Chapter 5

An Introduction to Useful Accounting Concepts

This chapter provides an introduction to some accounting formalisms that we will use and refine in the subsequent chapters. The two major formalisms discussed here are firstly, the Social Accounting Matrix (SAM) that is commonly used to represent nominal currency flows inside an economy under the assumption of flow equilibrium, together with the corresponding accounting for real product flows; and secondly, the Financial Accounting Matrix (FAM) that contains the stocks of financial assets. The FAM is less common in applied models, and one of the innovations of this thesis will be to integrate it with the SAM to represent nominal flow *dis*equilibria and their impacts on financial stocks over time. This chapter introduces and discusses the FAM concept, leaving the details of how we make use of it to later chapters.

5.1 Social Accounting Matrix

A Social Accounting Matrix is simply an ordered listing of all money flows between different parts of an economy at a specific level of disaggregation. To illustrate the concept, let us start from a simple money flow chart and see how it is represented in SAM form.

Figure 5.1 is a simple representation of money flows in an economy. Blocks denote different accounts, arrows represent money flows between them (all money flows are converted to domestic currency). The value added generated in the Production block is distributed between firms, households, and government in the Income Distribution block. The resulting disposable incomes flow, according to the demand patterns, partly into the Production block (as final consumption and investment expenditures) and partly into the Financial Sector block as savings. From the financial sector, money is injected back into use of income accounts through loans. Foreign trade is by SAM convention also routed through the Product Markets account: total demand from final domestic consumption demand, investment demand, and export demand, is matched to GDP (value added) plus imports.

Let us now see how such a flow chart would be represented as a SAM. Each of the blocks becomes an account of the SAM, listed in exactly one row and exactly one column. The content of the cell belonging to column A and row B then denotes the money flow from A to B. In our example, the SAM corresponding to Figure 5.1 is depicted in Table 5.1. We see that all money inflows into the product markets, for instance, are contained in the first row, and all money outflows from the product markets in the first column of the matrix.

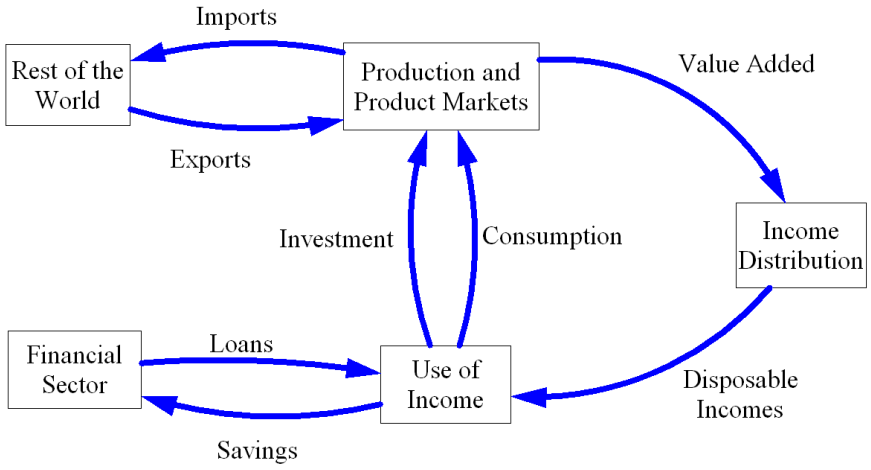

Figure 5.1: *A simple money flow diagram*

From / **To**	Product Markets	Income Distribution	Use of Income	Financial Sector	Rest of the World
Product Markets			Consumption and Investment		Exports
Income Distribution	Value Added				
Use of Income		Disposable Incomes		Loans	
Financial Sector			Savings		
Rest of the World	Imports				

Table 5.1: *A Simple Social Accounting Matrix*

A Social Accounting Matrix is primarily useful to describe nominal flows and flow equilibria. A Social Accounting Matrix must be balanced, that is, the sum of each row must equal to the sum of the corresponding column, meaning that inflows into each account must equal the outflows (definition of a flow equilibrium). We will revisit this assumption in Section 5.3, but first let us discuss the SAM structure in some more detail.

The tiny SAM of Figure 5.1 and Table 5.1 is useful as a first introduction to the concept, but too simplified to be of much use in practice. For example, the treatment of intermediate inputs in it is entirely absent. Let us now consider a more realistic SAM structure that closely corresponds to the one that we will be using in this thesis. Since the transition between flow chart format and table format is straightforward, we only reproduce it as a flow chart, this being in our opinion the more intuitive format.

The flow diagram of the more detailed SAM is pictured in Figure 5.2. Here, each arrow represents an array (a bundle) of time-dependent flows, and each rectangle represents a group of accounts in the SAM. As the traditional SAM is a flow-equilibrium system, total inflows into each

account must equal total outflows, thus nothing accumulates in any of the rectangles. Let us walk through the SAM to understand how it fits together. Let us begin with the Use of Income group of

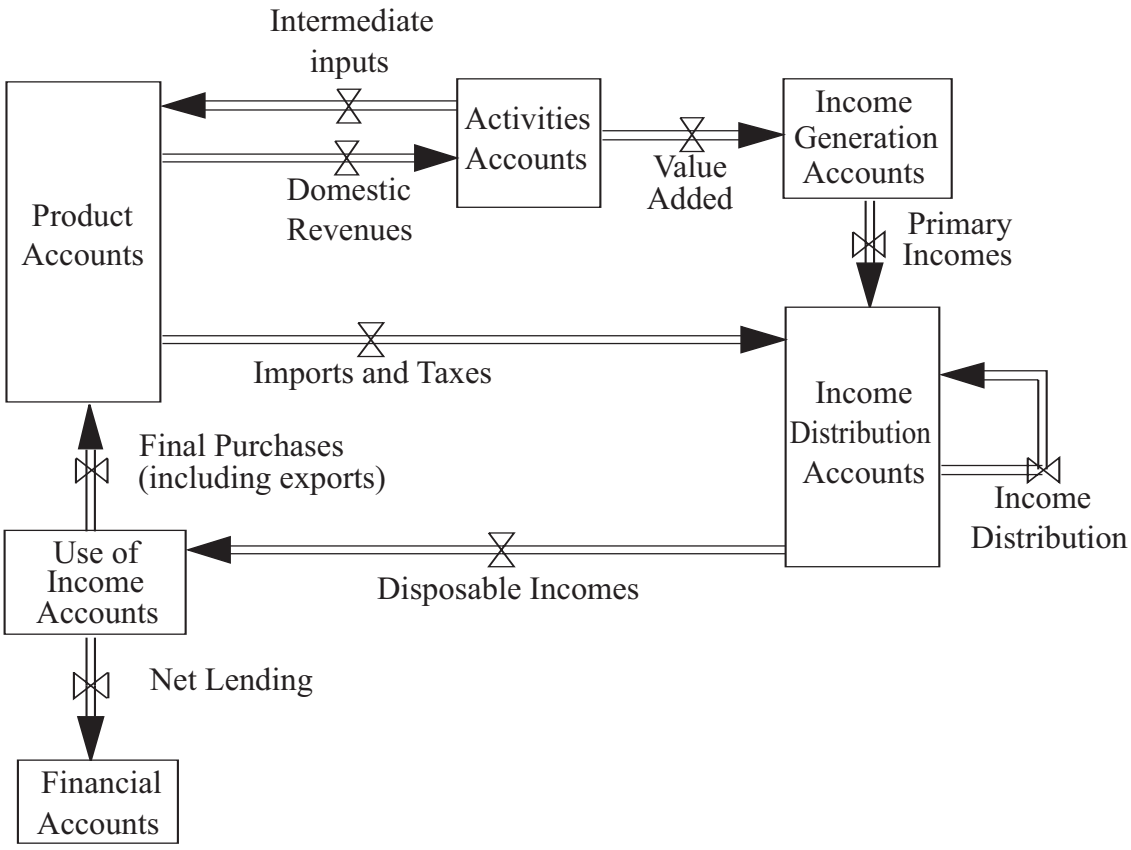

Figure 5.2: *A more realistic SAM*

accounts. It has a sub-account for each of the "institutions" in the model. The distinct institutions we consider here are the private sector, the commercial banks, the central bank, the government, and the rest of the world (foreigners). Each of these has a disposable income inflow and an outflow of nominal purchases (the latter being zero for both banks). If the purchases of an institution do not equal its disposable income, the difference must be made up by net lending. Flow equilibrium requires that the sum of all institutions' net lending flows must equal zero.

Next in the loop, the "Nominal Purchases" group of flows represents the product demand of each of the institutions for products of each of the six product types distinguished in the model[1]. All inflows of money into the product markets have their place here. For example, the product demand of the "Rest of the World" institution for the different products describes exports, and the demand of the private sector is equal to consumption plus investment demand. Finally, the demand emanating from the government use of income account is just that, government demand; and the commercial banks and the central bank do not purchase any products (a stylization common in models).

All the money entering each of the six product accounts is split between taxes and producer revenues. The latter are divided between imports and revenues of domestic firms. The taxes and import revenues go to the "Income Distribution" group of accounts (to the sub-accounts of

[1]Food crops, cocoa, mining, manufacturing, government services and other services. This particular choice of products and corresponding productive sectors is justified in Chapter 7.

government and of the Rest of the World, respectively), while the revenues of domestic firms (comprising both domestic and export sales) go to the "Activities" group of accounts. From these revenues, intermediate input costs are subtracted (and go back into the product markets), while the rest of the money, that is the value added by each sector, goes to the "Income Generation" group of accounts. The "Income generation" group of accounts converts the value added by sectors into value added that accrues to different factors of production, that is, different labor types (male/female, formal/informal, and urban/rural) and firm profits. The "Primary Private Incomes" group of flows converts income by labor type into income by institution, giving all labor income to households and all profit income to firms.

We thus come to the "Income Distribution" group of accounts, with a sub-account for each institution (this time splitting the private sector into firms and households). As we described above, its two inflow groups are "Primary Private Incomes" giving the incomes of firms and households, and "Imports and Taxes" giving the incomes of government and of foreigners. These incomes are redistributed between the sub-accounts of the different institution with the "Income distribution" group of flows. This group of flows describes property incomes (such as interest payments) and transfer payments (such as aid grants to the government from the rest of the world, transfers from the government to households, and private transfers from abroad). The resulting total incomes are the disposable incomes of each institution, going from their "Income Distribution" accounts into their "Use of Income" accounts.

We have now completed the circulation of money loop that corresponds to Figure 5.1. The two major changes from Figure 5.1, apart from increased detail, are demand for intermediate inputs and the disappearance of the side loop of Figure 5.1 that went to the Rest of the World. The reason for this is as follows: The intermediate input demand has been omitted from our first discussion of the SAM concept only to simplify presentation; and the Exports/Imports side loop has now been integrated into the main circular flow, merely a change of notation.

5.2 Real Product Flows

Our discussion of the circular flow of money in the previous section must have left the reader (especially one with any exposure to Ecological Economics ideas) wondering: "But what about the real product flows that are the basis for much of the nominal flows you discuss". Our answer is that an accounting system for real flows naturally fits with the nominal flow accounting above.

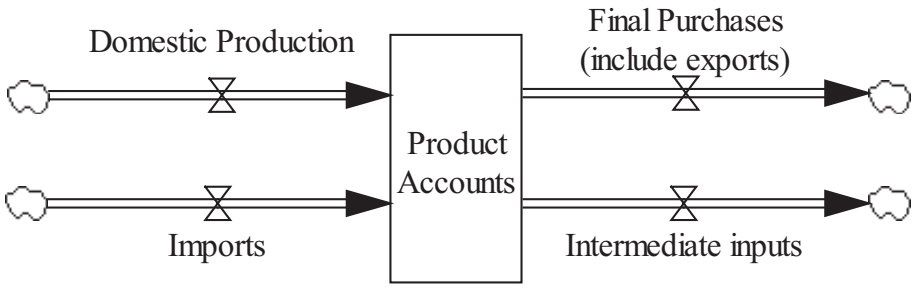

Figure 5.3: *Real Product Flows*

Figure 5.3 shows the flow chart of that accounting system. Note that this flow chart is essentially identical to a part of Figure 5.2 involving the Product and Activities account groups, except that the arrows point the other way because goods flow in the opposite direction to money being paid

for them. The real and nominal product flows can be converted one into another by means of the appropriate price indices.

The next thing that an ecological economist could object to here is that the product flows appear to go from a void and end in another void, contrary to conservation of matter. Our response to that is that "real product flows" still refer to the *value* of the products (measured in constant, that is, inflation-adjusted, prices) rather than to the material content thereof, and value does indeed continually get created in the process of production and destroyed in the process of consumption (unlike money, that tends to circulate in closed loops).

As Daly Daly [1996a, p.28] remarks, there is probably a fairly close connection between the flow of value in real terms and the corresponding material flows (especially in an economy that is as close to subsistence level as Ghana); thus the real product flows could be used to estimate material throughput. However, we do not do this here as it would take us beyond the scope of an already ambitious program. This is not meant to imply that material throughtput is irrelevant to economic analysis; but in our case, just compiling and analyzing data on money flows and corresponding product flows is enough of a challenge in itself.

We do use the real material flows accounting to compute intermediate input requirements, using the Leontief approach (Chapter 7).

This almost completes our introduction into the SAM accounting technique. One last issue to discuss is the relationship of the equilibrium assumption to the SAM methodology. As we have discussed above, a "proper" SAM must "balance", that is, the sum of each row must equal the sum of the corresponding column. Translated to the flow chart representation, this means the total inflows into each account must equal total outflows, which in turn means there can be no accumulation of stocks anywhere. This abstraction can perhaps be justified if one works with only one time slice, as e.g. the CGE's do, though even there stocks have been introduced in various ad hoc ways. The assumption of flow equilibrium, however, is entirely untenable if one wants to consider a series of SAMs for several years, as we do. Each of the institutions we consider will typically have a deficit or a surplus (government deficit, current account deficit, etc.) that will over time determine the behavior of important stocks such as the foreign debt or the money supply.

The question thus arises of how best to integrate stocks with the SAM formalism. We are certainly not the first to attempt that. In fact, the Social Accounting Matrix methodology has itself been adapted to describe stocks and stock-flow relationships. However, as the description of that technique in Taylor [1990] illustrates, the resulting SAMs become large and unwieldy very quickly. We will take another approach, namely combining an almost-unchanged SAM with a different entity called the Financial Accounting Matrix. We introduce and discuss the latter in the following section, and leave the details of its integration with the SAM to the following chapters[2]

5.3 Financial Accounting Matrix

The purpose of the Financial Accounting Matrix is keeping track of financial stocks in an economy, that is, of total liabilities of different agents in an economy toward one another. In the same way that a flow of money always goes *from* an agent *to* another agent, a financial asset is a liability of one agent to another. Thus, in the same way that a Social Accounting Matrix (SAM) is a systematic listing of monetary flows in an economy, the Financial Accounting Matrix (FAM) is a systematic listing of the financial stocks, in a square table such as Table 5.2. The first instance

[2]Essentially, we throw out the financial sector accounts of the SAM and feed the net lending flows into the FAM instead. However, implementing this fairly intuitive idea turns out to be not quite trivial.

known to the author of arranging financial stocks for use in a model in the form of a FAM, rather than a series of double-entry balance sheets, is Easterly [1990].

In the FAM, assets of agents are arranged in rows, and liabilities in columns. Thus for example, the intersection of "Commercial Bank Liabilities" and "Household Assets" is an asset of households and a liability of commercial banks, that is, deposits held by households at the commercial banks.

While the SAM and the FAM thus share some common features, there are also important differences between them. Firstly, the FAM need not fulfill any "balancing" requirement. In fact, the difference between the total assets (row sum) and total liabilities (column sum) of an agent equals the agent's net worth, and can be positive or negative[3].

A second difference between the SAM and the FAM is that while most processes in the SAM such as e.g. private purchases of food) are described by a single entry in the SAM, even "simple" financial transactions typically affect more than one entry in the FAM. For example, a bank loan to the private sector will in the simplest case increase the stock of loans of the private sector to the banks, as well as increase the stock of private sector's deposits by the same amount. This makes the task of disentangling the different causes of changes in financial stocks less than trivial. (We will address that by developing a new formalism called Transaction Matrices, see Chapter 7.)

The position of an asset in the FAM as presented in Table 5.2 does not uniquely define the asset. An important additional characteristic is the denomination of an asset (e.g. domestic or foreign currency); in addition, asset types of the same denomination can have other properties (e.g. time deposits vs. checking deposits) that distinguish them. However, location in the FAM plus denomination exhausts the types of assets commonly differentiated in CGE models. [4]

In principle, any non-diagonal cell of the FAM can be occupied (Diagonal cells' values are irrelevant since they represent "institutions' liabilities towards themselves"). However in practice, in any given model only a small part of these assets will be represented. Thus in Table 5.2, private sector is not allowed to borrow from abroad, and the government does not lend to private sector. The choice of assets to allow in a model should be guided by the realities of the country being modeled.

The FAM structure we present here is, in fact, the one we use for Ghana in this project. The private sector is allowed to hold deposits, cash and government bonds, and borrows from commercial banks. Both loans and deposits can be either denominated in local currency (cedis) or in foreign currency (dollars). Commercial banks borrow cedis from the central bank, accept deposits of either denomination from the private sector, and borrow in dollars from the rest of the world. They hold the resulting assets in form of government bonds(cedi-denominated), forex reserves, cash and cedi deposits at the central banks, and loans to the private sector of either denomination. The central bank issues cash, accepts deposits from and gives loans to commercial banks as just discussed, makes loans to and accepts deposits from the government, both cedi-denominated, and has foreign assets and liabilities, both forex-denominated. As a matter of

[3]This is one of the reasons we think the FAM notation is superior to the double-entry balance sheet notation commonly used to describe financial stocks e.g. in CGE models. In the double-entry notation, any financial stock must appear twice, once as somebody's asset and another time as somebody else's liability. Thus there is twice the number of symbols to keep track of (not a negligible problem as there is typically a lot of symbols already), and the requirement "every asset appears twice" generates a handful of additional equations to keep track of – while with a FAM, it's automatically satisfied as a FAM is a single-entry system.

[4]In more general terms, "denomination" can be used to distinguish between different types of assets that have the same issuer/holder combination, for example demand deposits, savings deposits, and equity all issued by commercial banks and held by the private sector. The FAM is thus not really a matrix but a stack of matrices (or a three-dimensional array), whose thickness is determined by the complexity of a given country's financial sector. However, in the present project we will not need that richness, and "denomination" will only refer to the cedi/forex distinction.

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			Government Deposits at the Central Bank		
Foreigners' Assets		**Commercial Banks' Foreign Liabilities**	**Central Bank's Foreign Liabilities**	**Government's Foreign Debt**	

Table 5.2: *Structure of the Financial Accounting Matrix*
Bold type denotes assets denominated in foreign currency

stylization, we pretend that the government holds all its assets as cash or deposits at the central bank, and that all foreign exchange entering the country as aid or official loans is held at the central bank on the government's behalf. On the other hand, we distinguish between the central bank's foreign liabilities (roughly of the same magnitude as its forex reserves) and the government's foreign debt (a much larger and growing stock).

5.3.1 Monetary Aggregates and Control of Money Supply

Now that the FAM is defined, let us introduce some closely related concepts that will be useful in our analysis in later chapters. The first concept we would like to introduce here is that of a fractional reserve banking system. The fractional reserve banking system derives its name from the reserve requirements imposed on the commercial banks. The primary reserve requirement mandates that the commercial banks will hold a certain fraction of their assets as deposits with the central bank, called required deposits. The secondary reserve requirement mandates that the commercial banks will hold an additional fraction of their assets in form of government bonds.

The other important concepts are the monetary base and the broad money supply. Monetary base is the sum of all liquid claims of non-government agents on the central bank. Reading from the FAM, we see that in our case this means the cash holdings of the private sector plus and cash and central bank deposits held by commercial banks. (In the following, we will also refer to commercial banks as "deposit money banks" or DMBs). The broad money supply is important as a proxy for overall demand in the economy, and the government attempts to control it through control of the monetary base[5], with the reserve requirements providing the link between them.

Broad money is the sum of claims of all non-government agents on the banking system, that is on the central bank or the commercial banks. Again reading from the table, we see that that in our FAM that equals cash and deposits held by the private sector.

This is the view of money supply from the side of the liabilities of the banking system. However, one can also look at it from the side of assets. As banks typically engage in financial transactions more than in current transactions, the gross stock of assets (or liabilities) of the central bank or the commercial banks will typically be much larger than their net worth. Thus, a frequent stylization in applied models is assuming that the net worth of commercial banks as well as of the central bank is zero. But even if we do not make this assumption, we can still re-cast the definitions of the money supply in terms of banking system assets, as we are about to see.

To make the presentation more compact, let us introduce some notation. Let us refer to the institutions that issue and hold assets by the letters $\{p, b, c, g, w\}$, 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. Further, let us describe the denomination of a stock by l for $l$ocal currency and \$ for foreign exchange. Then we can describe an entry of the FAM as $\Phi_{d\,i_1 i_2}$, where $d \in \{l, \$\}$ and $i_1, i_2 \in \{p, b, c, g, w\}$. In accordance with the matrix notation, the first (row) index refers to the issuer, and the second (column) index to the holder of the financial stock in question. Thus for example, $\Phi_{\$\,pb}$ refers to forex-denominated deposits of the private sector at the commercial banks.

Now we can restate our definitions of monetary base and broad money as

$$MB = \Phi_{l\,pc} + \Phi_{l\,bc} \tag{5.1}$$

$$M = \Phi_{l\,pc} + \Phi_{l\,pb} + \Phi_{\$\,pb} \tag{5.2}$$

[5]This describes typical monetary policy in developing countries. In developed countries such as the US, the policy is instead to target interest rates and let money supply be demand-determined.

Assets		Liabilities	
Net CB Claims on Government	$\Phi_{l\,cg} - \Phi_{l\,gc}$	Private Cash Holdings	$\Phi_{l\,pc}$
Net Central Bank Forex Reserves	$\Phi_{\$\,cw} - \Phi_{\$\,wc}$	DMB Cash Holdings and Deposits	$\Phi_{l\,bc}$
Loans to DMBs	$\Phi_{l\,cb}$	Net Worth	Ω_c

Table 5.3: *Central Bank Balance Sheet*

Assets		Liabilities	
Net Claims on Government	$\Phi_{l\,bg} + \Phi_{l\,cg} - \Phi_{l\,gc}$	Private Cash Holdings	$\Phi_{l\,pc}$
Net Forex Reserves	$\Phi_{\$\,cw} + \Phi_{\$\,bw} - \Phi_{\$\,wc} - \Phi_{\$\,wb}$	Private Deposits	$\Phi_{l\,pb} + \Phi_{\$\,pb}$
Credit to Private Sector	$\Phi_{l\,bp} + \Phi_{\$\,bp}$	Net Worth	$\Omega_c + \Omega_b$

Table 5.4: *Banking System Balance Sheet*

Let us define the net worth of the central bank and the commercial banks as the sum of their respective assets net of their respective liabilities. This can be written as

$$\Omega_c = \Phi_{l\,cb} + \Phi_{l\,cg} + \Phi_{\$\,cw} - (\Phi_{l\,pc} + \Phi_{l\,bc} + \Phi_{l\,gc} + \Phi_{\$\,wc}) \tag{5.3}$$

$$\Omega_b = \Phi_{l\,bp} + \Phi_{\$\,bp} + \Phi_{l\,bc} + \Phi_{l\,bg} + \Phi_{\$\,bw} - (\Phi_{l\,pb} + \Phi_{\$\,pb} + \Phi_{l\,cb} + \Phi_{\$\,wb}) \tag{5.4}$$

By inserting that into (5.1), we get

$$MB = \Phi_{l\,cb} + (\Phi_{l\,cg} - \Phi_{l\,gc}) + (\Phi_{\$\,cw} - \Phi_{\$\,wc}) - \Omega_c \tag{5.5}$$

$$M = \Phi_{l\,bp} + \Phi_{\$\,bp} + (\Phi_{l\,bg} + \Phi_{l\,cg} - \Phi_{l\,gc}) + (\Phi_{\$\,cw} + \Phi_{\$\,bw} - \Phi_{\$\,wc} - \Phi_{\$\,wb}) - \Omega_c - \Omega_b \tag{5.6}$$

To see the implications of these identities, it may be helpful to restate these identities in terms of balance sheets (Tables 5.3 and 5.4).

Much of the apparent complexity in the topic of money supply comes from the fact that we can consider it either from the asset side of these tables, or from the liability side, and the two totals are identically equal. Thus, money supply is often talked about as "credit" whereas its importance in economics comes mainly from its being a close proxy for private sector's liquid assets, which (besides being important in their own right) are an important determinant of demand.

Also due to the "dual nature" of the money supply, a policy whose goal is to change an item on one side of the banking system balance sheet often works by targeting some item on the other side. This is how that works out: in both tables above, net worth only changes gradually (mainly through interest flows), and the other items on the liability side are generally outside of the banking system's direct control, being an outcome of private sector's decisions to hold a certain amount of

cash or deposits. However, as the sum of the right side *always* equal the sum of the left side, central banks attempt to control money supply by influencing the items on the right side. Thus, to control broad money supply, one can limit credit to the private sector e.g. by increasing interest rates, and limit net claims of the banking systems on government by either restricting new government borrowing or trying to get the private sector to buy some of the bonds currently held by the banking system.

The net effect of a fractional reserve banking system is that the broad money supply, which according to Table 5.4 can be regarded as either outstanding loans or as the available liquidity in the economy, is largely determined by market forces rather than by central bank decisions as to how much new cash to bring into circulation. This is more pronounced in economies with deep financial systems such as the USA, where the total value of deposits far exceeds the cash in circulation, and therefore changes in the interest rate (which is the price of credit) of fractions of a percentage point have a measurable effect on the volume of outstanding credit; the effect is strong enough that developed country macroeconomics often ignore the volume of broad money altogether, focusing on the interest rate instead. In contrast, in developing countries where the total deposits are of the same order of magnitude as cash in circulation, the influence of interest rates on money supply is weaker, and broad money is closer related to monetary base; so that the policy importance of the monetary base is higher in the developing countries.

5.4 Summary

The Social Accounting Matrix formalism is a well-developed accounting framework for tracing nominal money flows within an economy, including its interactions with the rest of the world. It naturally integrates with accounting of real product flows as well. However, standard balancing requirements for a SAM imply a state of flow equilibrium that is an unrealistic abstraction, particularly if one is considering a time series of SAM's. A more realistic approach would allow for some flow disequilibria and thus would require financial stocks to absorb these.

In the present thesis, the financial stocks involved are arranged in the form of a Financial Accounting Matrix (FAM). In this chapter, we introduce and discuss the FAM concept and its relationship to money supply and fractional reserve banking system, and will discuss its integration with the SAM in later chapters.