Construction of Philippine SAM for the Use of CGE-Microsimulation Analysis

Caesar B. Cororaton[1]

This note documents the steps used in constructing the Philippine SAM for the use of CGE-microsimulation analysis. It consists of two sections: (i) a discussion of the construction of the 1994 SAM, and (ii) a discussion of the integration of information from the family income and expenditure survey (FIES) into the SAM

1994 Social Accounting Matrix

1. In the SAM construction, all data are in 1994. The source of data include: (a) input-output table, (b) labor force survey, (c) annual survey of establishments, (d) FIES, (e) national income accounts, (f) balance of payments account, (g) government accounts, and (h) the 1997 tariff study of Manasan and Querubin.

2. Constructing a SAM is a process of filling in the necessary cells of the matrix shown in Figure 1 with data from the various sources, and adjusting the matrix so that the sums of columns are equal to the sums of rows. There are 12 rows and columns, including the totals. The rows and columns from (a) to (d) are for production and commodities, (e) and (f) for value added, (g) for households, (h) for firm, (i) for government, (j) savings and investment, (k) rest of the world, and (l) for the total.

Sam: Basic accounts

		a	b	c	d	e	f	g	h	i	j	k	l
		x_p	x_g_p	x_c	x_g_c	lab	cap	hh	fir	gov	acc	row	tot
a	x_p	-	-	7	-	-	-	-	-	-	-		
b	x_g_p	-	-	-	7	-	-		-	-	-	6	5
c	x_c			-	-	-	-	11	-	-	13	-	
d	x_g_c	1		-	-	-	-	-	-	12	-	-	14
e	lab	2		-	-	-	-	-	-	-	-	-	15
f	cap	3		-	-	-	-	-	-	-	-	-	18
g	hh	-	-	-	-	16	19	-	20	21	-	22	23
h	fir	-	-	-	-	-	24	-	-	-	-	-	27
i	gov	-	-	8		-	-	28	29	-	-	30	31
j	acc	-	-	-	-	-	-	32	34	35	-	36	37
k	row	-	-	9		-	25	-	38	40	-	-	41
l	tot	4		10		17	26	33	39	42	43	44	-

[1]Research Fellow, Philippine Institute for Development Studies

Names of rows and columns:

x_p; x_g_p	**:production activities**		
x_c; x_g_c	**: commodities**	**fir**	**: firm**
lab	**: labor**	**gov**	**: government**
cap	**: capital**	**row**	**: rest of the world**
hh	**: household**	**tot**	**: total**

Names of Cells

1 : intermediate demand	**23 :total household income**
2 : labor compensation	**24 :capital revenue paid to firms**
3 :return to capital	**25 :capital revenue paid to row**
4 :total input	**26 :total capital income (18=26)**
5 : total output, producers' prices (4=5)	**27 :total income of firms**
6 :exports	**28 :direct taxes of households**
7 : output sold in domestic market	**29 :direct taxes of firms**
8 :indirect taxes	**30 :foreign transfers to govt**
9 :imports	**31 :total government income**
10 :composite goods in consumer prices	**32 :savings of households**
11 :household consumption	**33 :total household expenditure (23=33)**
12 : government consumption expenditure	**34 :savings of firms**
13 :investment expenditure	**35 :savings of government**
14 :total demand (10=14)	**36 :foreign savings**
15 :total labor compensation	**37 :total savings**
16 : labor income of households	**38 :payments of firms to row**
17 :total labor income (15=17)	**39 :total expenditure of firms (27=39)**
18 : total return to capital	**40 :government payment ot row**
19 :capital income of households	**41 :payments to row**
20 :dividend income of households	**42 :total govt expenditure (31=42)**
21 :gov't transfers to households	**43 :total investment (37=43)**
22 :foreign income of households	**44 :total receipts from row (41=44)**

3. There are 44 cells to fill in. I shall discuss each one in detail. The first step was to aggregate the 1994 IO, which was originally from 229 sectors into 48 sectors. There are 11 agricultural sub-sectors, including fishing and forestry, 31 industrial sub-sectors, including 26 manufacturing sub-sectors, and 6 service sub-sectors, including government services.

4. **Cell 1** in Figure 1 was directly taken from the aggregated IO. The breakdown of the sectoral value added in the original IO included compensation of employees, depreciation, indirect taxes (net of subsidies), and operating surplus. In the original IO, the ratio of sectoral compensation and the corresponding GVA were observed to be very low, while the ratio of operating surplus and the GVA were very high in the case for a developing country like the Philippines. One major reason behind this understatement of labor compensation and the corresponding overstatement of operating surplus is the presence of a large informal sector which does not officially record all payments to labor.

In fact, a sizeable part of the sectoral operating surplus is actually payment to labor. This can be seen from the national income accounts data. Thus the problem is how to get out the labor compensation part of operating surplus and add it to the original level of labor compensation in the IO. We addressed this problem by calculating an adjustment factor that will be added to **Cell 2**. The adjustment factor attempts to account for the labor component in the operating surplus. The adjustments applied involved the following steps:

4a. Derive the labor component in the household and unincorporated operating surplus by using the ratio calculated from the official 1994 gross domestic product (GDP) of the National Income Accounts (NIA) and compensation of employees, also of NIA, i.e.

$$adj\_T = HH\_OS\_{nia}*(L\_{nia}/GDP\_{nia})$$

where adj_T is the overall adjustment, HH_OS_{nia} household and unincorporated operating surplus, L_{nia} is compensation of employees from the NIA, GDP_{nia}.

4b. Disaggregate total adjustment adj_T into sectoral adjustment, adj_i, using the sectoral share of compensation of employees from the IO (L_{IO_i}), i.e.,

$$adj\_i = adj\_T*(L\_{IO\_i}*L\_{IO})$$

where L_{IO} the total compensation of employees from the IO. The sectoral adj_i was added to the original sectoral compensation of employees of the IO to get the adjusted sectoral payment to labor.

5. The sectoral payments to capital (**Cell 3**) were derived residually, i.e. sectoral value added (net of indirect taxes) from the IO minus the adjusted sectoral payment to labor.

6. The sectoral intermediate inputs plus value added (net of indirect taxes) determine the sectoral total inputs (**Cell 4**). The values in this cell are equal to the values in **Cell 5**.

7. Diagonal elements in the columns of commodities (**Cell 7**), which are sectoral output sold in the domestic market, were derived residually by subtracting the sectoral exports (**Cell 6**) from the sectoral output (**Cell 5**).

8. Information for the import row (**Cell 9**) was taken directly from the import data in the IO.

9. Adjustments were made in the indirect taxes row (**Cell 8**) to make it consistent with the official government accounts. The total sectoral indirect government taxes of the IO were observed to be substantially different from the 1994 national government accounts. The original sectoral values in the IO added up to only P95,402 million. In the government accounts total indirect taxes amounted to P 190,493 million, broken down

into P87,786 million (46.08 percent) as tariff revenue and P 102,707 million (53.92 percent) as local indirect tax revenue. The rows on sectoral indirect taxes were therefore adjusted to make them consistent with the 1994 government accounts. The adjustment entailed a number of steps:

9a. Computation of tariff revenue. The computation involved the use of the data on imports in the IO and the weighted average nominal tariff rate computed by Manasan and Querubin (1997), in which the average tariff rates are available in detailed sectoral breakdown. To utilize this set of information, the original IO was first aggregated into 48 sectors and matched them with the sectors of the average nominal tariff rates.

9b. Sectoral tariff revenue was computed as

$$m\_net\_{i} = m\_{i}/(1+tm\_{i})$$

where m_net_{i} is imports of sector i net of tariff, m_{i} is imports inclusive of tariff, which is the value of sectoral imports taken directly from the aggregated IO, and tm_{i} is the weighted average nominal tariff rate. The sectoral tariff revenue is given by

$$tm\_{i} = m\_net\_{i}*tm\_{i}$$

To make the total of the computed sectoral tariff revenue consistent with the overall tariff revenue in the government accounts, the former sum was normalized to the magnitude of the latter. The sectoral calibrated tariff rates were derived from these normalized sectoral tariff revenue.

9c. Computation of local indirect taxes. The total local indirect taxes (taxes levied on locally produced items) from the official government accounts was distributed to sectoral values according to the original IO sectoral indirect taxes as weights. That is, the original sectoral indirect taxes from the IO were normalized so that the computed total was made consistent with the total local indirect taxes in the official government accounts.

10. The sectoral sum of Cell 7, Cell 8, Cell 9 determines the sectoral composite goods in consumer prices (**Cell 10**), which is also equal to the sectoral total demand (**Cell 14**).

11. Information on household consumption (**Cell 11**) is the personal consumption expenditure of the IO table. Similarly, the data on government expenditure (**Cell 12**) was taken from the IO. The data in sectoral investment expenditure (**Cell 13**) was derived residually, i.e., Cell 13 = Cell 14 – Cell 1 – Cell 11 – Cell 12.

12. The sum of the adjusted sectoral labor compensation (Cell 2) determines the total labor compensation (**Cell 15**), which goes to the households as labor income (**Cell 16**). The sum of labor income across households is the total labor income (**Cell 17**).

13. The sum of the adjusted sectoral payment to capital (Cell 2) is the sum of total payment to capital (**Cell 18**), which is divided into capital payment to households (**Cell 19**), capital payments to firms (**Cell 24**, which is equal to **Cell 33** and will be discussed shortly), and capital payment to the rest of the world (**Cell 25**). Before discussing how Cell 19 was derived, we shall discuss how the total expenditure of households (**Cell 33**) was calculated. Cell 33 was taken directly from the national income accounts (NIA) as total disbursement of firms. This cell is equal to the overall income of households (**Cell 23**). **Cell 20** was taken from the NIA as well as payments of firm to households. **Cell 21** was also taken from the NIA, which is the sum of government transfers to households, SSS benefits, and payments of government to households. Similarly, **Cell 22** was taken from the NIA, which is the net factor income from abroad. Given values for all these cells, Cell 19 was derived residually, i.e., Cell 19 = Cell 23 – Cell 20 – Cell 21 – Cell 22.

14. **Cell 29** was also taken from the NIA as direct taxes of firms to the government. **Cell 38** was taken from the Central Bank statistics, which indicates dividends paid to foreign. Savings of firms (**Cell 34**) were derived residually, i.e. Cell 34 = Cell 39 – Cell 20 – Cell 29 – Cell 38. Finally, Cell 24 is equal to Cell 33, which in turn is equal to **Cell 27**.

15. **Cell 28** was taken from the N IA as the sum of direct taxes of households and SSS contribution. **Cell 32**, which is household savings, was derived residually, i.e., Cell 32 = Cell 33 – Cell 28 – Cell 11.

16. **Cell 31** was taken from the NIA, which consisted of government income less SSS contribution of households. This cell is also equal to **Cell 42.** The value for **Cell 40** taken was from the NIA, which indicates interest payments of the government to the rest of the world. Government savings is determined residually, i.e., **Cell 35 =** Cell 42 – Cell 40 – Cell 21 – Cell 12.

17. **Cell 36** was taken from the BOP accounts as the current account balance. **Cell 43** is the sum of all sectoral investment expenditure. **Cell 44** is the sum of all receipts from the rest of the world, while **Cell 41** is the sum of payments to the rest of the world.

18. Having been derived from various sources of data, all these numbers do not add up to a consistent SAM. Thus, an adjustment process had to be applied to balance it. A least square method was applied to do the adjustment in balancing the SAM. The idea behind the least square method is to find a matrix whose squared distance from the original matrix is minimized given equal total sums of columns and rows. Before applying the method, few preliminary steps were done:

18a. To lessen the computation process, the 48-sector unbalanced SAM was aggregated into 4-sector SAM. All agriculture sub-sectors were aggregated into agriculture one sector. Similarly, all industrial sub-sectors were lumped into one industry, and all service sub-sectors into on sector also. The lone government service sector was retained. Thus, these would result in a 4-sector SAM.

18b. Some of the cells were held fixed in the adjustment process. Essentially, those data that come from the 1994 IO were held fixed. In particular, all cells were held fixed except for the following cells: 19 – 22, 25, 29, 32, 34-36, 38, 40 and one section of Cell 7 where the government service sector intersects. Thus, these are the cells that change during the least square adjustment process. The adjusted values from this process were inputted back into the 48-sector SAM.

19. The 48-sector balanced SAM was aggregated into a 12-sector SAM for the use of the microsimulation exercise. The 12 sectors are: crops, livestock, fishing, other agriculture, mining, food manufacturing, non-food manufacturing, construction, utilities, wholesale trade and retail, other services, and government services.

20. The last disaggregation process involved the breaking up of labor into 4 labor types. The labor types include: skilled agriculture labor, unskilled agriculture labor, skilled production labor and unskilled production labor. The level of education of labor is assumed to determine the type of skills of labor. That is, those with zero education up to third year high school are considered unskilled labor, otherwise skilled. Data from the labor force survey (LFS) in 1994 and from the various 1994 annul survey of establishments (ASE) were used. The idea is to use the data from the LFS and from ASE to create percentage distribution of the 4 labor types per sector. The levels derived in the SAM were distributed to the 4 labor types using the derived sectoral percentage distribution.

21. A CGE model was specified and calibrated to the 12-sector SAM with 4 labor types and one household. At the 1994 base year without any change in the exogenous variables, the model runs in 3 iterations with a leon variable equal exactly to zero. This implies that the SAM is not only balanced, the model also satisfies the walras law.

Integration of household Data

22. The microsimulation exercise employed the entire 24,797 households in the 1994 FIES. The values in the FIES were adjusted using the adjustment multipliers that come along with the survey to convert the numbers to national figures. Therefore, from hereon FIES data refers to the adjusted national figures.

23. The basic problem encountered is how to integrate the FIES data into the balanced SAM. There are two routes that were followed. However, while the first route was completely done and implemented, the second route is still in progress. The difference between the two is that in the former the 1994 FIES was adjusted to the balanced SAM, while in the latter the SAM was adjusted to the 1994 FIES. The discussion below outlines the steps used in the first route.

24. The FIES has a separate column for direct taxes. This was taken out so that the expenditure items described below pertains only to household expenditure net of direct taxes. However, the overall total direct tax in the FIES does not match with the direct

taxes paid by households in the SAM. Thus the first adjustment was to normalize the FIES values with the SAM value.

25. One can recall that the household consumption column used in the SAM was derived from the IO. These numbers do not match in terms of levels with the overall total of the household expenditure in the FIES. Thus, the first step was to adjust the FIES data to the SAM consumption data by normalizing the expenditure items in the FIES so that the overall sum across these items will be consistent with the sectoral sum of consumption in the SAM.

26. The breakdown of the expenditure items in the FIES and does not match with the breakdown of the sectors in the SAM. Thus, the basic problem is how to make them consistent. There is no official conversion matrix available in 1994. However, there is one available in the 1990 official SAM, which we used in the conversion. Thus, we tediously converted the expenditure items in the FIES for each of the individual households to the sectoral breakdown in the SAM using one conversion 1990 matrix.

27. The second problem is in the income of households. In the SAM there are 5 different sources of income: labor income, capital income, dividends, government transfers and remittances from the rest of the world. Whereas, in the FIES the sources of income include: agriculture labor income, non-agriculture labor income, entrepreneurial income from various industries, other incomes that can easily be grouped into dividends, transfers and remittances from abroad.

28. We separated households in the FIES into those headed by a person whose educational level ranges from zero education to third year high school, and into those who finished high school and up. And then across households we summed up the labor income from agriculture and came up with two new categories of agriculture labor income: skilled and unskilled. To make the data consistent with the SAM, we then normalized the FIES data for skilled agriculture labor income with the sectoral sum of the skilled labor compensation across agriculture sectors in the SAM. We did the same process for agriculture unskilled income.

29. Similar process adopted for the labor income from non-agriculture. We separated labor income of the FIES from non-agriculture into skilled and unskilled using the same process above. We then normalized the FIES values with the sum of labor compensation for skilled and unskilled in all sectors in the SAM, except agriculture.

30. Fortunately, the sectoral disaggregation of entrepreneurial income in the FIES is generally consistent with the sectoral disaggregation in the SAM. We assumed payments to capital to households are all entrepreneurial income. Given this assumption, the only adjustment we did was to normalize the FIES values with the value derived in Cell 19 of Figure 1 above.

31. Lastly, household savings were derived residually. The overall total households savings is consistent with the SAM because both overall household expenditure and income are consistent with the SAM.

32. The 1994 FIES consistently integrated with the 12-sector SAM was used to calibrate the model with the same structure as in item # 21 above, but this time with 24,797 households. This CGE-microsimulation approach was used to analyze the effects of the actual tariff reduction in the Philippines from 1994 and 2000. The results are discussed in detail in two papers:

(1) Cororaton, C., 2003. Analysis of Trade Reforms, Income Inequality and Poverty Using Microsimulation Approach: The Case of the Philippines" PIDS Discussion Paper Series No. 2003-09

(2) Cororaton, C. 2003. Analyzing the Impact of Philippine Tariff Reform on Unemployment, Distribution, and Poverty UsingCGE-Microsimulation Approach.