Chapter 7

Compilation of a SAM/FAM Time Series 1990-2001

In this chapter, we describe the compilation of a stock-flow consistent dataset covering twelve years. The major data sources are IMF Ghana country desk reports and International Financial Statistics time series data.

7.1 Data Sources

To compile the SAM/FAM time series, we use five major groups of data, namely prices, financial stocks, balance of payments, fiscal data, and sectoral production data, listed in Table 7.1. All data were received as XLS files, with the exception of the data in IMF country reports, which had to be entered into XLS tables by hand.

Note that the order in which they are listed here roughly reflects their reliability. Firstly, prices such as food prices, interest rates, or the exchange rate, can be easily observed by anyone, and are available on a monthly basis. While errors are possible in computing aggregate indices such as the GDP deflator, we still rank price data as the most reliable.

Second, financial stocks, such as government debt or the assets and liabilities of the central bank, are continuously kept track of by the financial entities involved, and are available on a monthly basis as "exact measurements".

Third, balance of payments data are estimated rather than directly measured, but because they are reasonably well observable (all exports and imports must cross the border at one of a small number of points) and because of the importance of foreign exchange to a small, open economy like Ghana, they are fairly reliable[1].

Fourth, government transactions are spread over many ministries and agencies and are only assembled into an overall picture after the fact, and thus although "directly observed" by the government, still are less reliable than the previous three.

Finally, sectoral production data include estimates on many not readily observable activities, and are likely to be tainted by underreporting and estimation errors, and are thus least reliable of all.

[1] At least, this is likely to be true during the period in question, as the liberal trade policies provided little incentive for smuggling. The picture was quite different during the late seventies to early eighties, when hugely overvalued exchange rates led to massive smuggling of cocoa [Aryeetey and Harrigan 2000].

The reader might be wondering why we list data for individual sectors when the overall GDP decomposition by sector in real as well as nominal terms is available from both the World Bank and the IMF. The reason is that both of these are based on the same real-side GDP disaggregation from the Ghana Statistical Service, and this GDP disaggregation appears upon closer examination somewhat suspect, as discussed in Section 7.1.

Data Series	**Time Period**	**Freq.**	**Source**	**Comment**
Prices				
CPI Decomposition	1982-2003	M	BoG XLS file	
Interest rates	(1990/91)-2003	M	IFS	
Interest rates	*1994-2003*	*M*	*BoG*	
Exchange rate	1970-2003	M	BoG	
Wholesale crop prices	1970-2001	M	Ministry of Agriculture	
Financial Stocks				
Central Bank and Commercial Bank Balance Sheets	1990-2003	M	IFS	Do not show denomination of deposits and loans
Central Bank and Commercial Bank Balance Sheets	12.1991-2003	Q	BoG	Show denomination of deposits and loans
Government Domestic Debt by Holder	1990-1998	Y	BoG	
Government Domestic Debt by Holder	1999-2003	M	BoG	
Government Foreign Debt	1990-2003	Y	BoG	
Balance of Payments				
Export volume and price by export type	1989-2002	Y	IMF country reports	
Imports oil/non-oil volume and price	1989-2002	Y	IMF country reports	
BoP Services and transfers	1989-2002	Y	IMF country reports	
Fiscal Accounts				
Fiscal Accounts	1989-2001	Y	IMF XLS file from BoG	
National Accounts				
Sectoral GDP disaggregation	*1989-2001*	*Y*	*WDI 2002*	
Sectoral GDP disaggregation	*1989-2001*	*Y*	*IMF country reports*	
Real Private Investment	1989-2001	Y	IMF XLS file from BoG	
Cocoa Bean Production	1990-2001	Y	IMF country reports	Volume and nominal value
Operations of the Cocoa Board	1990-2001	Y	IMF country reports	
Principal food crops	1990-2001	Y	IMF country reports	Volume and nominal value

Fish catch	1989-2001	Y	IMF country reports	Volume and nominal value
Logs and Timber	1990-2001	Y	IMF country reports	Volume
Minerals	1990-2001	Y	IMF country reports	Volume and nominal value
Manufacturing	1990-2001	Y	IMF country reports	Volume index
Electricity	1988-2001	Y	IMF country reports	Volume
Social Accounting Matrix				
Social Accounting Matrix for 1993	1993		Powell and Round [2000]	Low labor type disaggregation
Social Accounting Matrix for 1993	1993		Powell et al. [1997]	Unpublished

Table 7.1: *Data Sources. The italicized sources have not been used in compiling our dataset.*

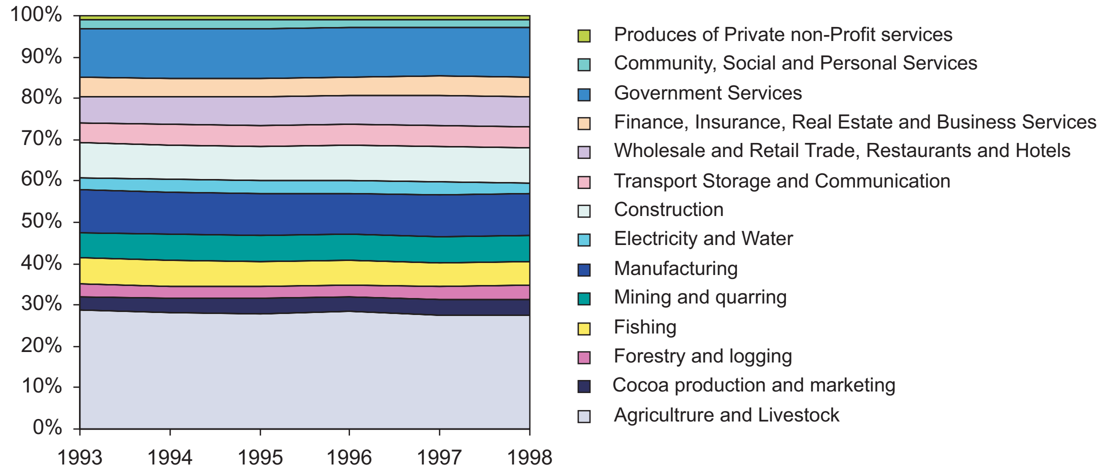

Figure 7.1: *Shares of Subsectors in Value Added*

Problems and Probable Errors in the Data

Splicing together of different tables into a coherent framework forces one to know each of the tables fairly intimately, and thus makes it easier to notice inconsistencies, strange behavior, and likely errors in them.

The table with the highest density of apparent errors is the national accounts table. Firstly, upon plotting the shares of different sectors in GDP in real terms (Figure 7.1) one notices that they are strangely constant from 1993 to 2001. This is quite unlikely given that all macro variables, such as current account deficit and government spending, vary greatly during the period. Nor are the subsectoral data from this table compatible with the raw data on the same subsectors from the IMF country reports (Figure 7.2 shows the corresponding series for manufacturing). Therefore we have to conclude that the official sectoral GDP decomposition was probably obtained from an educated guess on overall GDP growth rate by pro-rating according to 1993 shares of subsectors, 1993 being the date of the last major estimation effort for national accounts.

The problems with national account data do not stop there. Firstly, government demand as GDP component is taken to be equal to government current expenditure from the fiscal accounts. This is incorrect because firstly, a large part of government current expenditure (for example, interest payments on government debt) is not part of government demand in the national accounts sense; and secondly, a part of government capital expenditure belongs into government demand as well.

Another, more subtle error has to do with sectoral deflators. In 1993, as national accounts

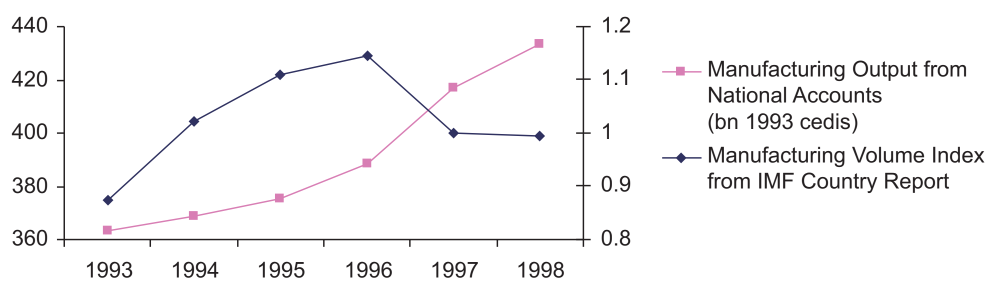

Figure 7.2: *Manufacturing output discrepancy*

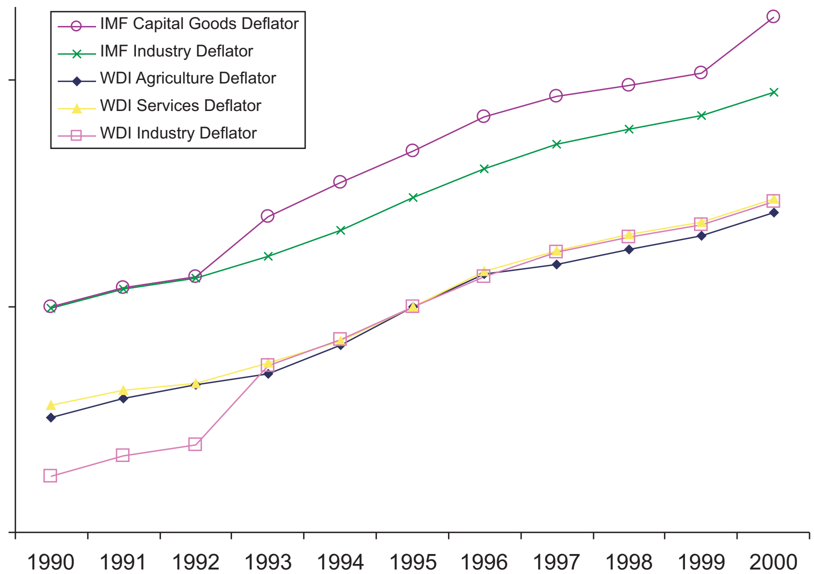

Figure 7.3: *Sectoral Deflators (Source: World Development Indicators 2002; International Monetary Fund)*

were comprehensively re-estimated, the deflator for industry was changed by about a factor of two (Figure 7.3). For pre-1993 data to be comparable to post-1993 data, the former would have to be adjusted to account for that change of deflator. For sectoral output, that was done by the IMF but not by the World Bank so that the latter's nominal industry output series display a jump in 1993. Unfortunately, while the IMF adjusted its pre-1993 deflators for sectoral data, apparently it did not do so for investment (Figure 7.3).

The failure to correct the deflator then skews the nominal-investment-to-nominal-GDP ratio upwards; Figure 7.4 shows the ratios of real investment to real GDP and of nominal investment to nominal GDP, the investment and GDP series taken directly from IMF data. We see that if we use the nominal values and just compare 1990 values to 2000 values, then the share of investment in GDP *increases* from 1990 to 2000; however, if we use real values of the same variables to build the ratio, investment as share of GDP *decreases* over the same period - a difference of considerable policy relevance.

The IMF-originated spreadsheets we have used come from Bank of Ghana rather than from an official IMF source. However, comparison to official IMF documents confirms the phenomenon. Thus, the investment-to-GDP ratio in 1996 is 13.8% when computed from the Statistical Annex to the 1998 IMF Ghana country report; the same ratio equals 23% when computed from the Statistical Annex to the 2000 report. The series in 2000 Annex start with year 1993, so the effect we describe is not visible from any one Annex alone. In an IMF Occasional Paper on Ghana [Leite et al. 2000, Table 3.4] the investment to GDP ratios are given for years 1975, 1985, 1993, and 1998, and equal 12%, 9.5%, 22%, and 25%, respectively; these numbers are discussed in the text as "[...] Investment in structures and equipment appears to be increasing steadily". Thus the confusion we discuss here appears to be alive and well.

As a result of all these problems with available aggregate data, we decided to re-compile sectoral output and national account tables using raw sector-level data and a Leontief assumption for intermediate inputs with the coefficients derived from the 1993 Ghana SAM. The following section

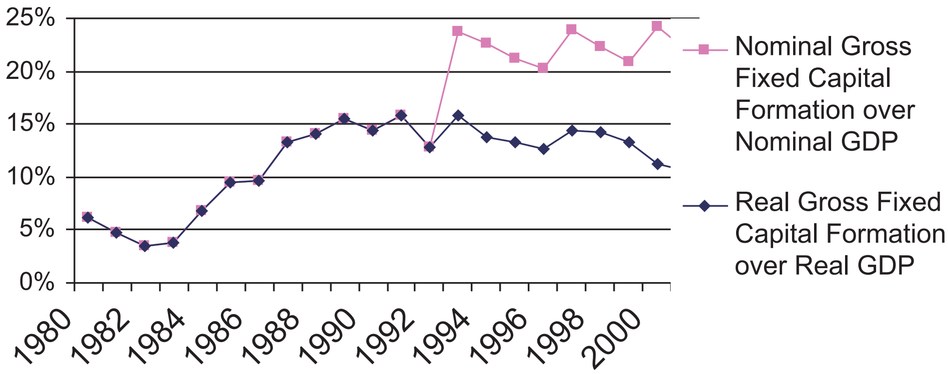

Figure 7.4: *Investment to GDP ratios computed from nominal resp. real time series (source: International Monetary Fund).*

describes how this was done and combined with the other data to form complete SAM/FAM time series for 1990-2001.

7.2 Sectoral Structure

To reconstruct national accounts from the original sub-sectoral data, we have to decide on the level of sectoral aggregation that we want to use. Aggregating too much can hide important details of sub-sectoral behavior, but disaggregating too much can make the resulting framework unduly complex, as well as produce a misleading illusion of precision if the chosen disaggregation level is not supported by available data.

The standard sectoral disaggregation for Ghana used in the 1993 SAM as well as in the compilation of sub-sectoral data is reproduced in Table 7.2. Unfortunately, the sub-sectoral data available from the IMF country reports does not allow to re-compile the accounts at that disaggregation. As Table 7.1 shows, "raw" sub-sectoral on both volume and price is only available for Agriculture and Livestock, Cocoa Production and Marketing,Fishing, and Mining and Quarrying. Further, volume data (but not producer price data) is available for Forestry and Logging, Manufacturing, and Electricity. No "raw" volume time series is available in the IMF Country Reports on any other subsector; however, one can use government fiscal data to estimate government services.

Based on this, we have decided to use the stylized sectoral aggregation portrayed in Table 7.3. There are two sub-sectors each in primary, secondary, and tertiary sectors. Agriculture is divided into cocoa production and food production for domestic use, consisting of food crops and fishing. For all of these, both volume and producer price index time series are available from IMF Country Reports IMF [2003, 1998]. We separate cocoa out because it is the leading agricultural export, and aggregating it with the rest would not allow us to investigate e.g. elasticities of transformation between cocoa and domestic food production.

The remaining primary sub-sector, forestry, is in our framework grouped with industry, for the following reasons: Firstly, it is in the Ghanaian case a non-sustainable extraction industry; second, it uses wage labor and comparatively high amounts of fixed capital and is not in the short-term constrained by the weather or other agricultural productivity factors. In all these, it is similar to mining or manufacturing, and different from food crop or cocoa production, which in Ghana is mostly done by small landowners with very primitive technology (and thus minimal fixed capital).

Agriculture	**Industry**	**Services**
Agriculture and Livestock	Mining and Quarrying	Transport Storage and Communication
Cocoa Production and Marketing	Manufacturing	Wholesale and Retail Trade, Restaurants and Hotels
Forestry and Logging	Electricity and Water	Finance, Insurance, Real Estate and Business Services
Fishing	Construction	Government Services
		Community, Social and Personal Services
		Producers of Private Non-Profit Services

Table 7.2: *The Sectoral Disaggregation of Ghana National Accounts*

Sectors	Nontraded Production	Exports	Imports	Total Production Volume Series	Nontraded Producer Price Deflator
Food Production	Yes	No	Yes		
Food Crops				IMFCR	IMFCR
Fishing				IMFCR	IMFCR
Cocoa	Yes	Yes	No	IMFCR	IMFCR
Mining	No	Yes	No	IMFCR	IMFCR
Other Industry	Yes	Yes	Yes		CPI[Industry]
Manufacturing				IMFCR	
Electricity				IMFCR	
Forestry and Logging				IMFCR	
Construction				See text	
Government Services	Yes	No	No	See text	CPI
Non-Government Services	Yes	Yes	Yes	See text	CPI[Services]

Table 7.3: *The Sectoral Grouping Used in This Thesis*

As it makes sense to aggregate sub-sectors of similar structure and behavior, we thus group it into the "Other Industry" sector, together with electricity and manufacturing. Another similarity of these three sub-sectors is that only volume time series are available, but no prices. We rescale these volume time series to 1993 constant currency using the sub-sector values from the 1993 Ghana SAM. Finally, as no data is available on the construction sector, it is proxied by taking the 1993 value from the 1993 SAM and assuming it to be proportional to the total of the other three industry sub-sectors through time. By adding these four (respectively, adding the first three and rescaling to account for construction), we obtain the volume series for "Other Industry". As the producer price deflator we take the CPI component describing industrial prices, rescaled to average value of 1 in 1993. The reason it is titled "Other Industry" is because it does not include mining.

Mining is separated from the rest of the secondary sector because of its unique position in Ghana. Namely, most of mining is foreign-owned, and produces almost exclusively for export. The high share of foreign ownership implies that the mining sector investment is not constrained by domestic factors such as credit availability. Finally, according to the 1993 SAM, the operating surplus in mining is 49%, as opposed to average 31% in the rest of the secondary sector. Finally, as export statistics are more readily available than statistics on nontraded goods, there is both price and volume data on mining. All these features set the mining sector apart from the rest of the secondary sector.

Finally, in the tertiary sector we distinguish between government and non-government services. Government services nominal value is taken to equal the sum of government wages and salaries and government current expenditure on goods and services. In our stylized account, we pretend that the government is the sole entity that pays for government services (and provides them to everybody for free). We use the CPI (rescaled to average value 1 for 1993) as the deflator for government services (it being one of the few price indices we have), and from that can define the volume of government services as the ratio between nominal value and the deflator.

Finally, we have non-government services. For these, no data is available in the IMF reports[2], not the least because a large part of these is provided by the informal sector, and is largely untaxed and unmeasured. The informal sector functions as a residual reservoir of labor exhibiting underemployment, and is thus likely to be demand-driven. Having no data on non-traded services, we formulate a hypothesis in Section 7.4. However we need to remember that while there is real data on the other sectors, non-traded non-government services are basically a placeholder: the values are in the right ball park, but we cannot base any conclusions about the structure of the Ghanaian economy on the time behavior of our non-traded non-government services.

Fortunately, the data situation on traded goods and services is somewhat better than on non-traded ones. On the export side, IMF country reports contain price and volume time series for over a dozen of goods exports sub-categories, as well as separately for services. On the import side, there are separate price and volume series for services, non-oil goods, and oil. Unfortunately, there is no distinction between food and manufacturing imports, so we have to assume the share of each of these two is constant and equals the share in the 1993 SAM, and that they both have the non-oil goods imports deflator.

Table 7.4 summarizes the sources for the export and import components.

[2]Except for commercial bank income/expenditure tables. But as the financial system in Ghana is extremely thin, these are a small share of the total.

Sectors	Export Volume	Export Producer Price	Import Volume	Import Price Deflator
Food Production	N/A	N/A	Pro-rated from non-oil imports	Non-oil import deflator
Cocoa	IMFCR	IMFCR	N/A	N/A
Mining	IMFCR	IMFCR	N/A	N/A
Other Industry	IMFCR	IMFCR	Pro-rated from non-oil imports	Non-oil import deflator
Non-Government Services	IMFCR	IMFCR	IMFCR	IMFCR
Oil	N/A	N/A	IMFCR	IMFCR

Table 7.4: *Imports/Exports By Sector*

7.3 Overall Accounting Framework

In a standard CGE manner, we use a Social Accounting Matrix to handle the nominal flows associated with production, consumption and distribution. For all accounts except the Use of Income accounts, the usual adding-up restrictions are imposed. This means that outflows into other SAM accounts must always equal inflows from other SAM accounts, and thus there is no accumulation of money in any of the accounts. The exception is the Use of Income accounts of the different institutions. These accept the disposable incomes as inflows, and from them the demand outflows are taken, with the residual being the net lending of the particular institution. These net lending flows, rather than go to another part of the SAM, leave the SAM and are cumulated inside the Financial Accounting Matrix (FAM), which stores the financial assets/liabilities of the individual institutions toward each other. All capital transactions (i.e. transactions that involve no change in net financial wealth), such as portfolio reallocation by households or issue of government bonds, then take place through changing the entries of the FAM.

7.4 Structure of the Social Accounting Matrix

To compile a Social Accounting Matrix time series, we combine national accounts, balance of payments, and government accounts data with the Social Accounting Matrix for 1993 compiled by the Ghana Statistical Service. We track product flows in nominal as well as in real terms. Table 7.7 shows the structure of the SAM.

To make the presentation more compact, we use vector notation. Thus, the index s goes over the set of sectors that we denote as

$$\{food, cocoa, industry, mining, govt, services\}$$

. The index f goes over the different factors of production, in our case consisting of operating surplus and all eight combinations of male/female, skilled/unskilled, and employee/mixed income. The index ι goes over institutions with firms and households separated, that is, *h*ouseholds, *f*irms, commercial *b*anks, *c*entral bank, *g*overnment and the rest of the *w*orld, denoted as

$$\iota \in \{h, f, b, c, g, w\}.$$

Finally, i refers to institutions with firms and households combined into a "*p*rivate sector", that is

$$i \in \{p, b, c, g, w\}.$$

The reason for using the two different indices is that while in the SAM it is both possible and useful to distinguish between firms and households, the data for the FAM does not allow such a distinction, as we will see in the section discussing the FAM.

Having defined the indices, we can now use matrix notation to populate the SAM. For example, the intermediate input demand of sector s_1 for products of sector s_2 can now be denoted as $II_{s_1 s_2}$ in nominal terms and $ii_{s_1 s_2}$ in real terms (1993 cedis). This is another notation we use throughout this document: lowercase names refer to real or volume terms (1993 prices), and the corresponding uppercase names refer to the corresponding quantities in current prices.

One final remark on notation: in a matrix of flows (such as the intermediate inputs matrix defined above) we use the first index to refer to the *source* of the flows and the second index to refer to the *destination* of the flow (traditionally these are referred to as sources and *uses* of funds).

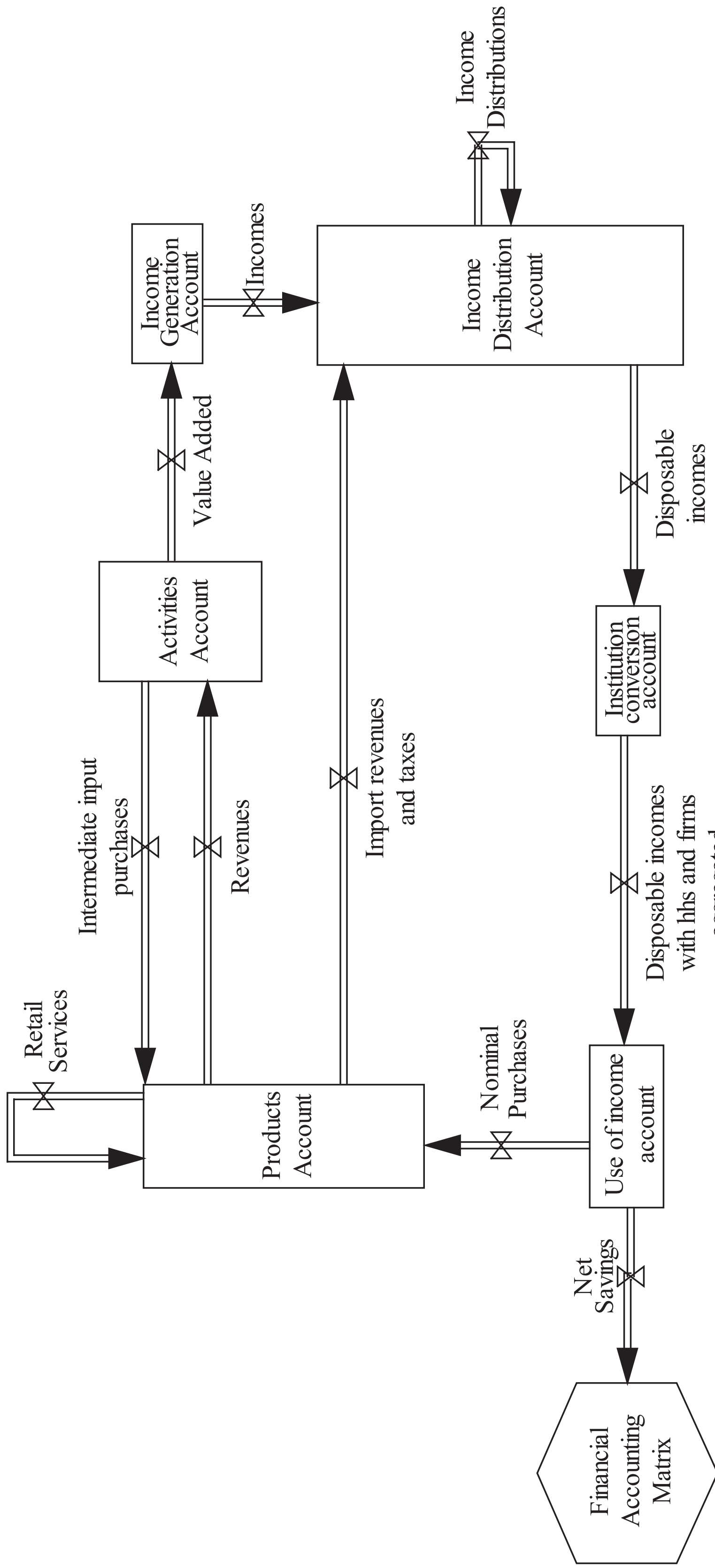

Figure 7.5: *Our Overall Accounting Framework as a Flow Chart*

	Products s	Activities s	Use of Income i
	$ret_{s_1s_2}$		
Products s		$ii_{s_1s_2} = ii^{nt}_{s_1s_2} + ii^{ex}_{s_1s_2}$	a_{is}
Activities s	$diag(rev_s)$		
Income Generation		$y_s = y^{ex}_s + y^{nt}_s$	
Income Distribution	$im_s = im^{nonoil}_s + g^{oil}_s$		

Table 7.5: *The real production flows*

This appears to us to be the most natural notation; however one has to be aware that if one writes these matrices out consistently with the SAM convention (columns denote sources, rows denote uses), then the first index refers to *columns*, not rows as usual in matrices.

Having introduced the requisite notation, we are ready to discuss how the SAM fits together. First, consider the product markets in volume terms, detailed in Table 7.5. As we discussed in Section 7.2 we have data on constant prices revenue of each productive sector except non-traded non-government services, as well as constant-price exports and imports of each sector.

Now we define the nontraded revenue in services to be proportional to the sum of all other revenues, with the factor of proportionality derived from the 1993 SAM. Now we can denote rev_s the total real revenue of domestic activities, by ex_s the exported part thereof, and by nt_s the non-traded part thereof, we can determine nt_s as

$$nt_s = rev_s - ex_s \tag{7.1}$$

We then assume, as is common in models, that all activities use Leontief technology, This determines intermediate input demand for export industries and nontraded industries, respectively:

$$ii^{ex}_{s_1s_2} = l_{s_1s_2}ex_{s_1} + \begin{cases} ii^{cocoa} & \text{for} \quad s_1 = industry \text{ and } s_2 = cocoa \\ 0 & \text{otherwise} \end{cases} \tag{7.2}$$

$$ii^{nt}_{s_1s_2} = \begin{cases} l_{s_1s_2}ex_{s_1} & \text{for} \quad s_1 \neq government \\ ii^{gov} \cdot \frac{l_{s_1s_2}}{\sum_s l_{s_1,s}} & \text{for} \quad s_1 = government \end{cases} \tag{7.3}$$

Here $l_{s_1s_2}$ is the Leontief matrix computed from the 1993 SAM (Table 7.6). ii^{cocoa} refers to the part of cocoa crop that was not exported raw, but processed prior to export and thus classified as industrial exports. While processed cocoa products are thus integrated into industrial exports, their share in industrial exports is not constant, and so cannot be represented through the Leontief technology. Likewise, the share of goods and services vs. wages in the provision of government services is not fixed but determined by the government, and this is accounted for in (7.3). Now that we know revenues and intermediate input cost, we can define the two real GDP components:

$$y^{ex}_s = ex_s - \sum_{s_2} ii^{ex}_{ss_2} \tag{7.4}$$

$$y^{nt}_s = nt_s - \sum_{s_2} ii^{nt}_{ss_2} \tag{7.5}$$

Need X Units of / For One Unit of	Cocoa	Food	Mining	Other Industry	Nongov. Services	Gov. Services
Cocoa		.029		.083	.119	
Other Agric.		.140		.043	.053	
Mining				.254	.053	
Other Industry		.040		.332	.044	
Nongov. Services				.249	.223	
Gov. Services				.038	.229	

Table 7.6: *The Leontief Matrix*

We take real private investment demand i_s directly from the IMF country report. All oil imports are done by the government-owned Tema Oil Refinery, here integrated with the government. Thus we denote the oil import vector (with only one nonzero component, equaling real oil imports) g_s^{oil}. The rest of government expenditure g_s^{nonoil} consists of two components, government services and government capital expenditure. Both of these are known in nominal terms from the fiscal accounts; we deflate the former by the CPI and the latter by the industry price index (both price indices are discussed in the Nominal SAM). Now we can decompose imports into oil and non-oil,

$$im_s^{total} = im_s^{nonoil} + g_s^{oil}.$$

In all that follows, the superscript im will refer to non-oil imports. Now that we have determined all the in- and outflows of the product markets, we can determine private consumption as a residual:

$$c_s = rev_s + im_s^{nonoil} - g_s^{nonoil} - i_s - ex_s - \sum_{s_1} ii_{ss_1} \tag{7.6}$$

Now that all demand pieces are defined, we group them into the overall demand matrix

$$a_{is} = \begin{cases} c_s + i_s & \text{for} \quad i = p \\ g_s^{oil} + g_s^{nonoil} & \text{for} \quad i = g \\ ex_s & \text{for} \quad i = w \\ 0 & \text{for} \quad i = c \quad \text{or} \quad i = b \end{cases} \tag{7.7}$$

Now that all real flows are determined, let us proceed to the SAM in nominal terms. First, let us introduce the different prices: The producer prices of nontraded goods, imports, and exports are denoted by P_s^{nt}, P_s^{im} and P_s^{ex}, respectively. The market wholesale prices are then equal to $P_s^{nt}(1+t_s^{nt})$, $P_s^{im}(1+t_s^{im})$ and $P_s^{ex}(1+t_s^{ex})$, respectively. Finally, we assume that imports and nontraded goods actually sold carry a retail service margin, so that the market retail prices $\tilde{P}_s^{nt}$, $\tilde{P}_s^{im}$ equal

$$\tilde{P}_s^{nt} = P_s^{nt}(1+t_s^{nt}) + \sigma_s P_{service}^{nt}(1+t_{service}^{nt}) \tag{7.8}$$

$$\tilde{P}_s^{im} = P_s^{im}(1+t_s^{im}) + \sigma_s P_{service}^{nt}(1+t_{service}^{nt}) \tag{7.9}$$

For lack of better information, we assume the share of imports is the same across intermediate imports and final demand. We can then define the retail absorption deflator as

$$\tilde{P}_s^{abs} = \frac{\tilde{P}_s^{im} im_s + \tilde{P}_s^{nt} nt_s}{im_s + nt_s}. \tag{7.10}$$

From / To	Prod.	Act. s	Inc. Gen. f	Inc. Distr. ι	Use of Income i
Products s	$Ret_{s_1 s_2}$	$II_{s_1 s_2}$			A_{is}
Activities s	$Rev_{s_1 s_2}$				
Income Generation(f)		Y_{af}			
Income Distribution ι	$IMT_{s\iota}$		$Y_{f\iota}$	$ID_{\iota_1 \iota_2}$	
Use of Income i				$Y_{\iota i}$	
Capital accounts i					$diag(S_i)$

Table 7.7: *Overall Social Accounting Matrix Structure*

Then the nominal counterparts of the real flows we have discussed can be computed straightforwardly as

$$I_s = \tilde{P}_s^{abs} i_s \tag{7.11}$$
$$C_s = \tilde{P}_s^{abs} c_s \tag{7.12}$$
$$G_s^{nonoil} = P_s^{abs} g_s^{nonoil} \tag{7.13}$$
$$II_{s_1 s_2} = \; = P_{s_2}^{abs} ii_{s_1 s_2} \tag{7.14}$$
$$\tag{7.15}$$

The remaining nominal inflows into the product markets are retail services and exports, valued at their respective market prices

$$EX_s = P_s^{ex}(1 + t_s^{ex})ex \tag{7.16}$$
$$Ret_{s_1 s_2} = P_{service}^{nt}(1 + t_{service}^{nt})ret_{s_1 s_2} \tag{7.17}$$

The outflows, on the other side, are valued at producer prices,

$$IM_s = P_s^{im} im^{nonoil} + P_s^{oil} g_s^{oil} \tag{7.18}$$
$$Rev_s = P_s^{nt} nt_s + P_s^{ex} ex_s \tag{7.19}$$

with the rest going to taxes

$$T_s = P_s^{nt} t_s^{nt} nt_s + P_s^{ex} t_s^{ex} ex_s + P_s^{im} t_s^{im} im_s \tag{7.20}$$

Since both taxes and import revenues go from the product account to the income distribution account, we group them into a matrix

$$IMT_{s\iota} = \begin{cases} IM_s & \text{for} \quad \iota = w \\ T_s & \text{for} \quad \iota = g \\ 0 & \text{otherwise} \end{cases} \tag{7.21}$$

Likewise, we group the final demand flows into a matrix

$$A_{is} = \begin{cases} C_s + I_s & \text{for} \quad i = p \\ G_s^{oil} + G_s^{nonoil} & \text{for} \quad i = g \\ EX_s & \text{for} \quad i = w \\ 0 & \text{for} \quad i = c \quad \text{or} \quad i = b \end{cases} \tag{7.22}$$

Knowing the revenues and the intermediate input costs for both nontraded and export goods allows us to define value added (minus taxes) as

$$VA_s^{ex} = P_s^{ex} ex_s - \sum_{s_2} II_{ss_2}^{ex} \tag{7.23}$$

$$VA_s^{nt} = P_s^{nt} nt + s - \sum_{s_2} II_{ss_2}^{nt} \tag{7.24}$$

$$VA_s = VA_s^{ex} + VA_s^{nt} \tag{7.25}$$

This value added is distributed across factors of production according to sector-specific fixed shares F_{sf} derived from the 1993 SAM (Table 7.8):

$$VA_{sf} = F_{sf} VA_s \tag{7.26}$$

We can then define the total income flow to a factor of production as

$$Y_f = \sum_s VA_{sf} \tag{7.27}$$

This income is then distributed to institutions as

$$Y_{f\iota} = \dots \tag{7.28}$$

Inside the Income Distribution account, there is a number of flows:

$$ID_{\iota_1 \iota_2} = \dots \tag{7.29}$$

From $Y_{f\iota}$ and $ID_{\iota_1 \iota_2}$ arises the disposable income of each institution,

$$Y_\iota^D = \sum_f Y_{f\iota} + \sum_{\iota_1} ID_{\iota_1 \iota} - \sum_{\iota_2} ID_{\iota \iota_2}. \tag{7.30}$$

As this disposable income vector comes from accounts ι that separate firms and households, and goes to accounts i that count them together as the private sector,nd after summing up households' and firms' income into "private", the disposable income flows are a matrix $Y_{\iota i}$ that sums up the firm and household disposable income into private sector disposable income, and sends all the other institutions' disposable incomes to these institutions. Now we can finally define the net lending flow vector

$$S_i = \sum_\iota Y_{\iota i}^D - \sum_s A_{is}, \tag{7.31}$$

closing the loop.

	Cocoa	Food Crops	Mining	Other Industry	Non-Government Services	Government Services
Comp. of Employees Skilled Male	12%	2%	14%	7%	15%	34%
Comp. of Employees Unskilled Male	35%	8%	27%	6%	13%	18%
Comp. of Employees Skilled Female	2%	0%	0%	1%	2%	16%
Comp. of Employees Unskilled Female	6%	1%	2%	1%	4%	11%
Mixed Income (Gross) Skilled Male	5%	14%	1%	20%	11%	0%
Mixed Income (Gross) Unskilled Male	24%	57%	6%	20%	10%	0%
Mixed Income (Gross) Skilled Female	0%	0%	1%	1%	4%	0%
Mixed Income (Gross) Unskilled Female	9%	17%	1%	10%	27%	0%
Operating Surplus (Gross)	7%	0%	49%	31%	14%	20%
Indirect Taxes on production	0%	0%	0%	1%	0%	0%

Table 7.8: *Factor Shares in Value Added*

Issuer / **Holder**	Private Sector Liabilities	Commercial Bank Liabilities	Central Bank Liabilities	Government Liabilities	Foreigners' Liabilities
Private Sector Assets		Deposits held by Private Sector, local- and **forex-** denominated	Cash held by Private Sector	Government Bonds held by Private Sector	
Commercial Bank Assets	Loans from Banks to Private Sector, local- and **forex-** denominated		Cash and Required Deposits held by Banks	Government Bonds held by Banks	**Foreign Exchange held by Banks**
Central Bank Assets		Rediscount		Government Bonds held by Central Bank	**Central Bank Foreign Exchange Reserves**
Government Assets	*Loans to and equity in state-owned enterprises*	*Government Deposits at Commercial Banks*	Government Deposits at the Central Bank		
Foreigners' Assets		**Commercial Banks' Foreign Liabilities**	**Central Bank's Foreign Liabilities**	**Government's Foreign Debt**	

Table 7.9: *Structure of the Financial Accounting Matrix*
Bold type denotes assets denominated in foreign currency

7.5 Financial Accounting Matrix

We have introduced Financial Accounting Matrix (FAM) in Chapter 5 as a way to present the liabilities of various institutions towards one another. The FAM only contains assets that are by their nature some other institution's liabilities, such as deposits, cash or government bonds. Table 7.9 is the complete listing of FAM entries in our dataset. As we have discussed in Chapter 5, we denote the entries of the FAM by $\Phi_{d\,i_1 i_2}$, where $d \in \{l, \$\}$ is the denomination, local or foreign exchange (the latter assumed to be dollars), and $i_1, i_2 \in \{p, b, c, g, w\}$ where p stands for the *p*rivate sector, b for commercial *b*anks, c for the *c*entral bank, g for *g*overnment, and w for the rest of the *w*orld. The first index refers to the issuer, and the second to the holder of the liability stock in question. Thus for example, $\Phi_{\$\,pb}$ refers to forex-denominated deposits of the private sector at the commercial banks. The reader might note that Table 7.9 contains two additional entries, namely $\Phi_{l\,gp}$ and $\Phi_{l\,gb}$ that describe loans to government-owned enterprises (the latter are by convention classified as part of the private sector, together with all other firms), and government deposits at commercial banks. While these are stocks that appear in the data, we will stylize them away for use in the model (see Chapter 8), because the composition of the government's domestic asset portfolio is not at the center of the present research. The stylization will also illustrate the use of the Transaction Matrix technique we develop for efficiently working with FAM time series.

7.5.1 FAM Time Series Compilation

The FAM time series are compiled from two major sources: firstly, balance sheets of the commercial banks and the central bank, and secondly, data on government debt stocks. Let us discuss the specifics of each in turn.

The assets and liabilities of the central bank and of the commercial banks are among the standard financial statistics, and are collected on a monthly basis. We could find three different datasets with that information, each with its set of flaws. Two were obtained as spreadsheets directly from the Bank of Ghana, and one is an excerpt from the International Financial Statistics available online from the International Monetary Fund. While the datasets were roughly consistent with each other, the actual numbers in the IFS and Bank of Ghana datasets were not identical.

The first of the Bank of Ghana datasets was monthly and quite finely disaggregated, but only started in 1996, continuing through to the present. This is the dataset that is used by the Bank of Ghana itself. The second Bank of Ghana dataset is quarterly, and starts in December 1991. Finally, the IFS dataset is monthly and goes all the way back into the 1980s, but is less disaggregated than the others, and in particular does not show denomination of deposits and loans. As the data on denomination is necessary to distinguish between nominal increases due to savings and due to capital gains, this is not a negligible flaw.

It would have been nice to use the dataset that the Bank of Ghana (BoG) itself uses, as it is closest to the original data and most disaggregated. However, its insufficient time coverage led us to choose the IFS dataset. It would perhaps have been optimal to somehow splice the two together, using BoG data where available and IFS data otherwise, but the effort required to do that cleanly would be outside of the scope of the present project.

Once we have decided to use the IFS dataset, we have to reconstruct the partition of deposits and loans into local currency- and forex-denominated. We do this by computing the respective shares of the different denominations from the quarterly BoG dataset, and applying those shares to the IFS totals.

This procedure has two potential problems. First of all, the quarterly dataset does not cover the first two years of our period. However, this turns out not to be a problem as these years were the beginning of a transition period, when forex-denominated loans and deposits were just beginning to be introduced. Thus, as Figure 7.6 shows, in the early 1990s the share of forex-

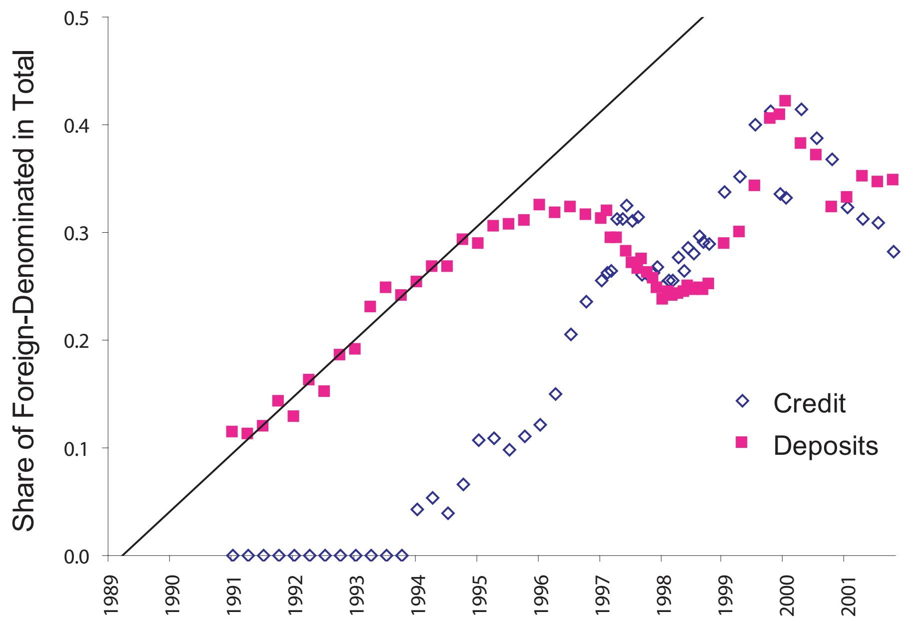

Figure 7.6: *Share of foreign-denominated loans and deposits in the respective total*

denominated stocks in the total was actually zero for loans, and was growing pretty linearly for deposits, allowing a credible extrapolation back to January 1990.

The second problem is of a statistical nature, namely that since the local- and forex- denominated stocks have been produced by pro-rating from a total, their residuals will probably be correlated, leading to spurious relationships if one does not formulate one's regressions carefully. This is not by itself tragic, but something to bear in mind for when we investigate the data.

The other time series necessary to compile the FAM are the government's debt stocks. These are unfortunately only available yearly until 1999, and monthly afterwards for domestic debt, and only yearly for foreign debt. Thus if we want to infer monthly time series from these, some interpolation scheme is called for. The simplest would be piecewise constant or piecewise linear interpolation, but as we are going to differentiate the series (to determine net savings, portfolio adjustment, etc.), this would have generated spurious discontinuities. Therefore, we use matlab to interpolate the yearly data using piecewise cubic functions, giving us piecewise quadratic derivatives.

A final piece of data that is missing in the SAM is the amount of forex held by the private sector in cash form (as opposed to deposits at banks). Anecdotal evidence suggests that is not negligible, but unlike for domestic cash, we do not see a way of estimating this, and thus assume it to be zero. Therefore, net worth estimates are likely to somewhat underestimate the net worth of the private sector and somewhat overestimate the current account deficit. A possible alternative approach to estimating that would be that the ratio of forex cash to domestic cash held by the public is equal to the ratio of forex-denominated deposits to local currency-denominated deposits, as both are outcomes of portfolio optimization by different population groups. However, transaction demand is likely to play a higher role for cash than for deposits, so that estimate would likely err in the opposite direction from ours; and ours (no forex cash held by the private sector) is easier to construct.

7.5.2 Net lending flows implied by the FAM

Since the FAM gives us information on all financial stocks in the economy, we can use it to find the changes in net worth, and thus the net lending, of each institution. As most savings of the poorer households are in the form of goods rather than financial assets, that would be an under-estimate of total savings. However, it would still be useful as it is financial savings that make resources available for new loans; and adequately accounting for non-financial savings would be a separate project in itself.

The changes in net worth of any institution are due to two sources: flows of new net lending and revaluation of old asset stocks. In our case, the latter refers to valuation changes of forex-denominated stocks due to changes in the exchange rate. We need to correct for these before we can isolate the effect of the new savings flows. This is done as follows.

Let e be the exchange rate, cedis to the dollar (available on a monthly basis). Let's define the depreciation rate of the cedi as

$$\hat{e}(t) = ln(e(t)) - ln(e(t-1)) \tag{7.32}$$

Then the change in Φ due to revaluation equals

$$(\Delta\Phi_{\$\, i_1 i_2})_{from\ revaluation} = \hat{e}\Phi_{\$\, i_1 i_2} \tag{7.33}$$

$$(\Delta\Phi_{l\, i_1 i_2})_{from\ revaluation} = 0 \tag{7.34}$$

(for derivation of (7.33), see Section 8.1.) Thus we can define the change in Φ net of revaluation as

$$D\Phi(t) = [\Phi(t) - \Phi(t-1)] - (\Delta\Phi)_{from\ revaluation} \tag{7.35}$$

and then the total change in net worth net of revaluation equals

$$S_i(t) = \sum_{d,i_1} D\Phi_{d\, i i_1}(t) - \sum_{d,i_1} D\Phi_{d\, i_1 i}(t) \tag{7.36}$$

which is nothing else but the net lending flow S_i that connects the SAM to the FAM.

7.6 Reconciliation

As we are working with fairly low-level data in a tight accounting framework, it is unavoidable that even after weeding out obvious errors in the data, such as those discussed above, the results will not "add up". Typically, any given table, such as a balance of payments or government accounts, is already forced to add up by those compiling it. However, when one aims to bring the different tables together into a watertight SAM/FAM framework, the different estimates for the same quantity (e.g. government deficit from the fiscal accounts vs. overall change in government liabilities in the financial stocks) typically do not match. The question then arises of how to reconcile different estimates of the same quantity.

We opt for using a hierarchical framework. This works as follows.

If there are two different estimates for a quantity, the hierarchical approach to reconciliation works by choosing the estimate from the more reliable data group, and if necessary adjusting the other group to match.

In most cases, reconciliation can be done by simply choosing the less reliable term as the residual. For example, nontraded food production is computed as the difference between total production of the industrial sector from sectoral statistics and industry exports from balance of payments data. However, there is one important case where one has to actually adjust the different datasets to match each other, and that is reconciliation of the net lending flows between the FAM and the SAM. This is discussed in the following section.

SAM/FAM reconciliation In this section, we describe our solution of the following problem: The SAM is determined from balance of payments, fiscal, and sectoral production accounts, in particular determining the net lending flows from each institution into the FAM. On the other hand, from the FAM itself we get an alternate estimate of the same quantity as described in Section 7.5.2 .

According to our hierarchical approach, the FAM estimate takes precedence over the SAM estimate, but there is no obvious residual to absorb the discrepancy. We solve that by adjusting the SAM data as follows. We have five institutions in the net lending vector, to wit, nonbank private sector, commercial banks, central bank, government, and the rest of the world. Note that as the SAM accounting is watertight (and thus money doesn't accumulate in the SAM) the sum of the five net lending flows must be identically zero (a version of the law of Walras).

We adjust the net lending of commercial banks by distributing the discrepancy to the private sector (with the assumed vehicle being either interest income on deposits or profit distribution to owners); the net lending of the central bank are assumed to accrue to the government - a common practice in applied models, according to which the net worth of the central bank can only change through revaluation. This leaves the private sector, the government, and the rest of the world. Due to the law of Walras, it is sufficient to reconciliate two of these and the third will automatically fall into line.

We thus complete the FAM/SAM reconciliation by spreading out the discrepancy in government deficit proportionally over all fiscal accounts, both revenue and expenditure, and likewise spreading the discrepancy in current account deficit proportionally across imports, private current transfers, and non-interest income debits, as the least easily observable components. The percentage to which they had to be rescaled for each of the years in the dataset is shown in Figure 7.7.

The last type of data adjustment we undertake is a smoothing of early jumps. As there were major overhauls of reporting systems in 1991-1993, many data definitions have changed then, which caused jumps in some data series. To somewhat alleviate that effect, when a series that was fairly stable post-1993 had apparently spurious discontinuities pre-1993, these were smoothed out in a way that preserved post-1993 values.

7.7 Discussion

7.7.1 Are Different Levels of Household Aggregation in Different Parts of the Framework Defensible?

One issue certainly needing discussion is whether a model that aggregates all households together with firms for the handling of financial stocks can have any claim on credible representation of distributional issues. We would like to argue that this is indeed the case.

Firstly, including financial stocks at all has to be an improvement on ignoring them, especially if one is interested in modeling macro policies and variables such as inflation. Second, a better

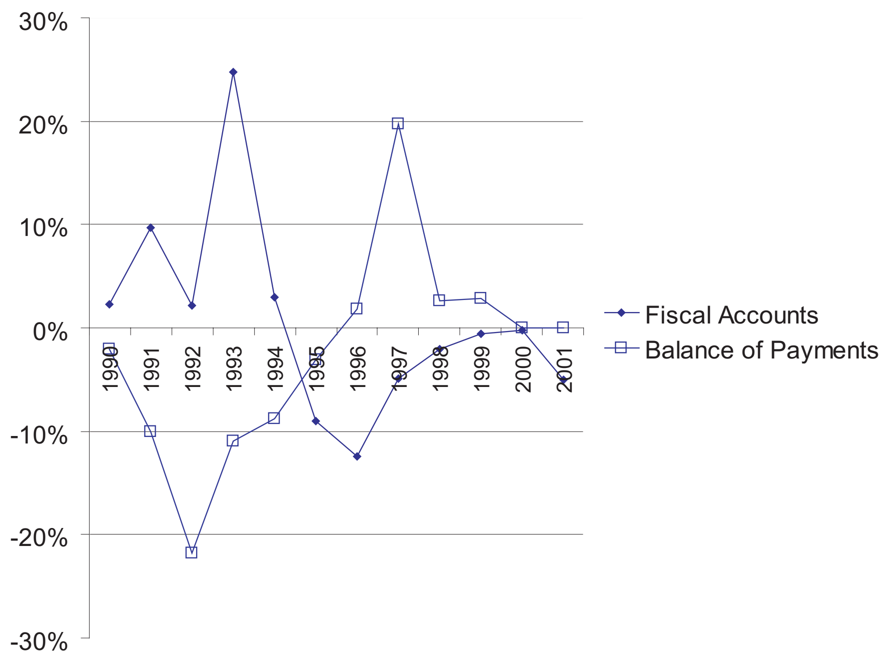

Figure 7.7: *Relative Adjustments During FAM/SAM Reconciliation*

disaggregation of financial stocks is simply not allowed by the data - the only way to get e.g. more disaggregated deposit data would be to make it up, introducing hidden assumptions. The way we do it, the difference in aggregation is out in the clear, easy for others to evaluate.

Finally, the main impact of more disaggregated financial stock data on the rest of the model would be through the influence of the wealth of different household groups on their consumption demand. However, we would like to argue that the consumption patterns of different household groups are not different enough for that effect to matter much. We support this claim by examining the results of Powell and Round [2000] who built a multiplier model based on the Ghana 1993 SAM (with a substantial disaggregation of factors of production and household types) and subjected it to unit income injections into various accounts (namely cocoa, mining, construction, and education and health). While direct impacts on the incomes of the different household groups clearly depended greatly on the specific place where the income injection happened, the indirect effects (i.e. the effects working through the income-consumption demand loop) only depended in magnitude on the total on-impact income that accrued to all households (Figure 7.8), and their pattern was virtually constant across all four injections (Figure 7.9). From this we conclude that the effects working through the income-expenditure loop are largely macro phenomena. Therefore, keeping this part of the model fairly aggregated does not taint the results of the more disaggregated sectoral/factor of production part of the model.

7.8 Summary

The challenges in compiling a complete flow of funds time series for Ghana for the 1990s are typical of a developing country. While much data is available, it is widely scattered and occasionally gravely deficient. In our case, the official Ghana Statistical Service estimates of real GDP time

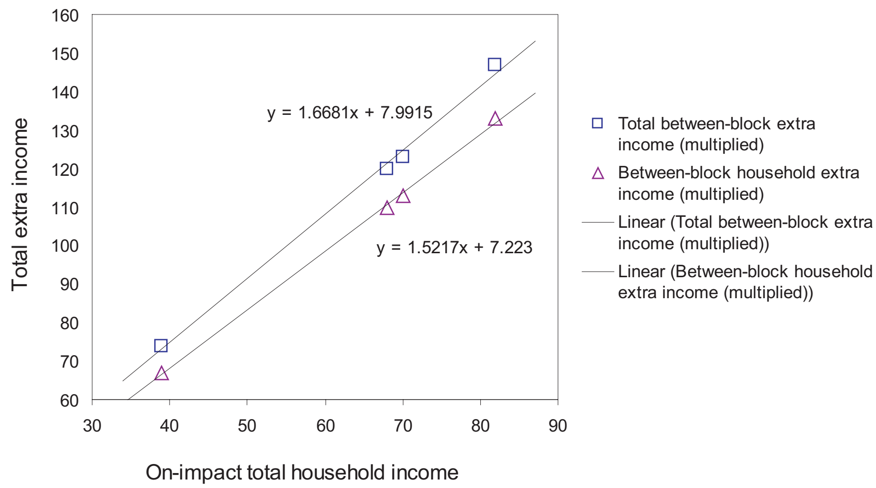

Figure 7.8: *Total Multiplier Effect as Function of Total On-Impact Household Income*

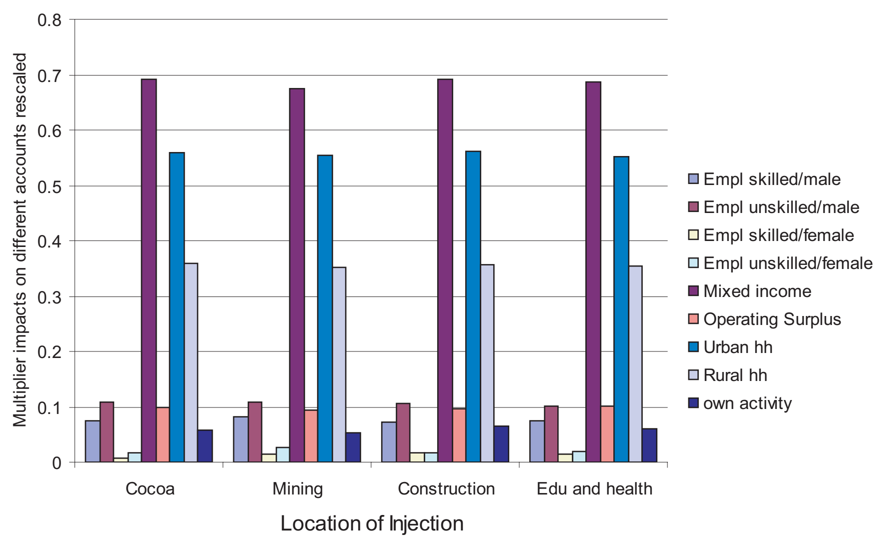

Figure 7.9: *The Patterns of Multiplier Income For Different Injections*

series by sector are very probably not trustworthy.

However, it is possible to compile what we think is a reasonably credible stock-flow consistent yearly SAM/FAM time series for 1990-2001 (including real product flows) using a combination of sectoral level output and price data, balance of payments, fiscal and financial stock time series. To reconcile the different estimates, we adopt a hierarchical approach, with financial stock data being considered more reliable than balance of payments data, which in turn takes precedence over fiscal and sectoral output data.

First, using sectoral, balance of payments, and fiscal time series together with the Social Accounting Matrix available for 1993, we construct reasonably credible time series of medium-disaggregation Social Accounting Matrices for the period in question. Then, combining financial stock data available from the IMF and data obtained directly from Bank of Ghana, we compile a yearly series of FAMs and derive the net lending flows implied by these FAM time series. The SAM time series is then adjusted to be consistent with these net lending flows.

Most of the financial time series are actually available on a monthly basis. While that does not fit the overall accounting framework, the additional data points will be useful in investigating behavior through time series econometric techniques.