Chapter 6

The Approach of This Thesis

This chapter reviews the approach that this dissertation takes towards answering the research questions. The subsequent chapters elaborate each of the steps reviewed here.

6.1 Introduction

As we have stated in Chapter 1, this thesis aims to answer three interrelated questions. Firstly, what was the cause of Ghana's poor macroeconomic performance in the 1990s, manifested in balance of payments problems, high inflation, and low GDP growth (compared to the second half of the 1980s)? Secondly, what were the distributive impacts of economic policies, specifically structural adjustment policies, during the 1990s? Finally, does the behavior of the Ghanaian economy during the 1990s confirm common assumptions of developing country models of either structuralist or neoclassical school?

In the discussion of the literature on models of developing countries in Chapter 4, we have seen that within the most used methodology for such models, Computable General Equilibrium (CGE) models, there are two opposed schools. The neoclassical school emphasizes relative price-driven allocation adjustments under permanent full employment, along with price levels determined by money supply. The structuralist school emphasizes quantity adjustments in output (and therefore variable employment of both labor and capital) and cost-driven prices. We have seen that the question of which of these theories is more realistic is an empirical one, and furthermore that it cannot be answered from within the CGE methodology, because the latter only uses data for one year in model calibration, and always uses more parameters than data points, and thus is incapable of falsification.

We have thus concluded that to decide between alternative hypotheses about the economy's behavior, we need to consider data time series rather than just data for one year. Furthermore, to cleanly handle the many variables needed to describe macro-sectoral interactions, we need an explicit, clean accounting framework. This framework should relate to each other both the different flows in any one year and the stock-flow relationships that hold over time. We found that the SAM formalism used in CGE's is good at the former (flow tracking) but not the latter (stock-flow relationships). This observation is the starting point of the method we use.

The research is segmented into distinct incremental steps, as described below.

6.2 Stock-Flow Consistent Accounting, Social Accounting Matrices and SAM/FAM Time Series

We use time series (mostly from the International Monetary Fund Ghana country desk reports) for sectoral output (real as well as nominal), balance of payments statistics, government accounts, and financial stock data to compile a complete description of money and product flows in the Ghanaian economy in each year from 1990 until 2001 (a Social Accounting Matrix time series) and an account of the financial stocks during the same period that is consistent with the nominal flows. To our knowledge, this is the first time that formal, complete and consistent flow of funds accounts have been compiled for a developing country for such an extended period of time.

We use the Financial Accounting Matrix to store the financial stocks; from the FAM we can compute the (revaluation-corrected) change in net worth of each agent, which equals net lending flows of each agent. This provides a link to the SAM. This way of estimating net lending flows is particularly valuable as normally net savings in the SAM are estimated as a residual and are thus very error-prone.

The compilation of the dataset is discussed in detail in Chapter 7.

6.3 Examination of the Behavior of Key Variables

Once the flow of funds for 1990-2001 dataset is compiled, we can proceed to investigate it for answers to our original question, namely the causal relationships that determined the behavior of the Ghanaian economy during the time period.

We do this by considering key behavioral variables such as the share of imports in domestic absorption or the price level, and see whether they can be explained using common assumptions such as those discussed in Chapter 4. As the time series for the real variables are still rather too short to make formal statistical significance testing reliable, we use the data from 1990 until 1997 to calibrate the equations, and then use the data from 1998 until 2001 for validation, by looking on how the equation fitted to the earlier period performs during the latter. If an equation passes this test well, we have a reason to expect that if we calibrate it to the whole time period, it will also perform well in the future and in counterfactual simulations. The details of this process are narrated in Chapter 9.

In contrast to the real-side variables that are available only yearly, for the nominal variables such as the exchange rate, the Consumer Price Index and the money supply, we have the luxury of monthly series for all of our period (even though financial stock coverage is somewhat shaky in the first couple of years). This allows us to investigate their interrelationships using rigorous econometric techniques (to be precise, ARIMA-X). The technical details of the process are presented in Chapter 11.

These chapters are the central part of the dissertation, in that the careful testing of alternative behavioral assumptions (such as whether a given sector is price- or quantity-clearing, or whether inflation is mainly driven by money supply or by cost factors) will allow us to evaluate both the models and the non-model research on the issue. If a given story about the economy's behavior depends on a behavior that is not present in the data, such a story can be discounted.

6.4 Methodological Contributions Towards a Model

This dissertation does not include building a model of the Ghanaian economy. The reason for that is that a CGE model would not tell us anything we did not know before building it, and a rigorously estimated dynamic model is beyond the scope of this already expansive project.

However, we do formulate two methodological suggestions, one major and one minor, that would be useful for building such a dynamic model.

The major suggestion is a formalism for describing financial stock behavior, useful for the following reason: While computing the changes in net worth as discussed in Section 6.2 allows us to make the SAM and the FAM *consistent*, it does not yet allow us to represent how a different vector of net lending (say, less government deficit) would impact the different financial stocks. To do that, we need an efficient way to represent financial transactions, which is not a trivial task as any financial transaction (such as deposit creation) affects several accounts in the FAM.

Our way of dealing with this is in our view this thesis' main contribution to economic modeling methodology, a technique we decide to call the Transaction Matrix (TM) formalism. The idea behind it is to formulate a "vocabulary" of financial transactions possible in a given economy; some linear algebra then allows us to easily decompose a given change in the FAM into the different transactions that caused it, and conversely to write out the implications of a given transaction for all stocks in the SAM. This massively simplifies the representation of financial sector behavior, as the TM formalism automatically takes care of the accounting restrictions that until now have made the modeling of the financial sector so tedious, and leaves the modeler free to specify behavior.

The Transaction Matrix formalism and the resulting simple decomposition of FAM dynamics are presented in Chapter 8.

The minor contribution is a bit of somewhat tricky accounting needed in an open economy model that combines demand-driven and supply-constrained sectors. It is presented in Chapter 10.

6.5 In-depth Discussion of Implications for Theory and Policy

While the Chapters 9 and 11 inspect many important aspects of the Ghanaian economy's behavior, they do not provide an overall picture of the interactions between the different parts, and thus are not by themselves useful for evaluating existing policies and making policy suggestions.

Therefore, Chapters 12 and 13 provide an extensive discussion of the results. Chapter 12 pulls all the disparate threads into an overall understanding of the Ghanaian economy's structure and behavior and uses that understanding to answer the last research question, namely the extent to which the Ghanaian economy can be said to conform to either neoclassical or structuralist theories of how a developing economy behaves.

Chapter 13 builds on that understanding to address the other two research questions, namely the reasons for the worsening macroeconomic performance of the 1990s and the distributional impacts thereof. It also contrasts the intended vs. the likely consequences of each component of the structural adjustment policy package in Ghana, and provides some recommendations in the cases where current policies are found to be deficient.

6.6   Discussion

This section's purpose is to answer two questions that are likely to occur to the reader at this point, namely the extent to which we address environmental constraints on GDP and the novelty of the proposed method.

How does this approach address environmental constraints on GDP growth? The main feature of our approach is its closeness to the available data. As the scope of the project is already quite ambitious, we cannot include any kind of ecosystem data into the project due to both poor data availability and additional work involved. The question then transforms into "what kind of environmental constraints on GDP growth can we hope to see in the data that we explore?". The main way in which such constraints are likely to translate into economic data is by forcing the sector in question to be supply-constrained rather than demand-driven. The way to distinguish between these two modes from the data is to look at how price behaves with respect to supply. If an increase in price goes together with an *increase* in supply, we probably have to do with a demand-driven sector; if an increase in supply is typically associated with a *decrease* in price, we probably are dealing with a supply-constrained sector.

Let us go through the productive sectors and see in which of these is there a possibility that environmental constraints were binding during the 1990s[1]. Firstly, services, both governmental and private, are not likely to have been constrained by environmental factors, as service provision relies mainly on labor and comparatively small amounts of capital (mostly imported in the Ghanaian case). Likewise, manufacturing relies mainly on labor and imported capital, and also on intermediate inputs. Thus manufacturing will only be constrained by environmental factors if the latter constrain provision of intermediate inputs, i.e. if the extractive industries are environmentally-constrained. Thus our first candidate for environmental constraints are extractive industries, which in Ghana means forestry and mining.

Finally, the environmental constraints are quite likely to be felt in agriculture. While population has grown, the share of population in agriculture has remained virtually constant, and the area of arable land has, if anything, diminished due to the encroachment of the savannah from the south of the country.

We will test these hypotheses in Chapter 9.

What will this approach contribute to economic theory or methodology?   We envision three major contributions to modeling methodology in this thesis. Firstly, it is to our best knowledge the first time that a complete, consistent flow of funds time series dataset at this level of disaggregation has been compiled for a developing country. In spite of all the data limitations we have discussed, demonstrating that compiling such a dataset extending for over a decade is possible for a country like Ghana is in itself a non-negligible contribution. A Social Accounting Matrix is useful because it provides a complete snapshot (at a certain disaggregation level) of an economy's structure in a given year; SAM/FAM time series augment that with a representation of how this structure has evolved over time and how the economy has reacted to past disturbances.

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[1]Our focus on behavior observed in the data will allow us to understand the Ghanaian economy in the 1990s. However, its conclusions need to be enjoyed with caution, as constraints that were not binding in the past can well become so in the future. Jumping ahead, in Chapter 9 we will see that agriculture has hit a supply constraint in about year 1995. It is not unlikely that forestry or mining might also hit resource constraints in the future even if they have not yet; but prediction of such events is beyond the scope of the present effort.

This will lead directly to the second contribution, namely empirical verification of common CGE assumptions that were incapable of verification within the CGE methodology itself. Questions such as: "Does non-traded production lie on a productivity frontier, implying a tradeoff between nontraded production and exports, or is nontraded production determined by demand? Does money supply determine the price level, or vice versa?" can now be addressed empirically, within a complete, consistent dataset.

While these first two contributions are based mainly on combining existing techniques in a somewhat novel way, the last one, namely the Transaction Matrix formalism, is to the best of our knowledge entirely novel. This formalism cleanly separates the structure of the financial sector ("What transactions are allowed? What assets are the different agents allowed to hold? What are the accounting identities we wish to impose?") from the description of agent behavior. The way this is achieved is that in a given model, the choice of a particular transaction matrix "vocabulary" lays down the structural constraints, and enforces them automatically, whatever behavioral decisions the individual agents may make.

6.7 Summary

This thesis proceeds in several steps. Firstly, we compile a complete (at a given level of aggregation), consistent dataset of financial stocks, nominal money flows, and real product flows for Ghana in 1990-2001. Then, we investigate key time series from that dataset to arrive at individual behavioral equations as well as a qualitative understanding of the economy's behavior. Then, we make some methodological suggestions that would be useful in building a dynamic model based on the insights gained. Finally, we discuss the implications of our findings for both theory and policy.

The major contributions of this thesis to theory and methodology are compilation of a consistent SAM/FAM time series for the period 1990-2001, use of that dataset to empirically verify assumptions of CGE models that up to now had to be specified a priori, and suggesting a compact formalism for describing financial stock behavior that cleanly separates structural constraints from behavioral descriptions.