

I-O tables are usually published five years after the reference period. The long time lag, its complexity as well as the tediousness and high costs of compiling survey-based input-output tables have motivated researchers to focus on projecting input-output tables. In their early study, Deming and Stephen (1940) proposed using least squares approach to adjust sample frequency table where marginal totals are known. Their approach involves the solution of normal equations. They also proposed an iterative method of adjustment and conclude that it is better than solving the normal and condition equations. However, Stephen (1942) reported that the iterative approach by Stephen and Deming (1940) only provides an approximation, they do not satisfy the normal equations. He then proposed a method of that converges to the least squares values and showed examples using the two and three dimensional cases. Stone and Brown (1962) then adapted the work by Stephen (1942) and proposed a biproportional adjustment of input-output coefficients and is well-known as the RAS procedure. The updating of input-output tables using RAS is known as non-survey or partial-survey method and has been the subject of long discussions and as a result, the alternative non-survey methods have been developed (Oosterhaven et al., 1986).

Meanwhile, Beautel (2002) introduced a new projection Euro method. The basic idea of this new approach is to derive I-O table using official information or macroeconomic data. The rows and columns of the input-output table use scale factors to derive the unknown rates for input and output from the gross value added by industries and final demand by use category. The advantages of Euro method are low costs involves, simple and robust updating procedure, relatively few data requirements for projection and only official data sources are used.

In order to be able to draw conclusions regarding projection techniques it is necessary to firstly assess their relative performance. Parikh (1979) applied RAS method in forecasting and examines an updating of the 1959 absorption flow matrices of nine European countries to the 1965 Input-Output table. The updated matrices were compared with the corresponding figures based on the actual 1965 tables at a 19-sectors level of aggregation. The percentage mean square errors between updated and actual coefficients were used to evaluate the methods. Butterfield and Mules (1980) also studied on cell by cell accuracy in the input-output matrices through a series of statistical tests and applied them to three non-survey estimates of input-output tables for the Australian State of Western Australia. The RAS method, the H-M (McMenamin-Haring) method and the N (Naïve) method were used to estimate the I-O coefficients. The sign test is the first test to gauge consistency. The second test, pertains to the regression analysis on the relationship between the estimated coefficient and benchmark coefficients. The third test termed as chi-square contingency table. Finally, the Mean Absolute Difference (MAD) and Standardized Mean Absolute Difference (SMAD) measures the absolute distance between estimated and benchmark coefficients. Based on these statistical tests, the results suggest that RAS is the best method.

Temurshoev et al. (2011) presented the relative performance of eight methods using Dutch and Spanish Supply & Use Tables (SUT). 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. The measures of Mean Absolute Percentage Error, Weighted Absolute Percentage Error, Standardized Weighted Absolute Difference, The Psi Statistic, RSQ (or coefficient of determination and $N0$ – number of zero elements in the estimated matrix X, whose corresponding elements are nonzero in the actual matrix X^{true} were used to assess their relative performance. They reported that GRAS, Harthoorn and Van Dalen and Kuroda methods provide good estimates in terms of projecting the SUT. GRAS is a popular bi-proportional technique proposed by Gunluk-Senesen and Bates (1988) and formalized by Junius and Oosterhaven (2003) which allows for negative elements in I-O tables.

METHODOLOGY

In this study, the MIO table for the year 2000, 2005 and 2010 were used as the base years for the iteration procedure for the compilation of a projected input-output table. The output matrix of domestic production at basic prices calculated for industry-by-commodity at basic prices calculated for commodity-by-industry were used to derive symmetry and industry-by-industry input-output table of domestic production at basic prices. The industries and commodities of the I-O tables were aggregated to 12 industries and 12 commodities in order to make the tables as comparable as possible for year 2000, 2005 and 2010. For example, there are 94 industries and 94 commodities for MIO table 2000, 120 industries and 120 commodities for MIO table 2005, and 124 industries and 124 commodities for MIOT 2010. For this study MIO table for 2000 was used as the base year to project the MIO table 2005. Similarly, MIO table 2005 was used to project the MIO table 2010. The industrial classification for the year 2000, 2005 and 2010 were aggregated in term of (1) Agriculture, Forestry and Logging; (2) Mining and Quarrying; (3) Manufacturing; (4) Electricity, Gas and Water; (5) Construction; (6) Wholesale and Retail; (7) Hotel and Restaurant; (8) Transport and Communication; (9) Finance and Insurance; (10) Real Estate and Ownership of Dwellings; (11) Business and Private Services; and (12) Government Services.

The data comes from MIO table for 2000, 2005 and 2010 as well as microeconomic data, viz., Gross Domestic Product (GDP) for 2005 and 2010 at current prices. This study involved two phases. In the first phase two projection methods, the RAS procedure and EURO method were used to project the MIO table 2005 using MIO table 2000 and then project the MIO table 2010 using MIO table 2005. The projection of I-O tables involved an intensive iterative procedure using Microsoft Excel Visual Basic programming. In the second phase, the projection performance of RAS and EURO methods were assessed based on Mean Absolute Deviation (MAD), Root Mean Squared Error (RMSE) and Dissimilarity Index (DI) (Saari et al., 2014).

The simplified input-output table is shown in Table 1. The row sectors of intermediate input are the producing sectors of inputs, while the column sectors of intermediate demand are consuming sectors of output.

Table 1
Simplified Input-Output Table

Absorption Matrix of Domestic Production at Basic Prices (Industry by Industry)			Intermediate Demand					Final Demand (f)					Total Output (X_i)
		Industry	Agriculture	Mining	…	Services	Total Intermediate Demand (d)	Private Consumption	Government Consumption	Gross Fixed Capital Formation	Changes Inventory	Exports	
Intermediate Input	*Industry*		$j=1$	$j=2$	…	$j=m$		$k=1$	$k=2$	$k=3$	$k=4$	$k=5$	
	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_1	u_2	…	u_m	ud	f_1	f_2	f_3	f_4	f_5	uX
Imported Products (m)			m_1	m_2	…	m_m	md	mf_1	mf_2	mf_3	mf_4	mf_5	mX
Taxes less Subsidies on Products (t)			t_1	t_2	…	t_m	td	tf_1	tf_2	tf_3	tf_4	tf_5	tX
Gross Value Added (v)			v_1	v_2	…	v_m	vd	vf_1	vf_2	vf_3	vf_4	vf_5	vX
Total Input (X_j)			X_1	X_2	…	X_m	Xd	Xf_1	Xf_2	Xf_3	Xf_4	Xf_5	XX

RAS Method

RAS is an iterative procedure which involves two diagonal matrices, that is, a diagonal matrix of row multipliers, $\hat{r}$ and a diagonal matrix of column multipliers, $\hat{s}$ (Stone, 1962; Stone and Brown, 1962). It is named after the typical sequence of matrices, where the matrix of input coefficients, A(1) is obtained by pre-multiplying the corresponding matrix of A(0) by $\hat{r}$ to obtain $\hat{r}A(0)$ and post-multiplying $\hat{r}A(0)$ by $\hat{s}$ to obtain $\hat{r}A(0)\hat{s}$. The estimation process of obtaining A(1) from A(0) involves achieving convergence using proportional adjustment of the base year I-O matrix elements successively along the rows and columns. After several iterations, the cells in the adjusted matrix will sum up to the required row and column totals of the current year. The data required for RAS is the shaded area of the simplified I-O table shown in Table 1 which includes total intermediate input, total intermediate demand, final demand, gross value-added, taxes less subsidies on products, imported commodities, total input and total output.

Let A(0) be the input coefficient matrix corresponding to the base year I-O table and A(1) is the projected input coefficients matrix corresponding to the projected I-O table. Then,

$$A(1) = \hat{r}A(0)\hat{s} \tag{1}$$

where, $\hat{r}$ is diagonal matrix of row multipliers
$\hat{s}$ is diagonal matrix of column multipliers

In matrix notation,

$$A(1) = \begin{bmatrix} r_1 & 0 & \cdots & 0 \\ 0 & r_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & r_n \end{bmatrix} \times \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \times \begin{bmatrix} s_1 & 0 & \cdots & 0 \\ 0 & s_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & s_n \end{bmatrix}$$

$$= \begin{bmatrix} r_1 a_{11} s_1 & r_1 a_{12} s_2 & \cdots & r_1 a_{1n} s_n \\ r_2 a_{21} s_1 & r_2 a_{22} s_2 & \cdots & r_2 a_{2n} s_n \\ \vdots & \vdots & \ddots & \vdots \\ r_n a_{n1} s_1 & r_n a_{n2} s_2 & \cdots & r_n a_{nn} s_n \end{bmatrix}$$

From matrix notation, it can be seen that each row of the matrix has a common r factor and each column has a common s factor. The r factors are called the *substitution* factors because they adjust each column for substitution effects and s factors are called the *fabrication* factors because they always change the fabricants of production.

The elements of A(0) is obtained as follows:

$$A(0) = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix}$$

where $a_{ij} = \dfrac{\sum_{j=1}^{n} z_{ij}}{X_j}$,

z_{ij} is intermediate input and X_j is total input

Let Z(1) be the input-output flow matrix of the projected year which is unknown, Y(1) is the known output vector and A(1) is the new coefficient matrix to be estimated corresponding to Z(1). If Y(1) is converted into a diagonal matrix and indicated by the sign ^ over it, hence,

$$Z(1) = A(1)\hat{Y}(1)$$
$$= [\hat{r}A(0)\hat{s}]\hat{Y}(1) \tag{2}$$

Let $d*$ to be the row total of intermediate demand of matrix Z(1), then

$$d* = Z(1)\boldsymbol{i}$$

$$= [\hat{r}A(0)\hat{s}]\hat{Y}(1)\boldsymbol{i}$$
$$= [\hat{r}A(0)\hat{Y}(1)]\hat{s}\boldsymbol{i}$$
$$= \hat{r}[A(0)\hat{Y}(1)]\hat{s} \tag{3}$$

where, i is a column vector in which each element is equal to 1.

Vector i is used to sum the flow matrix across the rows, that is to obtain the row sums of the flow matrix Z(1).

Let u* to be the column totals of Z(1), then

$$u* = Z(1)'i \quad \text{and}$$

$$u'* = i'Z(1)$$

$$= r'[A(0)\hat{Y}(1)]\hat{s} \tag{4}$$

where, r' is a row vector

Equations [3] and [4] consist of two unknown r and s, the known information on the coefficient matrix, A(0), the new row and column constraints $d*$ and $u'*$ and the new output level, Y(1). Thus, if these equations are solved simultaneously, then the values of the r and s vectors can be calculated and then the projected matrix A(1) can be derived on the basis of equation (1). By repetition of equation (1), we would find (Source: Miller and Blair, 2009),

$$\begin{aligned}
&\mathrm{A}(1) = \hat{\mathrm{r}}^1\mathrm{A}(0)\hat{\mathrm{s}} \\
&\mathrm{A}(2) = \hat{\mathrm{r}}^1\mathrm{A}(0)\hat{\mathrm{s}}^1 \\
&\mathrm{A}(3) = [\hat{\mathrm{r}}^2\hat{\mathrm{r}}^1]\mathrm{A}(0)[\hat{\mathrm{s}}^1] \\
&\mathrm{A}(4) = [\hat{\mathrm{r}}^2\hat{\mathrm{r}}^1]\mathrm{A}(0)[\hat{\mathrm{s}}^1\hat{\mathrm{s}}^2] \\
&\vdots \\
&\mathrm{A}(2\mathrm{n}) = [\hat{\mathrm{r}}^\mathrm{n}\cdots\hat{\mathrm{r}}^1]\mathrm{A}(0)[\hat{\mathrm{s}}^1\cdots\hat{\mathrm{s}}^\mathrm{n}]
\end{aligned} \tag{5}$$

Euro Method

The Euro method was developed by Beutel (2002). It corresponds to the basic idea of RAS approach. The fundamental aim is to develop a series of reliable and consistent input-output tables, which is dependent on official macroeconomic data (GDP). However, to ensure a consistent system, any arbitrary adjustments of input coefficients are avoided. The beginning point of the iteration procedure is an I-O table consisting of value added by industry and total final demand by use. The iteration procedure commences with the assumption that, in the first iteration, the given growth rates for value added by sectoral, final demand by use categories and total value added as the starting point for the unknown growth rates characterising the activity levels of input and output sectors. The growth rates will be marginally adjusted until the projected exogenous variables are reproduced.

The data required for EURO is the projected year *t*, that is, vectors of gross value added by industries, v_j, totals of final demand by use category, Xf_j , and total gross value added, vY. Thus, the original base year I-O table at basic prices consist of intermediate input ($z_{11},...,z_{nn}$), final demand ($f_{11},...,f_{n5}$) and value added ($v_1,...,v_m$).

The growth rates is defined as, $p = \frac{v(1)_j}{v(0)_j}$ (6)

where, $v(0)_j$ is actual value j for base year, $j=1,...,m$
$v(1)_j$ is macroeconomic statistics j for projected year t, $j=1,...,m$

is the basis for updating the intermediate input, $z_{11},...,z_{nm}$, and final demand, $f_{11},...,f_{n5}$. The growth rates for input is 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 I-O 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 I-O table is solved to guarantee the consistency of the system in terms of supply and demand.

The I-O matrix is then weighted with row multipliers for inputs, T2, where, T2=W0*T1 and column multipliers for outputs, T3, where, T3=T1*W1. By calculating the average I-O matrix weighted with row multipliers, T2, and column multipliers, T3, we obtain inconsistent I-O table, T4, where, T4=(T2+T3)/2.

Based on inconsistent I-O table, input coefficient and Leontief inverse are calculated.

$$a_{ij} = x_{ij} / X_j \tag{7}$$

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

where, a_{ij} is input coefficients for domestic goods and services
z_{ij} is intermediate input of goods and services
X_j is total input of goods and services
I is identity matrix,
A is matrix of input coefficient

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

$$Y = (I - A)^{-1} f \tag{8}$$

where, Y is total output of goods and services
f is column vector of final demand.

The consistent I-O 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 per cent).

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

$$d = \frac{p0}{p1} \tag{9}$$

where, d is deviation
$p0$ is growth rates between projected year (before iteration) and base year
$p1$ is growth rates between projected year (after iteration) and base year

The observed deviations are used to correct the rates of W0 and W1 during the iteration. 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,

$$af = 1 - \frac{[(1-d)100]c}{100} \qquad \text{if } d < 0 \tag{10}$$

$$af = 1 + \frac{[(d-1)100]c}{100} \qquad \text{if } d > 0 \tag{11}$$

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, revised I-O matrix is obtained. The rates for input and output are marginally changed during the iteration until the projected rates for gross 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 within the one percent margin.

Assessing Projection Method

The RAS and EURO methods produce different MIO table estimates, thus it is desirable to assess their relative performance. There are several forms of error measures being used for evaluation. However, no particular error measure has been found to be best under all situations and for all types of data (Armstrong, 2006). In most applications, they tend to produce different results for different method type. Thus, in this study, the three statistics used were MAD, RMSE and DI to measure the performance of RAS and EURO methods based on the closeness of the estimates to the actual matrices.

RESULTS

The application of the RAS procedure and EURO method were done using Excel and Excel Visual Basic Programming. The rows and columns entries were iteratively changed until convergence was reached between the row and column sums of the new total. However, due to space constraint, only the projected I-O table for 2010 using EURO method is displayed in Table 2.

Table 2
Projected Malaysia Input-Output Table 2010 using EURO Method

PROJECTED USE MATRIX OF DOMESTIC PRODUCTION AT BASIC PRICES **USING EURO METHOD** 12 INDUSTRY x 12 INDUSTRY 2010 (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	12,749	407	64,033	39	202	2,536	20	103	165	9	18	618	80,900	12,255	1	2,864	(7,226)	18,589	26,483	107,382
Mining & Quarrying	2	211	548	44,110	820	2,289	469	31	151	175	18	44	363	49,229	1,019	0	6,654	1,277	57,366	66,316	115,545
Manufacturing	3	11,368	11,872	359,820	10,576	28,194	7,038	4,512	15,989	2,992	1,078	2,701	11,804	467,944	111,640	445	13,748	6,174	559,545	691,553	1,159,497
Electricity, Gas & Water	4	566	273	10,187	8,992	356	993	2,548	1,572	710	563	981	2,367	30,108	15,608	181	36	(47)	2,888	18,667	48,775
Construction	5	12	2,030	8,743	2,366	640	522	56	3,974	47	7,605	171	11,490	37,657	20,301	-	39,429	2	81	59,813	97,470
Wholesale & Retail Trade	6	2,589	5,779	58,823	596	3,126	5,738	624	2,272	3,159	253	937	5,376	89,271	12,739	1	8,018	375	22,420	43,552	132,823
Hotel & Restaurants	7	5	22	328	182	572	3,147	11,721	244	120	84	125	1,235	17,786	31,922	47	21	1	309	32,299	50,085
Transport & Communication	8	1,197	1,534	23,198	585	3,995	4,684	1,533	38,853	6,883	504	3,934	5,824	92,725	29,699	26	3,652	109	29,439	62,925	155,649
Finance & Insurance	9	1,265	61	12,014	196	3,031	2,703	1,318	18,793	33,934	1,116	1,557	620	76,609	13,723	42	0	(0)	21,972	35,737	112,346
Real Estate & Ownership of Dwellings	10	0	95	16	45	0	1,695	3,152	3,445	1,276	3,674	1,567	2,557	17,522	28,112	0	0	(0)	0	28,112	45,634
Business & Private Services	11	306	1,112	4,785	822	3,683	2,457	1,660	4,932	3,873	922	13,250	5,966	43,770	5,679	2,238	1,308	0	30,913	40,138	83,908
Government Services	12	10	93	510	213	460	573	324	2,666	494	393	776	8,456	14,970	14,734	88,733	11	3,265	7,593	114,335	129,305
TOTAL INTERMEDIATE INPUT	13	30,279	23,827	586,565	25,432	46,548	32,555	27,500	92,996	53,830	16,219	26,062	56,675	1,018,490	297,431	91,714	75,741	3,931	751,114	1,219,930	2,238,420
Imported Products	14	6,704	5,975	374,371	4,103	23,644	5,474	1,844	11,829	877	1,127	13,353	13,942	463,243	60,993	9,262	101,280	-	28,440	199,975	663,218
Taxes less Subsidies on Products	15	1,325	106	11,347	212	518	162	89	368	166	16	814	42	15,165	18,796	1,049	2,757	-	1,951	24,553	39,718
Gross Value Added	16	69,075	85,636	187,214	19,028	26,760	94,632	20,652	50,456	57,473	28,272	43,679	58,646	741,522	-	-	-	-	-	-	741,522
TOTAL INPUT		107,382	115,545	1,159,497	48,775	97,470	132,823	50,085	155,649	112,346	45,634	83,908	129,305	2,238,420	377,220	102,026	179,778	3,931	781,504	1,444,458	3,682,878

In order to determine whether the RAS or EURO method performs better in projecting the MIOT for 2005 and 2010, they were evaluated using three error measures - the MAD, RMSE and DI methods. The results shown in Table 3 and Table 4 indicate the EURO method has on the average the smallest MAD, RMSE and DI. In 2005, the EURO method registered a smaller MAD (0.020), RMSE (0.036) and DI (0.421). Similarly, in 2010 the MAD (0.018), RMSE (0.031) and DI (0.460) also registered smaller values of error measures. Therefore, we can conclude that the EURO method performed better than RAS based on the smaller value of MAD, RMSE and DI.

Table 3
Assessment of RAS and EURO Method for year 2005

	2005	MAD		RMSE		DI	
	Sector	**RAS**	**EURO**	**RAS**	**EURO**	**RAS**	**EURO**
1	Agriculture, Fishery & Forestry	0.013	0.009	0.028	0.016	0.651	0.514
2	Mining & Quarrying	0.013	0.012	0.024	0.024	0.604	0.486
3	Manufacturing	0.010	0.018	0.019	0.043	0.364	0.307
4	Electricity, Gas & Water	0.045	0.031	0.065	0.052	0.556	0.452
5	Construction	0.010	0.011	0.013	0.014	0.317	0.302
6	Wholesale & Retail Trade	0.018	0.018	0.024	0.027	0.598	0.441
7	Hotel & Restaurant	0.052	0.045	0.086	0.074	0.491	0.509
8	Transport & Communication	0.033	0.026	0.055	0.050	0.396	0.442
9	Finance & Insurance	0.035	0.012	0.070	0.018	0.544	0.399
10	Real Estate & Ownership of Dwelling	0.033	0.017	0.050	0.041	0.522	0.339
11	Business & Private Services	0.024	0.017	0.036	0.028	0.506	0.451
12	Government Services	0.036	0.021	0.046	0.031	0.597	0.414
	Average	**0.027**	**0.020**	**0.043**	**0.035**	**0.512**	**0.421**

Table 4
Assessment of RAS and EURO Method for year 2010

	2010	MAD		RMSE		DI	
	Sector	**RAS**	**EURO**	**RAS**	**EURO**	**RAS**	**EURO**
1	Agriculture, Fishery & Forestry	0.015	0.011	0.024	0.019	0.530	0.528
2	Mining & Quarrying	0.037	0.011	0.092	0.019	0.673	0.534
3	Manufacturing	0.030	0.016	0.071	0.033	0.304	0.335
4	Electricity, Gas & Water	0.038	0.025	0.086	0.045	0.561	0.561
5	Construction	0.010	0.018	0.016	0.026	0.370	0.517
6	Wholesale & Retail Trade	0.023	0.014	0.042	0.031	0.860	0.390
7	Hotel & Restaurant	0.015	0.040	0.021	0.065	0.389	0.562
8	Transport & Communication	0.028	0.011	0.052	0.018	0.284	0.344
9	Finance & Insurance	0.048	0.009	0.078	0.012	0.427	0.488
10	Real Estate & Ownership of Dwelling	0.024	0.027	0.046	0.051	0.509	0.451
11	Business & Private Services	0.026	0.014	0.042	0.026	0.793	0.397
12	Government Services	0.054	0.023	0.086	0.030	0.809	0.413
	Average	**0.029**	**0.018**	**0.055**	**0.031**	**0.542**	**0.460**

CONCLUSION

Our empirical application of RAS procedure and EURO method to project Malaysia's Input-Output tables, suggest that the EURO method gives the best projection estimates. The EURO method has been found to be robust, less expensive, minimal data requirement and not requiring arbitrary changes of input coefficients. Hence, the EURO method is suggested for the projection of the I-O table for Malaysia to assist in economic planning and decision-making.

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