An Estimation of Input – Output Table for the Cambodian Economy 2003

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1. Introduction

A computable general equilibrium (CGE) analysis has never been applied to conduct policy assessments in Cambodia due to data constraints and limited skills and interests in economic modelling among Cambodian researchers. As a result, some important policy issues for the country, such as trade liberalization and other reform strategies have been treated qualitatively. To fill these gaps, the paper will document methodologies used in estimating an input – output table, a prerequisite for a construction and an application of the CGE model for Cambodia.

2. Methodology and Sources of Data

The estimation of an input-output table requires extensive survey data on the structure of an economy. Normally, such surveys are not available for small and least developed countries like Cambodia. Consequently, an input-output table has to be constructed by using table(s) of a representative economy as a starting point to reflect an economy in question. For example, Mark Horridge (2000) uses a composite input-output table of Greece, Turkey, and Portugal in his estimation of the table for the Albanian economy. The same procedures are applied to the Cambodian case. The input-output table has the form as shown in table 1.

Table 1: Schematic Input – Output Table

	57 Sectors	**Final Demands: Households, Investment, Government, Exports**	**Total Demand for goods**	***Less* (CIF Imports + Tax on Imports)**	**Demand for domestic goods**
57 Commodities	Intermediate demands	Final demands for goods and services	Intermediate + final demands	CIF + Taxes on imported items	Total less imports
Primary Factors	Wages and profits				
Tax On Domestic Products	Taxes on Production				
Total Cost	Value of local production				

Source: adapted from Mark Horridge (2000)

In the table above, the cell "Intermediate demands" represents a 57x57 matrix showing the use of 57 commodities by 57 industries. The values include both imported and locally-produced goods and the values of any indirect taxes levied on that flows

Similarly the cell "Final demands" represents a 57x4 matrix showing the use of 57 commodities by 4 final demanders. Each cell would show the value of a commodity (domestic plus imported, including tax, but excluding trade and transport margins) used by a

final demander. Adding these "final demands" to "intermediate demands" gives the total demand for goods. The final column is the total demand for domestically-produced goods which include the total demand for good less imports (valued at tax-inclusive prices).

The cell "Wages and profits" includes wages and the value added of firms. The next cell "Tax On Domestic Products" shows only tax on the *output* of the corresponding sectors since taxes on *inputs* are already included in the intermediate demands values.

The sum of all costs of local industries [Intermediate demands, Wages and profits, Tax On Domestic Products] gives the value of local production. In a balanced input-output table, this should be equal, for each sector, to the final column "Demand for domestic goods".

The "balance" condition can also be expressed in aggregate terms using the GDP identity:

GDP expenditure = "Final demands for goods and services" - "CIF Imports"
= GDP income = "Wages and profits" + "Tax on Domestic Products" + "Tax on Imports"

To estimate the input-output table for Cambodia, our approach is:

(i) Use estimates from the Economic Institute of Cambodia (EIC) and Cambodian authorities to get the column sums for each column in the IO table.
(ii) Distribute these column sums between cells in each row using the input-output proportions from the represent table.
(iii) Adjust input-output proportions to ensure that supply = demand for each sectors while preserving production, gross value added, labor income, and other aggregates at their targeted levels[1].

Steps used in the estimate are shown in figure 1 below. The IO table of the representative economy used for the estimate is a combined input-output table of Vietnam and Thailand obtained from database of the Global Trade Analysis Project, Purdue University in the US (GTAP). The composite table is in the form shown in table 1 above and it can be extracted by using Crusoe program written by Mark Horridge which may be downloaded from Monash University, Centre of Policy Studies (CoPS) website http://www.monash.edu.au/policy/crusoe.htm.

The combined table of Thailand and Vietnam are chosen because of the expected similarities between their economic activities and technologies with that of Cambodia.

[1]The methodology embodied in (i) to (iii) is known as RAS procedure. In preparing input-output data, the need often arises to adjust some matrix A so that it sums to given row and column totals. Given an original matrix A(i,j), size r×c, and target vectors of row totals R(i), size r, and column totals C(j), size c, the RAS attempts to find a new, similar, matrix B(i,j) such that:

$\sum_i B(i,j) = C(j) \quad j = 1,...,c$

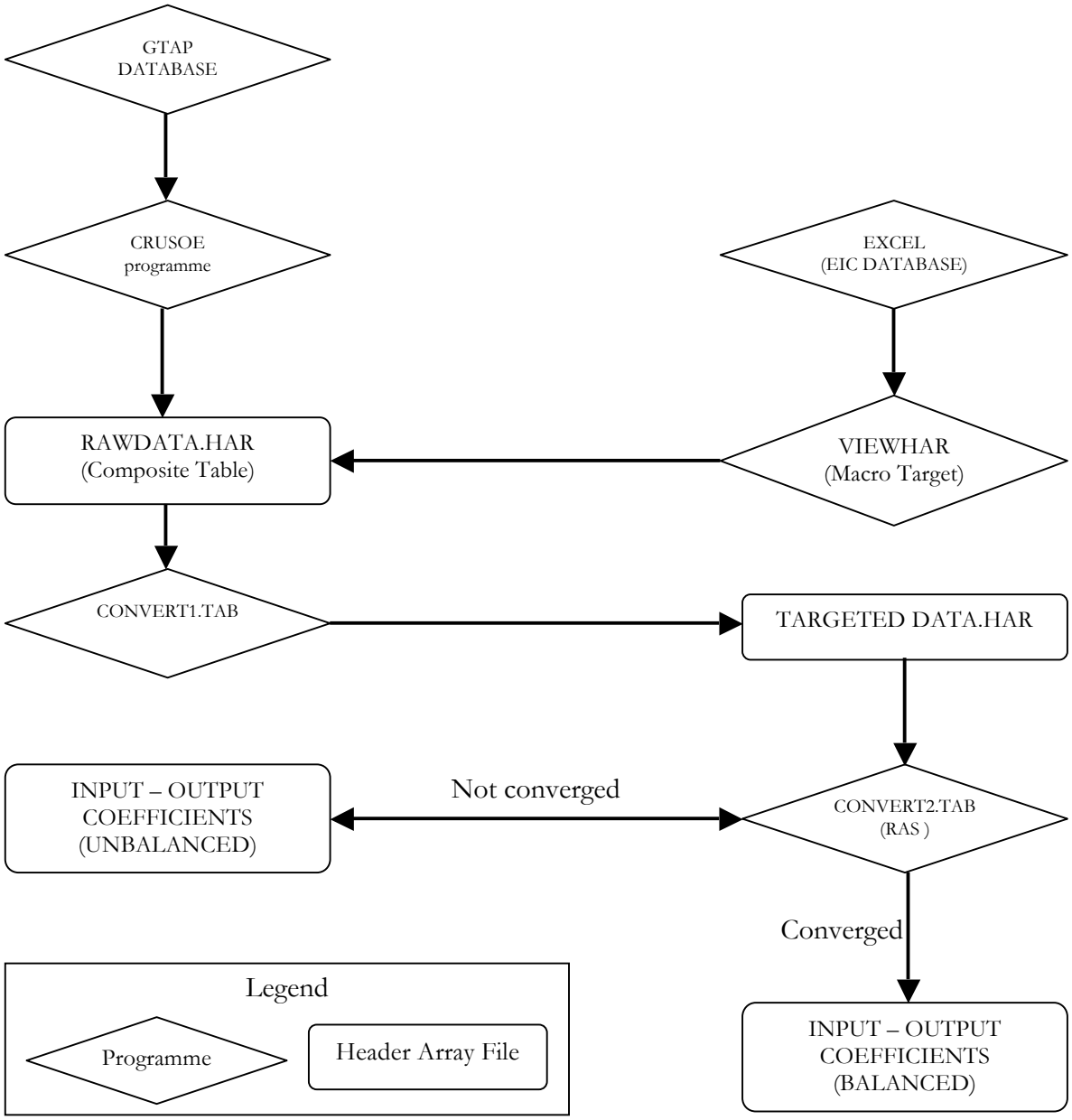
$\sum_j B(i,j) = R(i) \quad i = 1,...,r$

The new matrix B(i,j) is related to the original A(i,j) via:

$B(i,j) = rm(i).cm(j).A(i,j) \quad i = 1,...,r \; j = 1,...,c$

where rm(i) is a vector of row multipliers and cm(j) is a vector of column multipliers. For further detailed discussions, refer to DAGG Guide by Mark Horridge: http://www.monash.edu.au/policy/gpmark.htm

Figure 1: Steps in Input – Output Table Estimates



Main source of data for Cambodia is from the EIC, one of the leading independent research institutes in Cambodia. Other data from the Cambodian National Institute of Statistics (NIS), National Bank of Cambodia and other international organizations (the World Bank and IMF) are also used as secondary sources in this exercise. However, macroeconomic aggregates available for this IO estimate consist of the followings:

- Both GDP by income and expenditure
- Imports and Exports of goods and services
- Some industrial outputs
- Gross Value-added
- Labour Income
- Tax Revenues

These raw data are gathered and processed by using EXCEL and VIEWHAR programmes for following rounds of the estimate by applying TABLIO[2] programme. From TABLIO programme (CONVERT1.TAB), we get distributions of their targeted levels. We then put them in their responding rows and columns of the composite IO table for the next round of adjustments. We finally scale the table until we get converged input-output coefficients matched with known features of the Cambodian economy by repeatedly running CONVERT2.TAB.

3. Estimating Macroeconomic Aggregates of Cambodia

Macroeconomic data are obtained from the EIC's Macroeconomic Model based on survey data and official data released periodically by sector's ministry of the government. The model is dynamic consisting of 22 sectors with extensive accounts of each sector. The model has been used extensively for the country's national account estimates and forecast and in other policy debates in Cambodia.

Table 2 is the controlled data on final demands (GDP by expenditure) and estimated total imports and exports of goods and services. Note that these trade data are covered both recorded and unrecorded imports and exports.

Table 2. GDP by Expenditure Categories in 2003
(Million US$ at Constant 2000 Prices)

Private Consumption	3,811
Government Expenditure	242
Gross Investment	1,016
Exports of Goods & Services	2,676
Imports of Goods & Services	3,216
GDP	**4,533**

Source: EIC and National Institute of Statistics

The Model produces quite detailed information on the economic activities of Cambodia. However, we use data on domestic production, and gross value added (includes incomes from labour, capital, land, of which labour income by sector is available), imports and exports, and tax revenues for our estimate of the IO table. These estimated data from the model may be different from the officially released data due to different methodologies used, especially for the estimation on the informal economic activities.

To conform to GTAP classification in its input-output database which comprises of 57 commodities x 57 industries (table 1), we need to adjust our 22 sectors of EIC for some of these aggregates are more detailed than GTAP sectors[3]. Therefore, we add Rubber to Chemical and Plastic sector which also include petroleum products. Trade is combined with Hotel & Restaurant Services resulting in new 20 aggregate sectors compared to its original 22.

[2] VIEWHAR and TABLIO CODE (shown in Figure 1) are developed by CoPS with its well-known GEMPACK (General Equilibrium Modelling PACKage), for further information, visit: http://www.monash.edu.au/policy/gempack.htm

[3] For detailed classification of GTAP sectors, see the Appendix Table, and for more information on GTAP project, visit its website: http://www.gtap.agecon.purdue.edu/

Gross Value Added, Labour Income, and Domestic Production of these sectors are adjusted accordingly as shown in table 3.

Table 3. Sectoral Shares in Gross Value Added and Labour Income in 2003

No.	Sector	Gross Value Added	Labour Income
1	Paddy	0.0864	0.1502
2	OthCrops	0.0838	0.1610
3	Livestock	0.0540	0.0851
4	Fishing	0.0987	0.0980
5	Forestry	0.0264	0.0021
6	Mining	0.0033	0.0025
7	FoodBevTbaco	0.0294	0.0272
8	TCF	0.1419	0.1187
9	WoodPaperPrt	0.0048	0.0011
10	ChemRubPlas	0.0084	0.0092
11	NonMetlMin	0.0023	0.0040
12	OthManuf	0.0152	0.0113
13	ElecGasWater	0.0050	0.0027
14	Construction	0.0610	0.0543
15	TradeHotel	0.1340	0.1344
16	TranspComm	0.0656	0.0210
17	Finance	0.0106	0.0036
18	PubAdmin	0.0206	0.0462
19	RealEstBus	0.0717	0.0217
20	OtherSev	0.0768	0.0457
	Total	**1.0000**	**1.0000**

Source: EIC and NIS

4. Distributing Sectoral Shares in Gross Value Added into GTAP Sectors

In order to distribute shares of the above sectoral aggregates into their corresponding sectors of GTAP, some data on national account estimated by NIS are used. But only details on Gross Value Added of some sectors are available.

The distributions are shown in the table followings. In these tables, we show to which of the GTAP 57 sectors each of EIC 20 sectors corresponds. Table 4 shows distribution of sectoral share in Gross Value Added into its corresponding sectors of GTAP.

In the distribution of each original sectoral share, we use available breakdown of the sector estimated by NIS and other sources, and for the rest we follow the proportions in the composite table. However, we allow zero distribution of Wheat, and Mining of Coal, Oil, and Gas into GTAP sectors where practically these sectors are not significant in the Cambodian economy.

Table 4. Distribution of Sectoral Share in Gross Value Added into its GTAP Sectors in 2003

No.	Sector	GTAP Sectors			
1	Paddy	pdr : 1			
2	OthCrops	wht : 0	gro : 0.0671	v_f : 0.4514	osd : 0.0914
		c_b : 0.0279	pfb : 0.0015	ocr : 0.3607	
3	Livestock	ctl : 0.3888	Oap : 0.6112	rmk : 0	wol : 0
4	Fishing	fsh : 1			
5	Forestry	for : 1			
6	Mining	col : 0	oil : 0	gas : 0	omn : 1
7	FoodBevTbaco	cmt : 0.0328	omt : 0.1353	vol : 0.066	mil : 0.014
		pcr : 0.079	sgr : 0.0847	ofd : 0.3869	b_t : 0.2012
8	TCF	tex : 0.0460	wap : 0.9264	lea : 0.0276	
9	WoodPaperPrt	lum : 0.7361	ppp : 0.2639		
10	ChemRubPlas	p_c : 0.1446	crp : 0.8554		
11	NonMetlMin	nmn : 1			
12	OthManuf	i_s : 0.0432	nfm : 0.0145	fmp : 0.0523	mvh : 0.1803
		otn : 0.0089	ele : 0.3452	ome : 0.1984	omf : 0.1570
13	ElecGasWater	ely : 0.7490	gdt : 0	wtr : 0.2510	
14	Construction	cns : 1			
15	TradeHotel	trd : 1			
16	TranspComm	otp : 0.5817	wtp : 0.0381	atp : 0.1814	cmn : 0.1980
17	Finance	ofi : 0.8254	insr : 0.1706		
18	PubAdmin	osg : 1			
19	RealEstBus	obs : 0.2653	dwe : 0.7347		
20	OtherSev	ros : 1			

5. Imports & Exports and User-specific Import Shares

The imports and exports of goods and services by sector obtained from the National Bank of Cambodia and EIC estimates are used in the breakdown. These estimated data are different from one source to another due to different estimates of informal international trade and smuggling. However, some adjustments are done to conform to the national aggregates.

To distribute imports of the 57 GTAP commodities to each user, we follow the assumption that the same import-dependence is applied for each non-export user and that all exports are totally locally-produced.

6. Distributions of Other Primary Factors

To comply with GTAP distinction of primary factors into Unskilled Labour, Skilled Labour, Capital and Land, Gross Value Added is split into four following the proportions of that sector in the composite table.

However, the total labour income is maintained the same as it is distributed in table 3. Capital and Land are adjusted accordingly to ensure that their sum equals to the targeted Gross Value Added of each sector.

The distribution of sectoral share in labour income is shown in table 5. In the composite table, labour income is divided into two groups – skilled and unskilled labour. Since no information is available on this division, we follow the proportions of the composite table to split shares of labour income into these two groups. But only shares of total labour income in their aggregated sector are shown in the table below.

Table 5. Distribution of Sectoral Share in Labour Income into its GTAP Sectors in 2003

	Sector	GTAP Sectors			
1	Paddy	pdr : 1			
2	OthCrops	wht : 0	gro : 0.0671	v_f : 0.4514	osd : 0.0914
		c_b : 0.0279	pfb : 0.0015	ocr : 0.3607	
3	Livestock	ctl : 0.3888	oap : 0.6112	rmk : 0	wol : 0
4	Fishing	fsh : 1			
5	Forestry	for : 1			
6	Mining	col : 0	oil : 0	gas : 0	omn : 1
7	FoodBevTbaco	cmt : 0.0345	omt : 0.1416	vol : 0.0348	mil : 0.0153
		pcr : 0.0956	sgr : 0.0809	ofd : 0.4283	B_t : 0.169
8	TCF	tex : 0.0460	wap : 0.9264	lea : 0.0276	
9	WoodPaperPrt	lum : 0.7361	ppp : 0.2639		
10	ChemRubPlas	p_c : 0.0644	crp : 0.9356		
11	NonMetlMin	nmn : 1			
12	OthManuf	i_s : 0.0492	nfm : 0.0258	fmp : 0.0490	mvh : 0.1912
		otn : 0.0165	ele : 0.2648	ome : 0.2120	omf : 0.1914
13	ElecGasWater	ely : 0.7490	gdt : 0	wtr : 0.2510	
14	Construction	cns : 1			
15	TradeHotel	trd : 1			
16	TranspComm	otp : 0.5817	wtp : 0.0381	atp : 0.1814	cmn : 0.1988
17	Finance	ofi : 0.7223	insr : 0.2777		
18	PubAdmin	osg : 1			
19	RealEstBus	obs : 0.95	dwe : 0.05		
20	OtherSev	ros : 1			

7. Estimation of Indirect Taxes

Main indirect taxes are VAT, excise, and import tariffs. All three fall mostly on imports. Domestic tax collections are hampered by corruption due to weak enforcement of law on taxation. Major excises are levied on Petrochemicals, Beverages & Tobacco, and Motor Vehicles.

Since, we do not have sector-specific taxation. For domestic and imported use of each of the 57 GTAP commodities, we assume:

(a) the same commodity tax rate for each intermediate user.
(b) a rather higher tax rate for households.
(c) lower tax rates for investment and government users.

(d) a very low tax rate for exports

Table 7. Tax Revenue in 2003 (Million US$)

	Imports	Domestic	Total
VAT and turnover tax	79	36	116
Excise Tax	41	8	50
Customs Duties	94	5	99
Other	4	38	42
Total	219	88	307
Share of Total	0.7139	0.2861	
Share of GDP	0.0483	0.0194	0.0677

Source: EIC complied from Ministry of Economy and Finance

However, it is important to note that due to prevalence of smuggling and inefficiencies in tax collections, the potential tax collections are much higher than official reports. As a result, the estimated "effective tariff rates" is far below the official rates.

8. Trials and Adjustments of the Table

Putting all information above into the composite table results in inequalities between cost of production and sale for each commodity. To eliminate these imbalances, we make the following adjustments:

(i) scale all columns so that it meets all its targeted domestic costs of production, gross value added, labour income, and GDP by income and expenditure, and to ensure that demand equals supply.
(ii) the scaling above causes imbalances between domestic costs of production and sales of each commodities, so we adjust all usage of each commodity to equate demand with supply. The imbalances were reduced but not eliminated. We finally:
(iii) adjust all household, investment, and government usage of each commodity to equate supply with demand.
(iv) the above adjustment causes a slight differences between aggregate demands to their targets. We uniformly scale household, investment, and government demand vectors to meet the target totals. More small imbalances occur.
(v) further adjustments of these tiny deviations are needed by repeating step (i) to (iv) till we obtain the final balanced table. However, more repetitions may be needed to exactly reach the targeted data.

9. Further Improvement

Most of data on industrial production (output) are not available. The outputs are obtained by following the ratios of output to value-added in the composite table. When available, they can be easily integrated into the table.

Data on imports and exports are drawn from different sources and adjusted to meet their sums. Therefore, precautions are needed for the use of these highly disaggregation data. The informality of international trades is also problematic. Further works are needed to align the

compilation of trade data. The effective tariff rates are far below official rates due to under collections and smugglings.

No detailed information on household and government expenditure are available, these should be cross-checked later with data from the recent socioeconomic survey. Composition of government spending is also entirely based on the composite table.

References

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