Modelling a Flow of Funds and Policy Simulation Experiments in the Financial Sector for India

By

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Abstract:

The objective of this thesis is to analyse policy effects on the financial sector in India by modelling a flow of funds for four sectors with six financial instruments for the period of 1951-1993 with associated simulation techniques. In the general equilibrium model, the whole financial sector is endogenised by means of demand functions for asset choice in the four sectors and each financial market is solved by the market clearing conditions.

An important innovation is that the Almost Ideal Demand System (AIDS) is utilised for a system of demand function, and cointegration techniques are adapted into the econometric methodology. The policy simulation experiments are conducted with a view to analysing the delivery of loanable funds to sectors which are the most in need of poverty-reducing economic growth, at the same time, they are largely in line with the financial reforms that started in the early 1990s in India. The system-wide simulation designed in this thesis will permit us to analyse a wide spectrum of policy effects on such issues as the determinant of interest rates, financing capital formulation, the role of financial institutions, government debt and allocation of credit, as a result of interactions in the *disaggregated* economic sectors.

The key finding is the significant role of interest rates in portfolio selection and thereby on the flow of funds for India. The policy simulations, however, reveal that the liberalisation of interest rates may be no better than the administered rates in ensuring loans to private sectors. Possible perverse outcomes from the liberalised interest rate regime are also highlighted in the stochastic simulations, as policies become sensitive or fragile in the face of uncertainty in the economy. These demonstrate the importance of a *gradual* de-regulation in the financial sector, rather than an indiscriminate attempt at financial decontrol.

Key Words:

Flow of funds; Almost Ideal Demand System; Cointegration; Deterministic Simulation; Stochastic Simulation; Policy analysis; India; Financial Sector; Financial Reforms; General Equilibrium Model

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Contents:

Chapter 1 Introduction

A flow of funds in the financial sector arises from financial transactions among economic agents. These financial activities of an economy are then registered in a flow of funds account, which shows the flows of borrowing (i.e. sources) and lending (i.e. uses) of funds among disaggregated sectors for a certain financial instrument. There are two important aspects in a flow of funds study. One is that the non-financial activities that generate income and production are linked through each sector's net worth in the account, i.e. Net Acquisition of Financial Assets (NAFA) is equal to its excess of saving over consumption and capital expenditure. This interrelationship between financial and non-financial conditions in the economy provides greater insight to identify the influences of financial market activities on the real economy or vice versa. The other aspect is disaggregation. Disaggregation is essential in empirical work, since the balance sheet and flow of funds data of different sectors clearly show marked differences with respect to their net wealth positions and the pattern of assets and liabilities. In the disaggregated financial markets across sectors, interest rates and financial stock and flows for the spectrum of assets emerge as a result of interactions between disaggregated sectors. This distinguishes a flow of funds analysis from the traditional macroeconomic models such as the textbook type of IS/LM model, in which typically only money and one homogenous non-money asset are considered in an aggregated economy. It also departs from a simple term structure equation in determining interest rates. In this respect, the flow of funds accounts offer an excellent opportunity for the empirical study of financial sector development and thereby resource mobilisation (Green and Murinde, 1999 and Green, Murinde and Moore, 2002).

The flow of funds model is potentially a fruitful approach for analysing developing economies, because their financial systems tend to be characterised by a range of restrictions such as administered interest rates, credit control and reserve requirements (Fry, 1995). The flow of funds framework is able to incorporate these developing country-specific features and contributes to identifying effective policies for encouraging poverty-reducing economic growth. Further, there is the favourable aspect of a flow of funds analysis for developing economies. In industrial economies, interest rates and prices play a major role for an efficient resource allocation providing much of the fundamental and timely information on the economy, to which the policy is directed. On the other hand, in developing economies where the markets are fragmented and strictly governed, in which interest rates and prices tend to be administered, interest rates do not particularly function as an equilibrium mechanism. In this case, the quantities in a flow of funds analysis would provide us with a more useful insight into the formation of economic policy (Green *et al.* 2002).

However relatively few flow of funds studies have been done for developing countries. Modelling a flow of funds requires relatively detailed data. Therefore, the apparent impediment in developing countries is the limited or non-existent availability of data, particularly in the case of low-income developing countries. However, there does exist a comprehensive detailed presentation of flow data for India: The Reserve Bank of India (RBI) publishes from time to time the flow accounts in the Reserve Bank of India Bulletin.

In this thesis, using the published flow accounts a flow of funds is constructed and used to conduct policy simulation experiments, in order to address the impact of government policy changes and financial reforms on the financial sector, and to investigate the appropriate policy instruments for financial development in India. The main intellectual foundation for this project was provided by Brainard and Tobin (1968): in the general equilibrium model, the whole financial sector is endogenised by means of demand functions for asset choice in the disaggregated sectors, and each financial market is solved by the market clearing condition. This is a complete flow of funds model in a consistent manner.

In the thesis, the real sector is assumed to be exogenous and so the emphasis is on the development of the financial sector. Financial development is a necessary condition for the promotion of economic growth, (though it is not a sufficient condition), because as Copeland (1949) argues that financial sources are the cause of expenditures: it is the changes in credit flows, which alter total spending on goods and services, since without credit, aggregate expenditure is severely constrained. McKinnon (1973) and Shaw (1973) are also great sympathizers with 'the role of financial deepening as a means of accelerating economic growth of developing countries'[1].

The methodology taken in our study has a number of following contributions.

i) By treating the asset demand system as analogous to the consumer demand system, innovatively, the linear approximation of the Almost Ideal Demand System (AIDS) of Deaton and Muellbauer (1980a) is utilised for a system of demand functions. Given that only annual data are available for India, our estimated model is a long-run equilibrium model, to which the AIDS provides data-coherent theoretical properties, satisfying axioms of rational choice. The AIDS is flexible in allowing us to include policy variables presenting subsistence level portfolios. The AIDS approach is a relatively new development in the field of flow of funds models. Therefore its application to a developing country, which has rarely been attempted, is a further contribution to the existing literature.

ii) The application of the AIDS model is greatly motivated by the empirical work of Barr and Cuthbertson (1991a, 1991b, 1991c, 1992a, 1992b and 1994) for the portfolio behaviour for the UK, obtaining statistically and theoretically sensible results. This study however goes beyond the study of Barr and Cuthbertson, because all the AIDS model for a single sector is consolidated to embody the whole financial sector for the simulation policy experiments. The empirical performance of such a complete flow of funds model is rare even for industrial economies; in many cases the study tends to stop at individual sectors. Covering a wide range of assets and considerable sectoral disaggration, such an undertaking is huge and therefore tends to discourage researchers (Green, 1982).

iii) Our policy simulation experiments are expansionary in terms of delivering loanable funds to private sectors for economic activities. At the same time, this is largely in line with the de-regulation and liberalisation of the financial reforms that started in the early 1990s in India, such as removing the ceiling for interest rates, lowering reserve requirements and the disciplinary stance of fiscal deficit. Simulation quantifies the potency of policy instruments on the flows, hence it can give a clear picture of the channels through which policies may affect different sectors of the economy (Green *et al.* 2002). Clear understanding of the outcomes of policy instruments is necessary for the re-design of the financial reforms. The system-wide model designed in this thesis will

[1] There has been, however, increasing dispute over the causation as to whether finance causes growth or vice versa (see for example, Sen, 2000). Yet, such a discussion is beyond the scope of this thesis.

permit us to analyse the considerable spectrum of policy effects on such issues as the determinant of interest rates, financing capital formulation by firms, the role of financial institutions, government debt and the allocation of credit.

iv) A flow of funds in India was modelled and simulated by Sen, Roy, Krishran and Mundlay (1996) using the published flow accounts for the period from 1970-71 to 1989-90. The study was conducted in line with the stabilisation macroeconomic policy undertaken in the early 1990s in a simple general equilibrium framework. However, there are a number of limitations with their study. First, the sector study is confined in a specific manner; there are only two sectors of banking and household sectors with four financial assets, assuming financial flows in other sectors to be policy-determined. Second, the data is drawn from the flow accounts in an ad-hoc manner, largely neglecting the elements which can be determined by the behavioural equations. Third, the financial sector is not properly specified in the general equilibrium system, therefore market clearing identities are fragmented. Here, the approach is more extensive and consistent in scope. There are four sectors of banking, other financial institutions (OFIs), private corporate business (PCB) and household sectors with six financial assets, that are modelled for the period of 1951-52 to 1993-94. The data employed are the complete net transactions of uses and sources of funds, satisfying the market clearing conditions in a consistent manner.

The thesis is organised in the following manner.

In Chapter 2, the empirical literature on the demand functions for a flow of funds model is reviewed. This survey is aimed at addressing the main features of the different types of demand functions from both theoretical and empirical aspects, so that it will contribute to the building of a flow of funds model for developing economies. The survey demonstrates the difficulty in obtaining plausible estimates of interest rates on a priori grounds. The main cause is the heavy parameterisation giving rise to multicollinearity. The attraction of the AIDS in consumer demand theory is highlighted.

Chapter 3 is dedicated to the financial system and the compilation of the flow of funds matrix for India. After independence, financial markets had been functioning in a heavily regulated framework in India. In particular, regulations imposed on the banking sector such as administered interest rates and mandatory high reserve requirements are closely associated with fiscal devices, and they have repressed financial development. Financial liberalisation started in the early 1990s, aimed at the de-regulation of the financial system. In section 3.1, the course of reforms and their effects on the financial markets are examined, versus their condition in the pre-reform period. This section has direct relevance to our interpretation of empirical results. In section 3.2, the India-specific property of the financial intermediaries is spelled out. In this section, a flow of funds matrix, which forms a foundation for econometric estimation, is compiled using the published flow data. The matrix gives important insights into how India's financial system functions.

In Chapter 4, the data set, the AIDS model specification and econometric methodologies employed in the empirical analysis are described and justified. In section 4.1, a theoretical flow of funds model in a general equilibrium framework for India is presented, in which a number of behavioural equations and market clearing identities are identified. This is followed by the derivation of stock data for econometric estimation. In section 4.2, the theoretical model, AIDS, is thoroughly examined. Since the data are potentially non-stationary, section 4.3 discusses cointegration techniques and emphasizes the role of cointegration identifying long-run, equilibrium relationships.

The building blocks of a single sector study for a system-wide flow of funds are set up in Chapters 5 to 8, in which econometric estimation and results are presented for the four sectors. Asset shares are the dependent variables in the model with interest rates (or AIDS prices) as the principle explanatory variables, the system of estimations is estimated using the Seemingly Unrelated Regression technique. General to specific methodology, by enforcing theoretical restrictions, is employed for the long-run model in order to obtain economically plausible results with a view to attaining sensible simulation solutions in the subsequent chapters. In Chapter 5 the banking sector is modelled. The number of regulations imposed on this sector is an obstacle to modelling a portfolio behaviour for this sector. Despite this, the estimated model provided an intuitively plausible result. Modelling the PCB sector in Chapter 6 is equivalent to modelling the determinants of capital structure, since this sector is a deficit sector. The flow of funds approach to capital structure is distinguished from other empirical analyses of corporate finance, in that the capital structure is viewed as a macroeconomic rather than microeconomic problem. The OFIs sector consists of term lending institutions and investment institutions and is modelled in Chapter 7. With substantial intra-transactions in this sector, in which many assets and liabilities cancel out, the sector is modelled in two ways: one is by using the data of net transactions (as with other sectors) and the other is by using the data of uses only (i.e. assets only). The result in the former is complemented by that of the latter. The novelty of the household sector study in Chapter 8 is that the demand for money is examined as an integral part of the portfolio behaviour in a system of equations rather than in an aggregate single equation framework. This allows us to examine the asset motive in the demand for money in a richer fashion, since the opportunity cost includes all the interest rates that are relevant to a flow of funds in the household sector. Overall, this single sector study highlights interest rates as being the principle determinant in asset choice, brings out a modest contribution to our understanding of the portfolio behaviour.

In Chapter 9, 10 and 11, we implement policy simulation experiments by integrating the separate sectoral models (derived in the previous four chapters) and market clearing conditions. In Chapter 9, the financial constraints are relaxed in turn, to examine the channel in which a higher proportion of loanable funds is transferred to the non-financial private sectors. Evidence reveals that lowering the cash reserve ratio and removing the ceiling of deposit rates are the most preferable policies. The simulation experiments are extended in Chapter 10 by de-regulating the administered deposit rate. This is a further step toward a complete liberalisation of interest rates in India. It is however revealed that the de-regulated deposit rate is no better than the administered rates in terms of assuring the funds reaching the private sector. Stochastic simulation is conducted in Chapter 11, in which the sensitivity of policies is analysed in order to assess how robust policies are, in the face of uncertainty in the economy. In order to qualify the uncertainty, the results in this chapter are compared with those in Chapter 9 (that is, deterministic simulation). It turns out that the more interest rates are liberated, the more sensitive or fragile policies become. The financial system's fragility is related to particular forms of government interference in the financial sector, but these simulation experiments highlight the importance of a gradual transition to de-regulated interest rates, rather than an indiscriminate attempt at financial decontrol for India.

The summary and the key policy implications drawn from the empirical analysis are found in Chapter 12, together with limitations and the area of promising research ideas.

Finally, the thesis may bear the following two prospects. First, although, it may be difficult to generalize results from one particular country, India's monetary controls and their effects share some common features with those of other developing countries. Thus, it is hoped that conclusions based on detailed flow of funds analysis of India-specific data will be applicable (or at least will give guidance) to the formulation of macroeconomic and financial policies aimed at growth stimulation and poverty reduction in other developing economies, where data is too sparse for detailed and conclusive study. Second, given the difficulty of conducting a complete flow of funds analysis and the scarcity of empirical literature available, it is hoped that the thesis will be a potential foundation or catalyst for further flow of funds research.

Chapter 2 Survey of Asset Demand Functions for Modelling a Flow of Funds

2.1 Introduction

A flow of funds account takes the form of a matrix: each column indicates disaggregated sectors and each row implies financial instruments. Entries in each cell indicate purchases or sales of assets during a discrete period of time. They can be positive, negative or zero depending on the position of a sector; for example, if the sector accumulates obligations in the asset in question, then it is a negative entry. The flow of funds matrix contains the interlocking nature of the accounting system as a whole (Board of Governors of the Federal Reserve System 1975). In its columns, though each sector is free to choose the composition of assets, total net acquisitions of financial assets (NAFA) in any time period are constrained by the sector's overall surplus or deficit on income and capital accounts. When stock data, rather than flow data, enter in the matrix, each column implies a given sector's balance sheet, since this is the presentation of assets and liabilities of the sector in question, at a point time. Since purchases of an asset by one sector are to be accomplished by sales of the asset by another sector, each row sums zero. Each entry in the matrix is determined either exogenously or endogenously. The latter accounts for portfolio choices of the disaggregated sectors, usually based on portfolio demand functions relating financial assets to interest rates. The market clearing conditions are normally met by equating the asset demand and supply, and each market is solved for either the asset yield (or the asset price) or the total supply. This constitutes a system-wide flow of funds model.

This survey has concentrated on demand functions for a single-sector study, because sector studies are the essential building blocks of a flow of funds model (Green and Murinde 1999), and also the empirical work of a complete flow of funds model is rare, exceptions are those of such as Green (1984) for the UK, Hendershott (1977) for the US[1]. To qualify in a system-wide model, we consider the following properties of a system of demand functions. First, the theoretical foundation is some form of utility-maximising behaviour by agents: it implies restrictions on the coefficients, then given potentially highly collinear explanatory variables, the estimation of asset demands is much facilitated by such restrictions (Perraudin, 1987, p.741). Second, there is the need to incorporate the adding-up restrictions implied by the accounting framework of the balance sheet, thereby it maintains the internal consistency of any solution: in each sector a change in one of the interest rates with its wealth fixed can change the distribution of asset holdings, but not the total, thus the interest rate coefficients must sum to zero across equations. Third, the demand and supply equations are properly specified, such that a market clearing condition determines the yields or quantities within the system, and the total impact of policy changes on the financial sector can be analysed (e.g. the impact of an increase in deposit rates on the increases in total deposits and the consequent portfolio switches).

In this survey, the aim is to address the main features of the various asset demand functions from both theoretical and empirical aspects, so that it will contribute to the construction of a flow of funds model for developing economies. This is a selective survey; demand functions are chosen, which are theoretically designed or empirically applied to financial asset choice with a view to modelling a flow of funds. The asset demand model is then largely classified into three types; the pitfalls model approach, the mean-variance approach and the consumer demand theory approach. All three approaches hold the common assumption of separability: the portfolio balance decision is separated from the consumption-saving decision (Tobin, 1969, Buckle and Thompson, 1992), though we will investigate some attempts at integrating both decisions in due course.

For many years portfolio modelling generated disappointing empirical results: it is said that modelling a portfolio behaviour is the 'graveyard of applied economics' (Buckle and

[1] Yet, each study faces some limitations. In the case of Green (1984), the household and corporate sectors are consolidated into a non-bank private sector. Further he claims the difficulty in simulating his model. Hendershott's model contains significant complexity in disaggregating financial assets, while explaining only three market-clearing interest rates for the developed economy (Green, 1993).

Thompson, 1992). The main problem lies in the heavily parameterised specification leading to statistical inefficiency. The particular attention is therefore placed on recent developments in portfolio modelling, which pave the way to mitigating the problem.

The outline of each section is as follows:

In Section 2.2, discussion centres around the pitfalls model. The basic accounting framework for portfolio modelling of *n* assets is set out in a simple stylised model as a system of linear equations. One of the model's main features is that it advocates the 'general disequilibrium' framework for the dynamics of stock adjustment to a 'general equilibrium'. The dynamics of cross-adjustment are incorporated in that the adjustment of any one asset holding depends not only on its own deviation of the previous actual level from desired level of asset holdings, but also on the deviations from equilibrium of other assets[2].

The pitfalls model is probably the most influential statement of wealth allocation from the viewpoint of empirical implementation for a flow of funds. At the same time it is known to have several limitations. First, there is no theoretical foundation in the pitfalls model: the explanatory variables are chosen in an ad hoc manner, not explicitly derived from the utility maximising behaviour (Buckle and Thompson, 1992). Second, the cross-adjustment mechanism makes the size of a flow of funds model very large, hence the model suffers from heavy parameterisation leading to anomalies in parameter. In order to mitigate this problem, the followers of the pitfalls model applied Theil's 'mixed estimation' procedure consisting of sample and prior information. Third, it is argued that the pitfalls dynamic model is a stock adjustment model and hence fails to distinguish between new cash flows and previously held wealth. Friedman (1977) referred to the 'optimal marginal adjustment model' to take into account the flow of asset demands and their role in the determination of the market rate of return.

Markowitz (1952) and Tobin (1958) laid the foundation of portfolio selection theory based

[2] The term 'Pitfall' originates from this point

on the mean-variance (M-V) hypothesis. M-V is an attractive way to bring a theoretical structure to asset-demand functions. In discrete time, it forms the asset demands of an investor who maximises a function of the mean-variance of his end-of-period real wealth. The early stage of the work is limited to the explanation of the quantities of the various assets that are specified as functions of the expected returns and the expected risks, treating the structure of interest rates as exogenous. The model specification is therefore similar to the pitfalls model (e.g. Parkin, Gray and Barrett 1970, White 1975, Bewley 1981 and Spencer 1984). Consequently, in general these studies tend to share the same problem of multicollinearity as experienced in the pitfalls model. On these grounds, these models are consolidated in the pitfalls type model in their discussion.

Frankel and Dickens (1983), Frankel and Engel (1984) and Frankel (1985) have brought the theory of mean-variance optimization to the asset demand functions by inverting the model: the properly specified interest rate equations based on the Capital Asset Pricing Model (CAPM) of M-V are linked with the portfolio demand functions and the estimation is to regress interest rates on asset shares. A similar approach was taken by Green (1990a). The CAPM itself is, however, subject to some methodological criticisms. Roll (1977) argued that the results were sensitive to a failure to include all relevant assets in the portfolio. The CAPM also requires stringent assumptions that expected returns and the "betas" (the covariance with the market return) are constant over time, but this is inconsistent with the changes in asset supplies and the consequent changes in expected returns. Besides, many empirical studies are embarrassed by the presence of statistically insignificant and wrongly-signed coefficients. In Section 2.3, discussion is focused on the CAPM-based inverted (demand) model, titled the M-V approach. This is a direct study of a determinant of interest rates using a flow of funds, and also a way of mitigating the theoretical problems of CAPM. The M-V hypothesis is tested by explicitly allowing expected returns to vary freely, and by imposing the constraint that the coefficient matrix is proportional to the variance-covariance matrix of the error term. In these tests portfolio shares do make a significant contribution to explaining asset returns, however its main theoretical restrictions are in general rejected, since the constraint of mean-variance optimization is rejected.

Barr and Cuthbertson (1989) advocated the demand for assets in the context of neoclassical demand theory. In demand theory the utility functional forms implicitly impose theoretical constraints of the basic axioms of rational choice, hence it does not need to assume homogeneity or symmetry, yet it is possible to test these properties. This is contrasted with the pitfalls model, which satisfies the minimum requirement of adding-up but is not consistent with the theoretical constraints of homogeneity and symmetry.

In consumer theory there is, however, no fixed functional form of utility function. A specific functional form is applied such as in the linear expenditure system (LES) and the Rotterdam model. These are the most popular demand models, however, the underlying specified utility function is an additive one, so that the system suffers from the limitations of additive systems (Thomas, 1985). There is therefore a trade-off between flexibility and the degree of freedom (Theil, 1980 and Prasad, 2000). A flexible functional form circumvents this problem without the cost of a reduced efficiency of estimates, including the Cobb-Douglas, the constant elasticity of substitution (CES), Translog (Transcendent Logarithm) and AIDS functions. In Section 2.4, the focus is on the particular flexible functional forms of Translog and AIDS models. The Translog model developed by Christensen, Jorgenson and Lau (1973) approximates the direct (indirect) utility function by functions that are quadratic in the logarithms of the quantities consumed (the ratios of prices to the value of total expenditure). The 'translog indirect utility function' has frequently been used in assessing the substitutability between financial assets with some fruitful results. The AIDS model, put forward by Deaton and Muellbauer (1980a), approximates the cost function by functions that are quadratic in the logarithms of prices. The AIDS model has a number of attractions in terms of empirical application as compared with other demand system, and is empirically well supported.

In Section 2.5, some empirical evidence and limitations on a flow of funds model for developing economies are reviewed, although there are limited sources of information. The concluding remarks are found in Section 2.6.

2.2 Pitfalls Model Approach

2.2.1 The Pitfalls Model

The pitfalls model, which provides a suitable accounting framework, explicitly incorporating balance-sheets constraints, is illustrated following Smith (1975). The desired allocation of n financial asset shares depends linearly upon their own and other rates of return and other explanatory variables, such that

$$\frac{a_i^*}{w} = \beta_{io} + \sum_{j=1}^{n} \beta_{ij} r_j + \sum_{j=1}^{q} \delta_{ij} X_j \qquad i = 1, 2, ...n \tag{2.1}$$

where a_i^* is the desired holdings of i th asset and w is the stock of wealth, r_j is the asset j th interest rate and X_j is the j th explanatory variable[3]. (Asset stocks and wealth are measured on an end-of-period basis, though time subscripts are omitted.) Since the budget constraint implies that $\sum_i a_i^* = w$, the consistency condition (or adding-up constraints) requires

$$\sum_i \beta_{io} = 1,\ \sum_i \beta_{ij} = 0\ (j = 1, 2, ...n), \text{ and } \sum_i \delta_{ij} = 0\ (j = 1, 2, ...q).$$

Since the dependent variable represents portfolio shares, the sum of the constant must equal one, and the change in any r or X can not alter the size of a portfolio, then the sum of the columns equals zero. Equation (2.1) also captures the wealth homogeneity constraint, which implies that any shift in an asset's share in the desired equilibrium is due to movements either of yields or of other explanatory variables, not due to the change of the total portfolio (Friedman, 1977).[4] The assumption of gross substitutes implies that the partial derivative of an asset share is positive with respect to its own return but non-positive with respect to other returns, i.e. $\beta_{ij} > 0,\ i = j$ and $\beta_{ij} \leq 0,\ i \neq j$, i.e. all financial assets are substitutes. But this is not a requirement of utility maximisation and it

[3] Brainard and Tobin (1968) include new saving and capital gain as other explanatory variables.
[4] However, an increase in total wealth will very often be accompanied by an upward revision of the expectation of yield and this will, for example, decrease the demand for money.

is empirically rarely supported[5].

The dynamic model takes a form of cross-partial adjustment. This is based on the optimization of quadratic cost functions where there are adjustment costs arising from the distance between the desired and the actual level of an asset holding[6]. Brainard and Tobin (1968) advocated that each asset adjustment depends upon a complete description of the disequilibria in the portfolio, referred as 'general disequilibrium'. This is given by

$$\Delta a_i = \sum_{j=1}^{n} \theta_{ij}(a_j^* - a_{j(-1)}) \qquad i = 1, 2, ... n \tag{2.2}$$

The equation (2.2) implies that it depends not only on its 'own' asset discrepancy but also on the 'cross' discrepancy. This is consistent with the balance sheet constraint: if there is an adjustment for an asset, there must be some offsetting adjustment in other assets in order to maintain the wealth constraint[7].

The adding-up restriction can be derived from (Smith, 1975, p.512): $\Delta w = \sum_i \Delta a_i = \sum_i \sum_j \theta_{ij}(a_j^* - a_{j(-1)})$. This equation can hold if and only if $\sum_i \theta_{ij} = 1$ (j = 1, 2, ... n). A coefficient θ_{ij} is interpreted as the partial effect on holdings of the i th asset of a unit increase in desired holdings of the j th asset accompanied by an equal increase in Δw. Alternatively, it is the speed of adjustment toward the long run equilibrium level. By substituting equation (2.1) into (2.2), the reduced model for estimation is derived as given by,

$$\Delta a_i = (\sum_{j=1}^{n} \theta_{ij}\beta_{jo})w + [\sum_h (\sum_{j=1}^{n} \theta_{ij}\beta_{jh})r_h]w + [\sum_h (\sum_{j=1}^{n} \theta_{ij}\delta_{jh})X_h]w - \sum_j \theta_{ij} a_{j(-1)} \tag{2.3}$$

[5] Assets with high negative covariance of returns could be complements, because hedging activities involve purchases of these assets and also if there are strong wealth or income effects resulting from an increase in the expected yield, the gross substitutes assumption will fail (Tobin, 1982).

[6] Christofides (1976) justifies the cross adjustment mechanism using a quadratic cost function.

[7] If $\Delta a_i = \varepsilon_i(a_i^* - a_{i(-1)})$ is adopted for all n assets, inconsistency arises. Since $\Delta w = \sum_i (a_i^* - a_{i(-1)})$, and $\Delta w = \sum_i \Delta a_i = \sum_i \varepsilon_i (a_i^* - a_{i(-1)})$, it must be $\varepsilon_i = 1$, i.e. consistency in a pure linear own-adjustment model requires that actual holdings adjust fully (Smith, 1975, p.510).

The pitfalls model itself is developed for a flow of funds model, and this type of model is widely used for a flow of funds empirical study among researchers. However the equilibrium relationship of the long-run model loosely implies the utility-maximisation theory (Owen 1986). Buckle and Thompson (1992) have formerly shown that the pitfalls model cannot be derived from utility maximising behaviour in comparison with LES, indicating that consistent preferences are not implied in the model.

2.2.2 Empirical Results, the Bayesian Approach and Imposition of Symmetry and Homogeneity

In the pitfalls model, each demand equation includes the yields on all competing assets. With a plausible degree of disaggregation of financial markets, empirically the model, especially the cross adjustment dynamic model becomes heavily parameterised. Multicollinearity is inevitable if assets are close substitutes, as their interest rates will tend to move closely together (Green and Murinde, 1999). Consequently, the estimated coefficients are likely to be incorrectly signed or statistically insignificant,[8] and the estimation results may not meet a priori economic intuition. Further, this fails to provide a plausible basis for simulation[9], (e.g. see Brainard and Smith 1976, Backus and Purvis 1980 and Backus, Brainard, Smith and Tobin 1980). The potential solution is considered by approaching estimation with priors, so that the underlying pattern of behaviour avoids being scrambled.

One way is to utilise a mixed estimation procedure: Theil-Goldberger mixed estimation or Bayesian approach is often employed by researchers. The technique involves combining a prior information (i.e. plausible values in coefficients) with the data. The mixed estimation procedure requires prior judgements of all moments of the first and the second

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[8] Green and Kiernan (1989) attribute these results to the interaction between multicollinearity and measurement errors on the expectation of interest rates among the interest rates in the asset demand functions.

[9] Green (1993) points out that the coefficient anomalies generate excessive volatility in interest rates when the model is solved and simulated.

order of the various parameters. The difficulty is, in particular, the construction of the second-order cross-moments (the prior covariance). This is a formidable task, especially when there are a large number of parameters to be estimated. The process can be simplified however by assuming that the variance and covariance among the errors in the priori-specified parameters are the same in estimating a system of demand equations.[10] With this simplified version, the mixed estimation technique demonstrates that explicit incorporation of a priori information is a way of dealing with the problems of a heavily parameterised model; some test results indicate that the mixed estimates are more plausible than the Ordinary Least Square (OLS) estimates, and in terms of forecast and simulation they also perform relatively well.

Table 2.1 shows selective empirical studies of the pitfalls type model, in which the proportion of the correctly-signed own-interest rate coefficients (on a priori ground) by OLS and the mixed estimations is presented. OLS is accompanied by the proportion of the statistically significant own-interest rate coefficients. The results testify the difficulty of obtaining statistically significant and plausible own-interest rate effects by unrestricted OLS; in many cases, the coefficients are insignificant at a 5% level. In the work of Smith and Brainard, the mixed estimates improve the OLS results. Kearney and MacDonald (1986) also claim that the mixed estimates are more consistent than those of OLS, and many of the peculiarities in their OLS estimates are moderated. However, a number of peculiarities still remain in the estimated coefficients in the work of Backus *et al.* (1980) without qualitative improvement. This led them to utilise only a prior information.

The other method to cope with the problem of multicollinearity on the estimated coefficients is to impose the a priori constraints of adding-up, homogeneity and symmetry in estimation. It is shown that the balance sheet property of the data ensures that the adding-up constraints hold automatically, whereas homogeneity and symmetry need to be enforced during estimation. Building the linear restrictions into the coefficients has

[10] Yet, Smith (1981) argues that the true covariance matrices for priors do differ across equations; the variances vary positively with the size of the coefficients and tend to be smaller for own than for cross effect.

advantages in empirical applications by reducing the number of independent interest rate coefficients, thereby decreasing the anomaly in the estimated coefficients in the face of the multicollinearity (Hendershott, 1977 and Taylor and Clements, 1983).

Homogeneity implies that an equal change in each return will not alter the composition of the portfolio, and it is relative rather than absolute interest rates, which affect the level of asset shares, hence $\sum_j \beta_{ij} = 0$ for all i ($j \neq 0$). The condition of symmetry requires $\beta_{ij} = \beta_{ji}$ ($j \neq 0$), i.e. the effect of a change in the return of j th asset on the holding of i th asset share equals that of i th asset on the holding of j th asset share[11].

The symmetry and homogeneity conditions are often maintained in empirical portfolio studies, though they are frequently rejected by the statistical tests. It is argued that the failure of the data to support homogeneity and symmetry is a consequence of the improper treatment of dynamics (Anderson and Blundell, 1982). This is however not necessarily the case. Roley (1983) has shown that the necessary and sufficient condition for symmetry is to exclude wealth effects on asset share, i.e. if symmetry holds, this implies that investors' utility functions exhibit constant absolute mean-variance risk aversion. Therefore, he argues that symmetry is not a general implication of utility maximisation, but depends on the individual utility function. There is some empirical evidence in which the symmetry constraint is met, however not satisfactorily. In the study of Parkin, Gray and Barrett (1970) on the portfolio choice for Discount Houses in the UK, symmetry constraints are generally supported in the long-run asset demand. However, it is pointed out that there appears to be no rigorous test of the constraints employed in estimation in Parkin *et al.*'s paper (Courakis, 1975). Hood (1987) estimated the dynamic adjustment portfolio model for the UK's personal sector and found that the estimated coefficients accepted the symmetry property in the short run. Yet, Hood's research is limited to a similar type of capital-certain

[11] Adding-up plus symmetry constraints automatically constitute homogeneity, but adding-up plus homogeneity do not generate symmetry.

Table 2.1 Selective empirical studies of portfolio behaviour with the pitfalls type model: OLS vs Mixed

Study	Sector	Period	Asset categories^	Proportion of the significant own interest rates by OLS at 5% level.	OLS Correct sign * (LR) (SR)	Mixed Correct sign * (LR) (SR)
Brainard and Smith (1976)	Savings and Loan associations	1952-69 Quarterly	Short-term marketable assets, Long-term marketable assets, Mortgages	NA	1/3 1/3	3/3 2/3
"	Mutual savings banks	1966-72 Quarterly	Above plus Time deposits, Other loans	NA	4/5 4/5	5/5 5/5
Backus and Purvis (1980)	Household	1954-75 Quarterly	Broad money, Bonds, Corporate Equities, Mortgage loans, consumer loans	2/5 (SR)	3/5 2/5	2/5 4/5
Backus, Brainard, Smith and Tobin (1980)	Households	1954-73 Quarterly	Time deposit at commercial banks, Time deposits at savings institutions, Shorts, Longs, Equity, Mortgages, Loans	2/7 (SR)	5/7 6/7	NA 5/7
"	Savings Institutions	1954-78 excluding 1966 (1) Quarterly	Shorts, Longs, Mortgages, Loans	0/4 (SR)	3/4 3/4	NA 3/4
"	Insurance and pension funds	1954-78 Quarterly	Shorts, Longs, Equity, Mortgages	0/4 (SR)	4/4 3/4	NA 2/4
"	Commercial banks	1968-78 Quarterly	Excess reserves, Borrowed reserves, A short, L short, Longs, Mortgages	2/6 (SR)	3/6 3/6	NA NA
Kearney and MacDonald (1986)	Private sector	1973-82 Monthly	Broad money, Bank loans, domestic bonds, Foreign assets dominated in foreign currency	1/4 (SR)	3/4 1/4	3/4 3/4

- NA= Not available, LR=long run model, SR=short run model, A, L = Unknown
- ^ Currency and Demand deposits are excluded since their nominal interest rates are zero.
- * Proportion of the correct sign (on a priori ground) on the own interest rates. LR in the upper and SR in the lower.
- Country covered is US, except the work of Kearney and MacDonald for the UK.

assets. In the empirical work of Taylor and Clements (1983) for Australia, both symmetry and homogeneity are rejected for the capital-certain assets in the long-run. Roley (1983) tested the symmetry restriction using the 'optimal marginal adjustment model' (discussed in the next section); the demands for two different maturity classes of Treasury securities are estimated for six categories of US institutional investors. The symmetry restriction is rejected in five out of six cases at low significance levels.

The gain in the empirical results by imposing symmetry and homogeneity are not necessarily promising. Owen (1986) tabulates the empirical studies, which were conducted in the 1970s or the 1980s and are viewed as the applications of the pitfalls type in five out of seven studies which are imposed of the restrictions; the proportion of the statistically significant coefficients among explanatory variables at a 5% level is less than half. Further, in the studies of Courakis (1975) and White (1975) for the portfolio behaviour in the banking sector with the imposition of symmetry and homogeneity, the presence of anomalies in the estimated coefficients is persistent, and in the latter case, the imposition of symmetry led to inferior results than would otherwise be expected[12].

2.2.3 Optimal Marginal Adjustment Model

Modigliani (1972) argues that the adjustment lag arises from the cost of shifting previously held assets, rather than from the allocation of newly accumulated wealth in the asset market. Because transactions costs in allocating new cash is less than those in reallocating existing portfolio holdings. It is then plausible to postulate that financial flow variables are potential determinants of investors' short-run asset demands due to the differentials in the transactions costs (Friedman,1977). The pitfalls model fails to capture this point. It is clear when the model (2.2) is rewritten by letting $\frac{a_i^*}{w} = \alpha^*_i$, then $\Delta a_i = \sum_{j=1}^{n} \gamma_{ij} \alpha_j^* \Delta w + \sum_{j=1}^{n} \gamma_{ij} (\alpha_j^* w_{(-1)} - a_{j(-1)})$ where $\Delta w + w_{(-1)} = w$. It implies an equal

[12] This is also the case in our current study for the corporate sector in Chapter 6; it turns out that the imposition of both restrictions led to an inferior result.

adjustment speed in the initially held assets and the new flows. In order to specify explicitly flow effects on a portfolio, the adjustment model needs to be modified by separating the existing holdings from the new cash flows. Such that a model referred to as the 'optimal marginal adjustment' by Friedman is specified as

$$\Delta a_i = \alpha_i^* \Delta w + \sum_{j=1}^{n} \theta_{ij} (\alpha_j^* w_{(-1)} - a_{j(-1)}) \tag{2.4}$$

The constraint on the coefficients θ_{ij} is $\sum_i \theta_{ij} = \overline{\theta}$ (for all j) which is not required to be unity. The modified model captures the effect of differential transaction costs by rendering the allocation of the new cash flows more sensitive to the yields than the reallocation of the existing asset holdings since there is no longer adjustment term as an element of the coefficient for Δw.

There are, however, some difficulties in the econometric estimation of equation (2.4). First, the equation (2.4) is over-described since $w_{(-1)} = \sum_j a_{j(-1)}$ for all j. The procedure, thus, requires some experiments to reach satisfying goodness of fit and statistical properties[13]. The other drawback is that there are too many explanatory variables to permit efficient estimation. Therefore in multi-equation models it may be impossible to apply two-stage least squares, and instead the instrumental variables technique of Brundy and Jorgenson (1971)[14] is utilised.

The empirical test of the optimal marginal adjustment model by Friedman for six major categories of corporate bond investors in the US using seven financial instruments supports the hypothesis embodied in this model; cash flow variables are a significant determinant of investors' short-run asset demands in the presence of transactions costs. The full-model dynamic simulation results are also supportive of this structural model.

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[13] See p.678 in Friedman (1977).

[14] This derives consistent estimators by using as instrument variables not only the leading principal components of the full-system set of exogenous variables, but also on an equation-by equation basis, the single-equation sets of exogenous variables themselves.

The effects of new investable funds on the asset demands may be decomposed as Role (1980) argues; i), flows affect the reallocation of assets already in the portfolio, ii) positive and negative new flows have asymmetric effects and iii) different sources of flows are allocated differently. Although these assumptions sound reasonable, Role's specified model seems intractable with so many parameters, and that it is difficult to interpret the estimated results.

2.2.4 Integrated Models

In the original pitfalls model Brainard and Tobin linked the real sector to the financial sector by incorporating Tobin's Q, through which financial events affect the real economy or vice versa. According to Tobin's Q theory, investment is stimulated when capital is valued more highly than replacement cost and discouraged when its valuation is less than its replacement cost. They envisage that the total change in wealth is treated as exogenous to the financial sector, i.e. the NAFA is given exogenously, hence the portfolio balance decision is separated from the consumption-saving decision (Tobin, 1969). However, for a rational household, appropriate levels of consumption may be primarily a portfolio matter or available financial resources determine the purchase of a commodity (Matthews and Thompson, 1986). The pitfalls model can be extended to form an integrated model; in the integrated flow of funds models, the sectoral NAFAs emerge endogenously.

Purvis (1978) specified saving and portfolio decisions in an integral fashion; both saving and asset flow demands depend on current and the desired level of holdings of individual assets, such that the saving function is given by

$$S = \sum_{j=1}^{n} \xi_j (a_j^* - a_{j(-1)}) \tag{2.5}$$

A change in wealth is now endogenous, and that saving and asset holdings are simultaneously determined. In the empirical work of the US household sector by Backus and Purvis (1980), the consumption equation can be derived from the budget constraint, and is given by $C = Y - \sum \Delta a_i$, where Y is income. The components of wealth enter into the consumption equation individually. Their study reveals that the lagged asset stocks influence consumption positively and that the composition of wealth is potentially an important determinant of expenditure in the short run. Buckle (1991) also estimated a model similar to the pitfalls model with the vector of dependent variables consisting of consumption, two real assets, five financial assets and two liabilities using co-integrating techniques and found a wider range of disaggregated wealth effects on consumption. The study of investment decisions and portfolio decisions for the UK private sector by Matthews and Thompson also support the integrated model. Integrating expenditure with the full range of asset demand decisions allows examination of some aspects of the interrelationships between financial and real assets.

2.3 Mean-Variance Approach

2.3.1 Inverted Model in a One-Period Utility Maximization Problem

One of the major problems in the M-V model is the assumption of the constant expected returns perceived by investors. Frankel and Engel (1984), Frankel and Dickens (1983) and Frankel (1985) developed an inverted version of the pitfalls model, in which expected rates of return are allowed to vary freely, and the M-V constraints are placed on the parameters, so that the hypothesis of M-V optimization behaviour is tested. Unlike the pitfalls model, adjustment lags are ruled out, as it is assumed that the financial markets are always in equilibrium.

More specifically, the process explores the relation between portfolio theory and CAPM by linking the inverted portfolio demand functions of the pitfalls type model and the interest rate equations that are specified based on M-V optimization. This brings more structure to an ad-hoc type of asset-demand functions. The logical explanation of this approach is given by Green (1990a, 1993). In a general equilibrium model, solving an interest rate in the market clearing condition is carried out by setting estimated asset demands equal to supplies, then it implies that the estimation of asset demands by the regression of an asset quantity on interest rates is equivalent to regressing an exogenous variable on endogenous variables. Then the appropriate way of modelling interest rates is to regress an interest rate on asset supplies rather than the other way round[15].

Following the study of Frankel and Engel, the demand functions $\alpha_t = \gamma + \beta(E_t r_{t+1} - iE_t r^n_{t+1})$ are inverted utilizing rational expectations as given by,

$$r_{t+1} - ir^n_{t+1} = -\beta^{-1}\gamma + \beta^{-1}\alpha_t + \varepsilon_{t+1} \qquad (2.6)$$

where

α : a column vector of n-1 asset shares

γ : a vector of intercepts

β : a matrix of coefficients

$E_t r_{t+1}$: a column vector of the n-1 expected real returns

$E_t r^n_{t+1}$: the expected real return on the n'th asset

i : a column vector ones, length of n-1

ε_{t+1}: a prediction error that is orthogonal to all information at time t.

The expected excess returns are now viewed as depending on asset supplies and are therefore free to vary accordingly.

The constraints on the parameters by the M-V hypothesis will be derived by assuming that investors maxmize a function of the expected value and variance of the end-of-period wealth (Frankel and Engel, 1984, p.315):

$$F[E_t(W_{t+1}), V_t(W_{t+1})] \qquad (2.7)$$

where $W_{t+1} = W_t + W_t\alpha_t' r_{t+1} + W_t(1-\alpha_t' i)r^n_{t+1}$.

By differentiating F[.] with respect to the choice variable α, we can solve for the expected relative returns as produced by,[16]

[15] The possible simultaneity between holdings of financial assets and the asset yields is also recognised by Weale (1986); he argue that the use of 3SLS with the lagged interest rates as instrument variables copes with this problem (p.145).

[16] See p.135 in Frankel and Engel (1984) for the detailed derivation.

$$E_t z_{t+1} = \rho \operatorname{cov}_t (z_{t+1}, r^n_{t+1}) + \rho\Omega\alpha_t \tag{2.8}$$

where

$z_{t+1} = r_{t+1} - ir^n_{t+1}$

$\rho \equiv -W_t 2F_2 / F_1$: the coefficient of relative risk-aversion which is assumed to be constant[17]

$\Omega = E_t\left[(z_{t+1} - E_t z_{t+1})(z_{t+1} - E_t z_{t+1})'\right]$

From equations (2.6) and (2.8), it is clear that $\beta^{-1} = \rho\Omega$ and Ω is the variance-covariance matrix of the error term, i.e. $\Omega = E_t(\varepsilon_{t+1}\varepsilon'_{t+1})$. This implies that the coefficient matrix β^{-1} should be proportional to the variance of the forecast error if M-V hypothesis is to hold[18].

Empirical Results

The estimation results applying the inverted model may be arguably superior to the previous studies of the M-V optimal portfolio to the extent that they use data on asset supplies allowing expected returns to vary over time and that the parameters are not determined as arbitrary. However, the overall test results did not please the advocators. Frankel and Engel (1984) estimated real rates of return on five national currencies relative to that of the US dollar and found only one or two coefficient estimates in each equation are significantly different from zero. Frankel and Dickens (1983) also report that only a few of the coefficients appear significantly different from zero in the estimation of the relative returns of five assets. The work by Frankel (1985) shows a surprisingly small magnitude of bond supply effects on expected relative rates of return, which leads him to conclude that the effects of asset supplies on expected relative returns are economically

[17] A constant relative risk aversion implies that demand functions are homogeneous of degree zero in expected returns, hence asset demands can be written as functions of the differentials between any n-1 expected returns and the remaining n'th return (Green 1991).
[18] The imposition of a constraint between the coefficient matrix and the error matrix requires non-linear maximum likelihood estimation.

insignificant (though statistically significant). In terms of the M-V hypothesis, the likelihood ratio test rejects the constraints on β^{-1} in all three cases, suggesting that investors fail to optimize with respect to the mean and variance of their real wealth.

Bollerslev, Engle and Wooldridge (1988) extended the inverted model by allowing the second moments of the returns to vary over time[19], applying the autoregressive conditional heteroskedasticity (ARCH) technique on the covariance matrix of a set of asset returns[20]. The ARCH approach turns out to be fruitful in that the expected relative returns are significantly influenced by the conditional second moments of the returns. Engel, Frankel, Froot and Rodrigues (1990) also found that the incorporation of the changing conditional variances improves the model statistically in their study of the U.S. stock market, though the M-V hypothesis is again rejected.

Green (1990a) and Green, Na and Maggioni (1995) considered market imperfection as one of the possible sources of the model's failure, hence they incorporated several different specifications of transaction costs. Yet, the test results using the UK asset market monthly data by Green (1990) bear some inconsistent aspects of our understanding of portfolio behaviour. Adjustment costs turn out to be insignificant, and the hypothesis of zero risk premium is rejected, i.e. $\rho\Omega \neq 0$. This implies that portfolio shares do contribute to explaining asset returns and that portfolio diversifications are significant factors in explaining asset returns. A subjective covariance matrix of relative returns are symmetric and positive semi-definite, implying that M-V optimization is accepted, however, the estimated coefficient of relative risk aversion is large in magnitude and perversely signed (i.e. negative). The latter suggests that investors are risk seekers and that they will choose a non-diversified portfolio. In the study of Na, Green and Maggioni (1995), a negative relative risk aversion is also observed.

These empirical results lead the authors to reject the M-V approach (or CAPM) to the

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[19] Because it is more likely that time-varying expected excess yields build around a time-varying covariance matrix.

[20] Ω in equation (2.7) is now a time-varying conditional covariance matrix.

portfolio theory, suggesting that investors' portfolio shares may be linearly related to expected returns, hence the more general portfolio balance approach (such as the pitfalls model) may be appropriate to explain investors' behaviour. The rejection of the M-V approach may be explained in that the theory requires indeed too many assumptions[21] and that the violation of any single assumption may be possible in contributing to the rejection of the theory. Among others, Fama (1970) points out that the assumption of portfolio choice in a one-period context does not take account of uncertainty or the state of the world: consumption and investment opportunities available in the future can be state dependent. Friend and Blume (1975) also comment that the model, in contrast to a multi-period model, fails to capture the possibilities of hedging against future changes in the investment opportunity set. In order to examine the uncertainty and future aspects in the portfolio choice the continuous time model or intertemporal capital asset pricing model is briefly considered.

2.3.2 Intertemporal Capital Asset Pricing Model (ICAPM)

The specification of the one-period maximization problem imposes the separation of portfolio selection and saving decisions, assuming that either investors have quadratic utility functions in portfolio returns or asset returns are normally distributed. In the case of ICAPM, in which the investor's lifetime utility maximization problem of consumption is solved, portfolio selection can be analyzed in either a separated or integrated manner, depending on different assumptions.

The problem of choosing optimal portfolio selection and consumption rules under uncertainty is typically formulated by

$$MaxE\left\{\int_0^t e^{-\rho t} U\left[\widetilde{C}_{(t)}\right]dt + B\left[W(T),T\right]\right\} \tag{2.9}$$

subject to wealth accumulation, where $\widetilde{C}$ = a real consumption. E = expectation

[21] Frankel and Dickens (1983) and Frankel and Engel (1984) list the required assumptions, such as a perfect capital market, optimisation of end-of-period expected utility, a normal distribution for underlying returns (or a quadratic utility function such as a negative exponential), a constant variance-covariance matrix of the returns over time, homogenous investors, rational expectations.

conditional on current wealth and $B[W(T),T]$ = a bequest function. By restating equation (2.9) in a stochastic dynamic programming form, first order conditions are obtained. The explicit demand functions for assets are then derived. Given continuous perfect market conditions, the equilibrium-expected excess asset returns are determined in the form of the inverted demand functions (Solnik, 1974).

The central feature of ICAPM is that asset prices are assumed to follow a 'Geometric Brownian hypothesis' or Ito's process, that is

$$\frac{dP}{P} = \pi dt + \sigma dz \qquad (2.10)$$

This states that over a short time interval, the proportionate change in the price level is explained by mean πdt and variance $\sigma^2 dz$, where dz is a stochastic part. The assumption of constant investment opportunity set, that is, π and σ are constant, implying $P(t)$ is stationary and log-normally distributed, combined with the constant relative risk aversion, lead to separability (Branson and Henderson, 1985). Merton (1969 and 1971) shows that the optimal portfolio allocation decision is independent of the saving decision in a continuous time model[22].

However, it is argued that a stationary Brownian motion for asset prices is not consistent with the dynamic of asset prices, because this implies that the prices of assets relative to each other would have the same random factor and so would all be perfectly correlated (Adler and Dumas, 1983). Merton (1973), Breeden (1979) and Cox, Ingersoll and Ross (1984) introduced non-stationary Ito's process where the parameters of π and σ in equation (2.9) would be functions of a vector of state variables such as shocks from government or weather[23]. Consumption and asset demands are then simultaneously determined as functions of state variables. In Merton's model, the expected excess returns on any assets are given by a 'multi-beta' version of the CAPM, whereas Breeden (1979) uses a single beta, 'consumption beta', i.e. the instantaneous expected excess return is proportional to its beta (or covariance) with respect to aggregate consumption. The latter

[22] Samuelson (1969) derived the model in a discrete version.
[23] Kouri (1974) and Hodrick (1981) also specified a similar integrated model.

makes the empirical test easier to the extent that the identification of aggregate consumption is less difficult than that of the market portfolio.

The integrated version may be more accurate to capture the dynamic movement of asset prices, hence the dynamic portfolio behaviour of investors under uncertainty than the separated version. There is however the difficulty of identifying the state variables for empirical application[24] and estimating the functional link between the parameters to the process and the state variables (Adler and Dumas, 1983). Although the theoretical model is attractive, these complexities may have discouraged researchers from conducting the empirical test. Unfortunately, there seems to be hardly any empirical evidence on asset demands using the ICAPM (even in the case of separated model)[25]. Furthermore, Green and Murinde (1999) point out that ICAPM diverges from the flow of funds, as its emphasis is on the regression relationships between asset returns and the aggregate consumption, rather than asset demand.

2.4 Consumer Demand Theory Approach

The final approach to portfolio modelling is based on neo-classical demand theory, in which the demand of a utility-maximising consumer depends on prices and total expenditure (Thomas, 1985). This approach reverts to Friedman's (1956) statement: the demand for money should be modelled in the same way as the demand for any goods.

One of the properties of the neoclassical demand approach is that it allows for testing of the basic axioms of utility maximisation behaviour. Whether the system of demand functions can be generated by utility maximization subject to a budget constraint depends on integrability, that is, the system of demand functions could be integrated to recover the underlying utility function (Ewis and Fisher, 1984). Testing integrability involves such theoretical restrictions as Slutsky symmetry, homogeneity, negativity (own-price effects

[24] Hodrick (1981) points out that at the aggregate level, the number of state variables is quite large.
[25] Fisher (1975) presents a theoretical prediction that the demand for each asset is positively related to its own expected nominal rate of return in the framework of a continuous time model, but this is not empirically demonstrated. Merton (1973) and Breeden (1979) illustrate how testable specifications can be generated from the model for empirical testing, though actual test is not conducted.

should be non-positive) and summability. The satisfaction of such conditions is essential for approximating the behaviour of aggregate data by demand theory. This implies that these restrictions are embedded within a maintained hypothesis, hence, unlike in the case of the pitfalls model, there is no need to assume, although it neatly allows, the testing of these restrictions (Anderson and Blundell, 1983a).

Of the greatest interest in demand functions is a flexible functional form. The survey focuses, in particular, on the Indirect Translog and the Almost Ideal Demand System (AIDS) models, and as an extension we briefly look at semi-nonparametric flexible functional forms. These flexible functional forms permit inference of consumer preferences without prior constraints about elasticities (Barnett and Lee, 1985), and distinguish themselves from other functions by allowing a greater variety of substitution patterns among financial assets[26].

2.4.1 Translog

Translog proposed originally by Christensen, Jorgenson, and Lau (1973) is to approximate the indirect utility function by functions that are quadratic in the logarithms of the ratio of prices to the value of total expenditure. The resulting utility functions have enough parameters to provide a good local second-order approximation to any utility function. This is a rigorous approach to analyse data since the translog specification is able to capture the interactive relationships between independent parameters (Evans, Green and Murinde, 2000).

Following Drake (1991), the indirect utility function V as a function of income normalised prices can be represented as in the equation (2.11),

$$\ln V = \ln V(V_1, V_2 \dots\dots\dots V_m) \tag{2.11}$$

The indirect translog utility function derived as a second-order Taylor-series expansion is

[26] The unitary elasticity of substitution of Cobb Douglas function and CES, both imply strict limitations on the behaviour of the consumer.

expressed as given by[27]

$$\ln V = \alpha_0 + \sum_{i=1}^{m} \alpha_i \ln V_i + \frac{1}{2} \sum_i \sum_j \beta_{ij} \ln V_i \ln V_j \tag{2.12}$$

Using Roy's Identity, budget share equations are generated as follows

$$S_j = \frac{\alpha_j + \sum_i \beta_{ij} \ln V_i}{\alpha_M + \sum_i \beta_{iM} \ln V_i} \tag{2.13}$$

where $\alpha_M = \sum_j \alpha_j$, $\beta_{iM} = \sum_j \beta_{ij}$

The equation (2.12) illustrates the expenditure share equations corresponding to the m asset demand equations. Since the equations for the budget shares are homogeneous of degree zero in the parameters, a normalization of $\alpha_M = -1$ is chosen. The homogeneity implies $\sum_i \beta_{ij} = 0$. Symmetry of the Slutsky matrix is given by $\beta_{ij} = \beta_{ji}$.

Empirical Studies

The indirect translog function has frequently been used in the study of financial asset substitutability in recent years. Empirical works are usually conducted utilizing the Full Information Maximum Likelihood (FIML) method with the assumption of a first-order autoregressive process. See Conrad (1980), Serletis and Robb (1986), Serletis (1991)[28] and Drake (1991). Overall empirical results are quite good. For example, Drake (1991) reports in the study on the UK data; i) the estimated equations are generally of a good fit, ii) the estimated elasticities of prices are generally highly significant and consistent with demand theory, in particular, the symmetry condition is accepted which is a rare occurrence.

The translog form appears to provide a data coherent specification, however, in the work of Ewis and Fisher (1984) it fails to satisfy the functional form restrictions. Ewis and Fisher tested the validity of the translog functional form by setting two restrictions of

[27] This is a homothetic version (i.e. unitary expenditure elasticity) of translog function (Serletis, 1991).
[28] Serletis demonstrates that the error correction model types perform better than the autoregressive or partial adjustment dynamic model.

linear homogeneity and neutrality on the US data[29], and found that they are rejected. The rejection of the functional form may be attributed to the hypothesis of homotheticity implied in the model. The insight is provided by the study of Serletis and Robb (1986): Their demand system for estimation is a quasi-homothetic version of the translog, incorporating 'subsistence level of expenditure in the model structure, thereby it allows for more complicated interdependencies among monetary assets. The integrability turns out to be more satisfactory than that of the homothetic version.

2.4.2 Almost Ideal Demand System (AIDS)

Deaton and Muellbauer (1980a) developed a more simplified flexible functional form, AIDS. AIDS is derived from duality, in which agents choose quantities so as to minimise the total cost to achieve a given level of utility, and this is equivalent to maximising utility, since the budget constraints equal the total cost (the detail is left until Chapter 4). The AIDS model approximates the cost function by functions that are quadratic in the logarithms of prices and the resulting cost function is concave, homogeneous of degree one in prices[30] and is increasing in utility, hence it is consistent with the axioms of rational choice. The cost function provides a local first-order approximation to any true demand system whether derived from the utility maximisation or not. Deaton and Muellbauer demonstrate that the AIDS has a number of advantages over Translog (and also over pitfalls models and the M-V approach for some advantages).

i) It is possible that the AIDS share equations can be modelled as linear in the parameters. Therefore, the AIDS model is far more tractable than the non-linear translog model, especially in the process of dynamic adjustment.

ii) It provides an efficient framework for imposing and directly testing restrictions in the parameters that are associated with the axioms of rational choice, while in the case of

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[29] Linear homogeneity implies $\sum_j \beta_{ij} = \sum_i \beta_{ij} = 0$ and given $\alpha_M = -1$, it also implies $\beta_{ij} = \beta_{ji}$. They included a monetary technological change as an explanatory variable and if neutrality holds, the effect on asset shares should be zero.

[30] Concave in prices means that as prices rise, cost rises no more than linearly, and homogenous of degree one in prices means that if prices double, outlay also doubles to stay on the same indifference curve.

Translog, homogeneity and symmetry conditions are independent of linear restrictions on estimated parameters and are therefore difficult to test on the Translog.

iii) AIDS is a member of the Price Independent Generalised Logarithms (PIGLOG) class of functional forms, which has a desirable aggregation property: it permits exact aggregation over consumers, and that it allows that presentation of market demands as if they were the outcome of decisions by a rational representative consumer. Besides, the PIGLOG yields long-run equilibrium in the levels of the variables. (This is relevant to the current study as a static model is considered.)

iv) It is flexible in that it allows other 'non-price sensitive' explanatory variables[31] without violating the theoretical property, for example real variables or policy variables are represented in the parameters of the cost function.

v) In order to mitigate multicollinearity, Deaton and Muellbauer suggest imposing appropriate restrictions, on a priori grounds, on parameters; these are empirically and theoretically permissible without adverse consequences for the properties of the AIDS model.

In contrast to the M-V approach in which expected utility is derived from terminal wealth, in the AIDS model, utility is assumed to depend on the expected one-period-ahead real value of all assets held, such that

$$u = u(a^{\tau}_{1t+1},\ a^{\tau}_{2t+1},..........a^{\tau}_{nt+1}) \tag{2.14}$$

Following Weale (1986), Barr and Cuthbertson (1991a) and Adam (1999), the AIDS cost function is given by

$$\ln C = \alpha_o + \sum_{1}^{n}\alpha_i \ln p_i^{\tau} + \frac{1}{2}\sum_i \sum_j \gamma_{ij}^{*} \ln p_i^{\tau} \ln p_j^{\tau} + \beta_o u \Pi (p_i^{\tau})^{\beta_i} \tag{2.15a}$$

and the budget constraint is

$$\sum_i a_{it}^{\tau} = \sum_i p_{it}^{\tau} a_{it+1}^{\tau} = W_t^{\tau} \tag{2.15b}$$

where

$a_{it+1}^{\tau} = a_{it+1} / Z_{t+1}$ = real asset holdings of the ith asset at the end of period $t+1$

[31] By 'non-price sensitive', it means that the explanatory variables are independent to AIDS prices.

Z = aggregate price level for goods

$W_t^\tau = W_t / Z_t$ = real wealth at end of period t

$p_i^\tau = \left[(1+r_i)(1-g)\right]^{-1}$

r_i = expected nominal return on asset i , between t and $t+1$

g = expected proportionate rate of goods price inflation, between t and $t+1$

$\Pi = p_1^{\tau\beta_1} p_2^{\tau\beta_2} p_3^{\tau\beta_3} ......p_n^{\tau\beta_n}$

The i'th asset share equation is solved using Shepherds's Lemma, such that

$$S_i = \alpha_i + \sum_j \gamma_{ij} \ln p_{jt}^\tau + \beta_i \ln(W^\tau / P^{*\tau}) \qquad (2.16)$$

where $S_i = a_{it} / W_t$ and $\gamma_{ij} = (\gamma_{ij}^* + \gamma_{ji}^*)/2$

$\ln P^{*\tau}$ may be interpreted as a composite real interest rate and defined by

$\ln P^{*\tau} = \alpha_0 + \sum_1^n \alpha_i \ln p_i^\tau + \sum_i \sum_j \gamma_{ij}^* \ln p_i^\tau \ln p_j^\tau$. But if $\ln p_i^\tau$ are reasonably collinear, Deaton and Muellbauer suggested a Stone index of the form $\ln P^{*\tau} = \sum S_i \ln p_{it}^\tau$. The model then becomes linear in the parameters.

The system implicitly imposes data admissibility; i) the adding up constraints imply $\sum_i \alpha_i = 1$ and $\sum_i \gamma_{ij} = \sum_i \beta_i = 0$, ii) homogeneity and symmetry require $\sum_j \gamma_{ij} = 0$ and $\gamma_{ij} = \gamma_{ji}$ respectively and iii) negativity implies that the matrix of coefficients $k_{ij} = \gamma_{ij} + \beta_i \beta_j \ln(W^\tau / P^{*\tau}) - S_i \delta_{ij} + S_i S_j$ (δ_{ij} =kronecker delta, $\delta_{ij} = 1$ if $i = j$ and $\delta_{ij} = 0$ if $i \neq j$) is negative semi-definite.

The dynamic model follows the two-step cointegration approach of Engle and Granger (1987)[32]. Long-run asset demand equations (2.16) are estimated by OLS. Assuming that all variables are integrated of order one and are cointegrated, OLS yields consistent

[32] The empirical work by Deaton and Muellbauer (1980a) on the static model (2.15) for non-durable consumer expenditure showed rejection of homogeneity and symmetry, although the AIDS is capable of explainning the commodity budget shares. They note that serial correlation in the residuals is induced when homogeneity restrictions are imposed. This suggested the need for the dynamic specification.

estimates for I(1) explanatory variables. The residuals from (n-1) share equations are then substituted in the error correction model; Barr and Cuthbertson refer this as error feedback equations (EFE)[33]. If we let the long-run AIDS model (2.16) be in vector notation $S_t^* = \Pi X_t$, then the EFE is given by,

$$\Delta S_t = \Pi\ \Delta X_t + L(S - S^*)_{t-1} + \varepsilon_t \qquad \varepsilon_t \sim IID(0, \sigma^2) \tag{2.17}$$

where X_t = q x 1 vector of independent variables

Π = n x q matrix of parameters

$(S - S^*)_{t-1} = e_{t-1}$: disequilibrium in the level of X in the previous period

L = n x $(n$-$1)$ matrix of parameters[34]

Equation (2.17) states that disequilibria in (n-1) asset shares at time t-1 influence the current period adjustment of asset shares. The 'general to specific' methodology is applied to obtain parsimonious dynamic equations while maintaining the estimates of the long-run parameters.

The advantageous feature of estimating (2.17) by the cointegration techniques may be revealed by comparing it with the unrestricted short-run model of the Autoregressive Distributed Lag (ADL)[35] type given by Weale (1986),

$$S_t = \Gamma \ln p_t + VS_{t-1} + UX_t \tag{2.18}$$

From this, the long-run model is derived as

$$S_t = (1 - V)^{-1}\Gamma \ln p_t + (1 - V)^{-1} UX_t \tag{2.19}$$

As it is clear from (2.18), the direct parameterisation of the long-run model is impossible; one cannot easily test and impose long-run restrictions of symmetry and homogeneity as these depend on the non-linear functions. Furthermore, testing down to a parsimonious dynamic representation may implicitly alter the long-run solution and the final equation may be inappropriate on a priori grounds (Barr and Cuthbertson, 1991a). With the EFE of

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[33] Barr and Cuthbertson generalise the quadratic cost of the adjustment function of Christofides (1976) for the dynamic adjustment and obtain generalized interdependent error feedback equations (EFE).

[34] Since $\sum_{1}^{n} (S_i - S_i^*)_{t-1} = 0$, only the ($n$-1) independent disequilibrium shares are required (Anderson and Blundell, 1983a).

[35] An error-correction model is a linear transformation of an ADL model (Pradhan and Subramanian, 1999).

a two-step cointegration process, one can directly estimate and impose restrictions on the long-run parameters and the long-run estimates are fixed in the specific adjustment model.

Empirical Studies

Several empirical works of the AIDS model for financial assets are shown in Table 2.2. The main works are those of Barr and Cuthbertson (B & C). As shown in the table the symmetry and homogeneity in the static model are not rejected in the study of B&C (1991a), (1991c) and (1994), while these restrictions are rejected in that of Weale. The work of B&C (1991b) links the long-run hedging demand and the short-run speculative activity for capital uncertain assets by an interdependent EFE; although it is disappointing that short-run homogeneity and symmetry are rejected, they have obtained intuitively acceptable parameter estimates and parameter stability. Other than that, in general, the AIDS dynamic model satisfies the conditions of symmetry and homogeneity. In terms of the own-price coefficients, except in the short-run study of B&C (1991c) and (1992b) and the work of Perraudin (1987), the proportion of the significant own-price coefficients is more than 50%. It seems that prices are well-determined as evidenced by almost all negative own price effects in both long- and short-run. All these empirical results support the use of the AIDS, especially with the two-step cointegration process [36].

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[36] The dynamic AIDS specification by Ray (1984) captures the effects of, not only, lagged purchases of the individual items, but also the past consumption of all the items via the lagged aggregate expenditure with an assumption of serial correlation of the errors (p.236, p.237). However, in the empirical work the tests for homogeneity and symmetry restrictions were rejected in both static and dynamic AIDS contexts.

Table 2.2 The study of financial assets using the AIDS model

Study	Sector	Period	Assets	Dynamic model	Static S & H	Dynamic S&H	Proportion of the significant own price coef. at a 5% level **	Proportion of the negative sign on the own price coef.
Weale 1986	Personal sector (UK)	1967:2-1981:3	NC, SD, BS, LAT	ADL	Rejected	Accepted	3/3 (SR)	All negative
Perraudin 1987	Non-bank private sector (UK)	1976:2-1985:4	NC+SD, TD, NS, GS, OS+NFCD, TB	--	Not imposed	--	2/5 (LR) (NS, *t*-ratio not available)	4/6 (LR)
B&C 1991a	Personal sector (UK)	1977-1986	NC, TD, SD, BS, NS	EFE	Accepted	Accepted	5/5 (LR) 2/4 (SR)	All negative
B&C 1991b	Personal sector (UK)	1977-1986	UT, CS, PSL, OS	EFE	Not imposed	Rejected	4/4 (LR) 1/2 (SR)	All negative (but one negative imposed in SR)
B&C 1991c	Company sector (UK)	1977-1986	M1, TD, PSL, FCD	EFE	Accepted	Accepted	3/4 (LR) 1/3 (SR)	All negative
B&C 1992b	OFIs (UK)	1977:4-1986:4	LQ, PSL, CS, FC, LN	EFE	--	Accepted	3/5 (LR) 1/5 (SR)	All negative
B&C 1994	Overseas sector * (UK)	1978-1986	NSD, CS, PSL, NFCD	EFE	Accepted	Accepted	2/3 (LR) -- (SR)	All negative
Adam 1999	Private sector (Kenya)	1973-1990	NC, TD+SD, GS, TK, NTK	EFE	Not imposed	Not imposed	4/5 (LR) 4/5 (SR)	4/5 (LR) 4/5 (SR)
Collins and Anderson 1998 (Non-linear)	Household sector (US)	1984:1-1993:7 (Monthly)	NC, UT, TB, SB	EFE	--	Accepted	4/4 (SR)	All negative

Data: quarterly except Collins and Anderson
B&C=Barr and Cuthbertson
-- : Not available, EFE=error feedback equations (Cointegration technique is employed), ADL= autoregressive distributed lag
S=Symmetry, H=Homogeneity, LR=long run, SR=short run

* Two-stage budgeting process is taken: the 'upper-level' decision constitutes holdings of net foreign currency deposit and the set of three sterling assets of NSD, CS and PSL, and the 'lower-level' decision, between NSD, CS and PSL. The test results are based on the lower level estimation
** When the number of price coefficients is less than the number of assets, it implies the coefficients being imposed of restrictions. In the case of Weale and Perraudin, there is no own interest rate for NC.

BS=Building society deposits
CS=Company Securities
FC=FCD and OS
FCD=Foreign Currency Deposits,
GS=Government securities
LAT=Local Authority Temporary Deposits
LN=Lending
LQ=SD, TD, BS and local authority temporary debt
NC=Notes and Coin
NFCD= Net foreign currency deposit = FCD less foreign currency loans
NS=National savings investment account
NSD= Net sterling deposits = SD + TD less Sterling loans
NTK=Non-traded capital
OS=Overseas Securities
PSL=Public sector long-term debt
SB=Saving bonds
SD=Sight deposits
TB=Treasury bills
TD=Time deposits
TK=Traded capital
UT=Unit Trust

2.4.3 Fourier and Asymptotically Ideal Models (AIM)

Drake, Fleissig and Mullineux (1997) have pointed out that the Translog and AIDS models are restrictive in that they can only approximate the data at a single point and may fail to converge to the true utility function. Whereas such flexible functional forms as the Fourier or the AIM possess global properties at the limit, implying an approximation at all points. The Fourier or AIM specification is an example of a semi-nonparametric function, that is, parametric enough to retain direct contact with economic theory but nonparametric enough to have desirable asymptotic properties: The Fourier or the AIM flexible form can be treated as the true cost function or indirect utility function in the analysis (i.e. direct contact with theory) and the number of parameters can increase with sample size (i.e. nonparametric statistical properties). In estimation, the order of the series expansion is increased until the function converges asymptotically to the true utility function. In addition, unlike ordinary flexible forms, it can be used to estimate an elasticity without a priori knowledge of functional form. The economic content of the parameter estimates is evaluated via elasticities, hence credibility of estimates depends to a considerable extent on whether or not estimated elasticity of substitution matrices are negative semi-definite. (Elbadawi, Gallant and Souza , 1983, Barnett, Fisher and Serletis, 1992 and Fleissig and Swofford, 1996)

Semi-nonparametric functions are frequently used in money or asset demand studies. For example, Fisher and Fleissig (1997) examined the liquid assets of the US monthly data utilizing the dynamic Fourier flexible form. Fleissig and Swofford (1996) find that a static AIM(2) (a second-order series expansion) with an AR(1) correction best fits the data of the US monetary assets. Drake, Fleissig and Mullineux (1997) also find that the AIM (2) with an AR(1) is the most appropriate specification for the UK financial asset data.

The semi-nonparametric function approach can provide an arbitrarily accurate asymptotic approximation of the levels and derivatives of any continuous function. Since the elasticities are functions of the derivatives, this approach provides precise estimates of the elasticities of substitution at each data point. However, in pursuit of the accuracy in estimation, the more flexible models have more parameters to be estimated, implying the need for large sample size and the functions become highly non-linear; thus there is a trade-off between size and tractability.

2.5 A Flow of Funds Model for Developing Countries

Relatively few flow of funds studies have been done for developing countries, despite the fact that it possesses a potential importance in identifying effective financial reforms and government policies for promoting economic growth. Because of its nature, the application of flow of funds models requires relatively detailed flow of funds data. Therefore, the obvious hindrance in modelling a flow of funds in developing countries is the limited or non-existent availability of data, particularly in the case of low-income developing countries in sub-Saharan Africa or South Asia. In many cases, there is neither the institutional framework nor the resources to compile systematic statistics in developing countries. For example, Honohan and Atiyas (1993) report that few of the individual country time series are long enough to carry out much worthwhile statistical analysis in the study of intersectoral financial flows in developing countries[37]. Bahra, Green and Murinde (1999) are also embarrassed by the paucity of data in studying transitional economies in Eastern Europe; in many cases, the longest available series is only the six years of 1991-1996, and the majority of this is annual. (See also Green, Murinde, Suppakitjarak and Moore (2000) in more detail, where the data problem is well documented in relation to a flow of funds model.)

Green *et al.* (2000) point out that one way to alleviate this problem is to explore the standard official sources, rather than resorting to country sources; there are the International Financial Statistics (IFS) Yearbook, the Government Finance Statistics (GFS) Yearbook, in addition, the United Nations System of National Accounts (SNA) which presents a statistical framework for flow of funds accounts. However, it also seems difficult to rely on these official sources. For such low-income developing countries, the

[37] Honohan and Atiyas (1993) quote that '....this data set spans 17 years (1970-86) for 17 countries, but of a potential total of 289 observations for that number of years and countries we have only 118 observations, though a sample of seventeen developing countries are regarded as having the best data availability!'(p.667).

statistics of IFS and GFS are disturbed with a considerable amount of missing data, or a lack of detailed data leading to large discrepancies between the current account and total financial transactions. As to the SNA, it is also unthinkable without statistical discrepancies for developing countries (Nakamura, 1998).

Alternatively Green and Murinde (1999) suggest that given a poor data set, simulation techniques without estimation may be a potential way forward. This is advocated by Brainard and Tobin (1968); a flow of funds model is specified and calibrated with guesstimated parameter values, then the simulation is exercised for policy experiments with the least data set.

There are so far two flow of funds studies conducted for developing countries using demand functions for asset choice; one for India and the other for Kenya[38].

The study for India by Sen, Roy, Krishnan and Mundlay (1996) is a rare complete flow of funds model (though it is a simple version) utilising the pitfalls model with the annual flow data published by the RBI. The portfolio choice behaviour of household and commercial banks are integrated with the real sectors of the Indian economy. The strictly controlled financial sector in India is elaborately built into the model framework. They find a weak impact of interest rates (though statistically significant) on the asset shares.

[38] There are some flow of funds models, which are specified in the context of a macroeconomic model for developing countries. Odedokun (1987) formulated a flow of funds model in order to evaluate the behaviour of a fiscal sector (treasury) and monetary sector (Central Bank) using Nigerian annual figures from 1968 to 1982. The reaction functions of public authorities are estimated to see whether the effect on target variables (prices, employment, GDP and external reserves) promotes expansionary or contractionary policies. Odedokun (1990) further studied a cross-sectional flow-of-funds model as a tool for analysing the determinants of the budgetary behaviour of Nigerian State Governments for each of the four years of the country's civilian regime, 1980-83. Green and Murinde (1998b) specified a macroeconomics model, that is explicit about the flow of funds among the various sectors of representative transition economies and suitable for policy analysis during the financial restructuring. It captures particular features in the transition economies by allowing for the co-existence of official and informal (or curb) financial markets of loans, foreign currency and goods. The model is applied by Bahra *et al.* (1999) to simulation experiments for the analysis of financial policies for Estonia and Poland. In their work, the parameters are not derived from estimation, instead the limited available time series are used to calculate elasticities for the model parameters.

As it is listed in Table 2.2, a sector study for Kenya is conducted by Adam (1999). The AIDS model is applied to a private sector, in which the asset portfolio consists of both financial and real assets. The empirical results are quite satisfactory, in particular the interest rates (or the AIDS prices) are well-determined. However, there are two shortcomings in terms of data. First, because of data limitations, the model is estimated using data for the consolidated private sector of households and enterprises. Second, data sources are inconsistent: while the data for financial assets are specifically those of private sector, the data for real assets are aggregated data.

2.6 Concluding Remarks

In this chapter, a selective survey of a system of demand functions for a flow of funds analysis has been conducted by classifying the models into three types; the pitfalls model, the M-V approach and the consumer demand theory approach.

Common to all three approaches is that each emphasises the importance of interest rates in the portfolio decision-making process. On the other hand, this is the reason why this kind of study is so difficult. In particular in the pitfalls approach, an array of collinear interest rates creates the problem of multicollinearity. Several attempts to mitigate the problem by incorporating prior information have not been fully successful. The optimal marginal adjustment model, which incorporates a flow variables in asset demand, is theoretically more plausible than the pitfalls adjustment model, yet at the expense of restricting the degrees of freedom.

The inverted model based on the M-V theory has shown the relationship between the asset shares and asset returns, but with little contribution to explaining portfolio allocation based on M-V optimization. The following limitations raise the question of the applicability of the M-V approach to a flow of funds model. First, in modelling capital-uncertain assets, in general the M-V theory (in a one-period model) is restrictive, in that portfolio choice is determined by one period ahead of expected returns, a risk aversion coefficient and the variance-covariance matrix of returns. Second, the model measures the excess returns, hence it does not provide any specific role for money in determining the interest rate structure; this role is taken over by capital-certain assets, while the capital-certain assets are viewed as being homogeneous. Although this contributes to a reduction in the number of estimated coefficients (as compared with the pitfalls model), the benefit is at the expense of severe restriction of possible substitution effects among a range of risk-free financial assets, which are the major element of a flow of funds (Barr and Cuthbertson, 1989). Third, a capital market is assumed to be always in equilibrium. Hence, a well-developed capital market is required in modelling a system of demand functions. This is far-fetched in a developing economy. Fourth, although the inverted model is a coherent approach by linking the demand function and the CAPM, albeit with the excess return being on the dependent variable and the quantity of assets being exogenous, it is probably not compatible with the financial system in developing economies, where interest rates tend to be regulated, thereby asset quantities are more likely to be determined in the market. Moreover, the inverted model is confined to a specified sector study, since the excess return is determined in the single sector, in other words, the market clearing endogenous variable is determined in a single sector without incurring a market clearing condition in a general equilibrium model. As it is reconciled, this is a divergence from flow of funds models towards more direct modelling of asset prices and returns (Green, 1993).

It seems that the demand for assets is best viewed as part of neoclassical consumer demand theory. Derivation of a demand system from consumer demand theory is likely to be more satisfactory than the heuristic approach adopted in the pitfalls model (Weale, 1986). One can define the portfolio allocation problem in terms of utility maximization subject to a budget constraint as similar to that of mean-variance analysis, however it departs from the M-V approach in that the consumer demand theory approach allows an analysis of holdings of not only capital-uncertain but also of capital-certain assets. Particularly, the AIDS model with a cointegration technique sheds light on asset choice. In applied economics, it provides a number of advantages over other types of demand function. Empirical works are theoretically and economically quite satisfactory, as evidenced in Table 2.2, which is contrasted with that of the pitfalls model and the inverted

M-V model. It is, however, argued that the neoclassical model neglects uncertainty or risk variables. Against this, Barr and Cuthbertson argue that these 'omitted risk variables' are in principle subsumed in the parameters of the cost function, hence, should any of the latter change, then this will be picked up empirically, either by a failure of homogeneity or symmetry or by parameter instability (see also Perraudin, 1987, p.755).

Developing countries tend to face the problem of obtaining adequate data for modelling a flow of funds. Although we found a complete set of flow accounts for India, it is limited to low frequency annual data, and that we model a flow of funds in a static model, which is the one in which stocks are stationary from period to period (Cohen, 1987)[39]. The AIDS model was developed for the static long-run model by Deaton and Muellbauer (1980a) who also empirically demonstrated that the static AIDS model explains the commodity budget shares. Subsequently, Barr and Cuthbertson have empirically shown that the AIDS is capable of explaining the financial asset shares satisfying homogeneity and symmetry in the *long-run*. It remains to be seen how robust the AIDS will be for a flow of funds in India.

[39] We should mention that we attempted a dynamic of error correction model. However, given a small sample size of 43 the multivariate dynamic model is overparametrised. Taylor and Clements (1983) face a similar problem.

Chapter 3 Financial System and Flow of Funds Matrix in India[1]

3.1 Development of the Financial Markets and its Monetary Policy Implications

3.1.1 Introduction

During the post-independence period until the early 1990s, the financial system in India was characterised by a heavily regulated framework such as interest rate controls, a directed credit programme and strict entry rules to the financial markets. In addition, money and capital markets were underdeveloped, and the budget deficit of the central government was automatically monetised by the Reserve Bank of India (RBI). Against this background, a macroeconomic crisis arose in the early 1990s. Due to a deficiency in the tax system and a significant proportion of unplanned expenditure in the fiscal sector, the budget deficit became persistent. Furthermore, India had to rely on foreign debt in order to fill the saving-investment gap in the face of a declining trend of external assistance flows in the 'seventies. The accelerating fiscal deficits led to a higher rate of inflation and a balance of payments crisis occurred in 1991. Since then, the government has launched a gradual financial reform programme as an integral part of its stabilization policies.

This section starts with a brief overview of the current main regulations imposed on commercial banks. Then the development of the financial markets in the pre- and post-financial reform periods will be discussed, including the government securities market, the credit market, the money market, the stock market and the foreign exchange market. The size of the transaction costs in the Indian financial sector is also briefly examined. The impact of the liberalisation in the financial sector on the conduct and effectiveness of monetary policy will then be examined. Concluding remarks summarise the major effects

[1] Notations are found in the last page of this chapter.

of the financial reforms on the real and financial sectors.

The main contribution of liberalisation and deregulation of the financial sector on a flow of funds is the increased financial intermediation and substitutability of corporate finance.

3.1.2 Main Regulations in the Banking Sector [2]

Table 3.1 presents the main regulations currently (in 2000/01) imposed on the commercial banks.

Table 3.1 Main Regulations in the Banking Sector

Regulations	
CRR (cash reserve ratio)	- Under the Reserve Bank of India Act 1934, every commercial bank has to keep certain proportion of the aggregate deposit liabilities as cash reserves with the RBI. - The ratio ranged from 3% to 15% over the period 1951-1994. Currently, it is 8.5% (RBI, 2000b).
SLR (statutory liquidity ratio)	- Banks are required to invest a certain proportion of their aggregate deposit liabilities in government securities or government approved securities (issued by public sector financial institutions) by the Banking Regulation Act, 1949. - The ratio was set at 20% until 1963. It reached its highest level of 38% in 1988 and is currently at 25 % (RBI, 2000b).
Priority Sector Lending Requirements	- When the major commercial banks were nationalised in 1969, the government stipulated bank lending to the priority sectors of agriculture, small industry and business and small transport operations. - Unlike CRR and SLR, there is no fixed proportion of their liabilities set up. However, about 40% of their resources after the reduction of CRR and SLR is forwarded to these sectors.
CRAR (capital to risk-weight assets ratio)	- Capital adequacy norms were fixed at 8% by RBI in 1992.

[2] The banking sector in general indicates here the commercial banks unless otherwise stated.

3.1.3 Government Securities Market

There has been a structural weakness in central government finance, in that revenue generation has been lower than expenditure required. This led to a significant volume of government debt during the 1980s. The RBI automatically monetised the component of the deficit which was financed by the ad-hoc issue of 91-day Treasury Bills, increasing the amount of reserve money. In order partially to neutralize the effect of deficit financing on the level of the money supply, CRR was frequently raised (it gradually reached 11% in 1988 from 6% in 1979), and also to facilitate the expanding government debt, an involuntary credit ratio by commercial banks under the provision of SLR was increased. Further, in order to keep the cost of borrowing from the market low, interest rates on government securities were suppressed: the Indian government manipulated government securities yields down by quoting the security prices below face value, besides captive market in credit allocation and the tax concession on the return of government securities supported the low level of the yields.

Fiscal reforms have taken place following the recommendation of the Chakravarty Committee 1985: the government was to finance its deficit directly from the market at market-related rates rather than through automatic monetisation by the RBI. See Table 3.2.

Although the reform started with the objectives of activating an internal debt management policy and for more effective monetary policy, it brought unintended results. The market-determined interest rates have led to an increase in interest payments, adding to the debt accumulation process during the last decade[3]. Furthermore, the market-related interest rates of the risk-free government securities attracted banks to invest in them, reducing other financial investments. It appears that the unbalanced budget position in the Central government and the corresponding policies forms vicious cycle and has adversely affected

[3] When government securities' yields were market-determined, this raised the nominal yields from around 7% or 8% in the 1980's to around 13% in the early 1990's.

the credit market in India.

Table 3.2 The Main Reforms in the Government Securities Market

1991	- The maximum coupon rate on central government securities was raised to near-market rates.
1992 - 93	- The system of selling 91-days Treasury Bills through weekly auctions was introduced. - The new instruments of 364-day Treasury Bills and Dated government securities[4] emerged at market-determined rates on an auction basis.
1994	- The automatic monetisation of the Central government budget deficit through ad hoc Treasury Bills came to an end. In 1997, the government's temporary shorfalls in finance were replaced by Way and Means Advances (WMA).[5]

3.1.4 Credit Market and Banking Sector

Credit in the banking sector was characterised as being a captive market in the sense that banks were forced to provide credits to the government sector or the government-owned financial institutions under SLR and the priority sector lending requirements. Combined with a high ratio of CRR, the usage of bank deposit resources at their own discretion was extremely restricted. For example, during the fiscal crisis in early 1990's with CRR and SLR being raised to the statutory maximum of 15% and 38.5% respectively, they had only about 45% of the resources and even out of this, 40% was allocated as loans to the priority sectors. Only the residual was allocated to the industrial sectors, despite the fact that bank financing was a prime external source of funds for the commercial sector due to a less-developed capital market.

Another disturbing feature was the structure of interest rates, which was complicated with about 50 lending categories and a large number of stipulated interest rates depending on

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[4] This is to convert maturity Treasury Bills to dated government securities when they become due, in order to fund maturing Treasury Bills.

[5] Section 17(5) of the RBI Act, 1934 provides that RBI should make advances to the state or central government repayable not later than three months from the data of advance. 'Ways and means' advances are granted at 1% below the Bank rate.

the loan size, usage and types of borrowers. There was, therefore, a significant cross-subsidy between sectors: pre-emption[6] of resources was at concessional rates of interest, on the other hand much higher lending rates were imposed on medium and large industries. In general, there were ceilings on bank lending rates and credit flows were quantitatively restricted. Because of the ceiling rate system, the cost of funds (i.e. deposit rate) was repressed.

The nature of pre-emption coupled with administered interest rates, represented financial repression in the credit market and prevented sound banking practice; i) banks were unable to satisfy the credit requirements of the productive economic sectors, ii) the restrictions on banks' use of funds affected their profitability, iii) the reduced role of the interest rate as an equilibrium mechanism led to inefficient allocation of credit. In addition, restrictions on entry norms and the dominance of PSBs (public sector banks)[7] constrained market forces in the banking sector.

The major financial sector reforms were undertaken with a view to encouraging competitive efficiency in the banking sector following the recommendation of the Narasimham Committee 1991. The major reforms involved i) the reduction of statutory pre-emption levels, ii) dismantling the complex administered interest rate structure, iii) laying down of capital adequacy requirements and iv) liberalisation of entry norms for domestic and foreign banks. See Table 3.3.

The financial sector reforms have had a significant impact on the banking sector. A general scaling down of pre-emption by lowering the level of CRR and SLR has encouraged banks to manage their asset portfolio in a more market-oriented fashion. The deregulation of lending rates contributed to the banks' profitability and so deposit rates were raised to attract investors. This also initiated interest rates as an equilibrium

[6] Pre-emption refers to policy-determined prior claims by SLR and Priority Sector Lending Requirements.

[7] The 20 nationalised commercial banks (14 in 1969 and 6 in 1980) and 8 state banks are collectively referred to as PSBs, which held 92 % of total deposits in the banking sector in the 1980's.

mechanism allocating resources in a more efficient manner in the credit market.

Along with the liberalisation, there was a movement towards a regulatory mechanism that would ensure the safety and solvency of the banking sector. In the last decade, an increased perception of risk was prevalent in the banking sector, especially after the South-East Asian and the Barings Bank crises. This was reflected in a shift of funds in favour of zero-risk investments; investments in government securities voluntarily exceeded the SLR during the 1990's, whereas the share of loans and advances in total assets showed a consistent decline over the same period. The banks' behaviour is consistent with prudent measures. By the end of March 1996, all public sector banks attained CRAR of 8 %.

Table 3.3 The Salient Reforms in the Credit Market and Banking Sector

1992	- CRAR (capital to risk-weighted assets ratio) was fixed at 8% complying with international standards[8].
1992-93	- The structure of lending rates for the commercial banks was simplified; the six categories of interest rates were reduced to four in 1992 and to three in 1993.
1994	- Banks were allowed total freedom to set their own lending rates on bank advance over Rs.2 lakhs in 1994 (1 lakh=100,000). - The interest rates on loans up to Rs.2 lakh were deregulated later in 1998 subject to small-scale borrowers being charged at not exceeding prime lending rate (PLR).
1997	- The SLR gradually decreased to 25% from its peak of 38.5% of Net Demand and Time Liabilities in 1990-92 and concessional rates were replaced by market-related rates.
1999	- The CRR gradually falls to 9.0 % from a peak of 15% in 1989-93.
1999-2000	- The Bank rate was lowered to 8.0% gradually from 12.0% in 1997 leading PLR to fall.
Other Reforms since 1991	- The interest rates on deposit and on advances of all co-operative banks[9] have been deregulated subject to a minimum lending rate of 13%. - Lending rates of OFIs (other financial institutions) were freed subject to a minimum rate of 15%. - OFIs were to comply with the CRAR; 4% in 1993 and 8% in 1996.

[8] Under the Basel Agreement, the capital adequacy is 8% of the risk-weighted assets.
[9] We will briefly discuss about co-operative banks in the next section.

3.1.5 Other Financial Markets

The main reforms in other financial markets are found in Table 3.4.

Table 3.4 The Main Reforms in Other Financial Markets

May 1989	- Call money rates were effectively freed from the regulated rate and the grant of entry was given to all participants in the bills rediscounting market as lenders, also in 1993, the OFIs are permitted to join in the call market as borrowers.
June 1989	- Certificate of Deposits (CDs) was introduced and it became a market-determined instrument in October 1993.
Jan. 1990	- Commercial Paper (CP) was introduced at freely determined discount to face value.
1992	- Beginning of relaxation of foreign exchange controls.
1992	- The CCI (controller of capital issues) which had regulatory control over all capital issues was abolished. - SEBI (Securities and Exchange Board of India) was given statutory powers for regulating the security markets. - Issuers of securities were allowed to raise capital from the market without any consent from any authority either for floating the issue or for pricing it.
Sept. 1992	- Foreign institutional investors (FIIs) were allowed unrestricted entry in terms of volumes of investment in the security market.
Dec. 1992	- Reserve Bank's Repurchase Agreements (Repos) was introduced.
March 1993	- Exchange rate transitioned from a basket-linked managed float to market based system via a transitional phase of dual exchange rate regime[10].

Money Market

Untill the late 1980's, the Indian money market was characterised by a limited number of participants, regulation of entry, limited availability of instruments and tightly regulated interest rates. The reform involved a phased decontrol and development of money

[10] During 1992-1993, the government introduced a dual exchange rate system with the official rate of exchange and the market rate of exchange.

markets with a view to the gradual integration among these markets.

The inter-bank call money market, which was the core of the money market till the late 1980s in India, was very active due to the high cash reserve requirement in India. After reforms, with the widening of the market through the participation of non-banking financial sectors and the introduction of CDs (Certificate of Deposits), scope for short-term funds in the banking sector has expanded. This was reflected in the declining trend of the commercial banks to hold excess reserves. However, the deregulation of the interest rate led the call money rate to vary in a highly volatile manner; during the South-East Asian crisis when the Reserve Bank undertook a series of tight monetary policy measures to control liquidity conditions, the average call rates reached the high level of 50 % in January 1998. The Repos were introduced so as to stabilise money market rates by influencing short-term liquidity. The Reserve Bank switched over from auction-based repos to daily fixed-rate repos in November 1997 to provide signals to money market rates and to set a floor to call rates to impart stability to short-term interest rates.

The introduction of Commercial Paper has widened the availability of short-term finance in the corporate sector, which can obtain funds at a lower cost than the cost of borrowing from banks.

Stock Market

During the pre-reform period, the stock market continued to suffer from serious deficiencies; i) the prevalence of many unhealthy practices, ii) the regulation of pricing and the high cost of issuing new shares, iii) eligibility of interest payment of debt as an item of expenses vis-à-vis dividend payment. These factors discouraged corporations from raising funds by issuing new shares and this ensured that a relatively high debt-equity ratio for Indian companies was the consequence.

In the post-reform period, issuers of securities have been allowed to raise capital from the market without any consent from any authority either for floating the issue or for pricing it.

Deregulation of the primary issues market led to a substantial decrease in the cost of raising funds in the capital market, and resulted in a significant shift in capital structure for the corporate sector; in 1992-93 the equity share constituted over 20 % of the total sources of funds from 7.8% in 1991-92 and during this time an unprecedented upsurge of activity was experienced in the stock market; the BSE (Bombay Stock Exchange) Sensex increased by 266.9%. A further step was taken to strengthen the entry norms and disclosure standards to ensure the quality of the issues in the rapidly growing market, for which SEBI (Securities and Exchange Board of India) guidelines were set up.

International Finance and Foreign Exchange Market

The experience of the external payments difficulties of the early 1990s highlighted the weakness of the debt-dominated capital account financing in India. This has brought out a policy of fully fledged liberalisation of the foreign investment regime since 1991. In particular, foreign direct investment flows have been encouraged with full repatriation benefits to foreign investors. Portfolio Investment in listed companies can be made by foreign institutional investors (FIIs) without any lock-in period for the remittance of the funds.

At the same time, a market-determined exchange rate and a relaxation of exchange controls were pursued in the post-reform period, aimed at the integration of domestic foreign exchange markets with foreign markets and more operational freedom for dealing banks. Also, significant measures have been taken in the direction of removing restrictions on imports and exports.

The evolution of the liberalisation in the foreign sector led to a considerable growth in the current and capital account transactions and has contributed to the overall balance of payments surplus since 1993-94. However, these external reforms were at the expense of a increase in domestic money supply. As is often the case in emerging markets, after the liberalisation there was a massive inflow of foreign funds into India generating excess liquidity. Against this, the RBI had to purchase foreign currency for domestic currency in order to avoid an appreciation of the exchange rate. This led to sharp increases in narrow money, consequently leading to a higher rate of inflation in the post-reform from 6 % in 1989 to 14 % in 1991 (CPI).

3.1.6 Transaction Costs

In general, in developing economies, transaction costs in the financial sector tend to be high. This is due to the under-developed financial intermediation and a relatively high risk involved in credit. Interest rate differentials between assets and deposit liabilities in the banking sector (though in an ad-hoc manner) may give an insight into the scale of these transaction costs. The mean annual interest rate differential between the government securities yields and deposit rates over the period 1951 to 1993 is 0.45%, whereas that between lending rates and deposit rates over the same period is 4.31% (the 4.31% amounts to about a third of the mean lending rates). There is a relatively large spread in the case of lending rates in comparison with the case of government securities yields. This implies that higher transaction costs are imposed on borrowers in India as compared with the case of borrowing by the government.

As to the Indian stock market, high transaction costs are imposed on issuers, but this is also the case for investors, making the net returns low even in the-post reform period. For example, against an investment of US$100,000, the Indian non-institutional investor faces charges about 66 times higher than investors in the USA (1998/99).

The factors, which contribute to high transactions costs for both issuers and investors, are considered to be:

i) The operation of an open outcry trading system on the floor of the stock exchange[11]: this tended to cause the intermittent trading of a relatively small number of stocks, and the market for most stocks is illiquid.

[11] The open-outcry was transformed into electronic trading in a 'big bang' in 1995 in India.

ii) The inefficiency in the process: the clearing system was fragile, and the settlement procedure was slow and unreliable as it was based on physical security certificates.

iii) Barriers to entry inhibiting competition, especially in the brokerage industry.

In the case of mutual funds that are popular investments for the household sector, the following specific factors contribute to the high costs.

i) In order to manage other people's funds a license (for which a fee is involved) is required from the regulatory body, SEBI (Securities and Exchange Board of India).

ii) There are a limited number of SEBI licensed portfolio managers (for example, 21 portfolio managers in 1998/99) in India, so that mutual funds face very little competition.

iii) The portfolio managers charge fees irrespective of the performance, i.e. the fees are not on a return-sharing basis.

The impact of transaction costs on heterogenous investors can be conjectured by the taxation system. In India, there is an increasing trend of indirect taxes as compared with direct taxes: the total indirect taxes as a percentage of GDP is around 7% in 1960-61, 10% in 1970-71 and 14% in 1980-81, whereas the total direct taxes as percentage of GDP is maintained at around 3% over the period (Report on Currency and Finance, 1998-99). This implies that the Indian tax system is regressive, and the tax imposed on the income derived from financial savings tends to be more in favour of the rich rather than the poor.

3.1.7 Monetary Policy in India

The RBI pursues its monetary policy using the instruments of the Bank rate, OMOs (open market operations), CRR, SLR and Selective and Direct credit control. Before the financial liberalisation, open market operations as a method of monetary control were a useless weapon, plagued by the underdeveloped securities' and money markets and administered interest rates. The effect of the Bank rate on other interest rates was also limited by regulated interest rates. Yet, the Bank rate may have influenced the level of money supply in a manner peculiar to developing economies. Due to the lack of substitutes for the short-term liquidity in the banking sector (for which re-discounting bills of exchange was a main source of short-term funds), the impact of the change in the Bank rate on the amount of credit might not have been trivial. The CRR, SLR and a selective direct control on credit were probably the main effective policy instruments. Since 1973, the RBI raised or reduced the CRR a number of times to influence the volume of cash within the commercial banking system and thus influence their volume of credit. Higher liquidity ratio, SLR, for the part of government securities[12], is to reduce banks' ability to grant loans and advances to business and industry, hence anti-inflationary. To the extent that there were few substitutes of credit, direct credit control also performed effectively during the pre-reform period. These features are probably common in other developing economies.

As a corollary to the financial reforms, the impact of the policy instruments on the financial markets has altered significantly. The liberalisation has initiated the transition from a direct monetary policy (i.e. CRR, SLR and credit control) to the use of indirect instruments (i.e. OMOs and the Bank rate) as the dominant tool of monetary policy. First, as other financial institutions and financial innovations develop, the CRR is seen as a tax on the banking system and its effectiveness is eroded as there is a loophole to avoid the CRR (Sellon and Weiner, 1997); e.g. an increase in the CRR leads banks to bid for more wholesale deposits. There is also pressure on RBI to reduce CRR to international levels and not to use it as an instrument of credit control (Datt and Sundharam, 2000). Second, the initiators of the financial reform envisaged that open market operations were to be the principal instrument of liquidity management in India. OMOs are attractive among others in that the base money is adjusted within short periods of time without incurring confusion in the financial markets and administrative problems in banks (Cargill, 1979). The evolution of the auction system of government securities at market-related interest rates is an important step. Third, the liberalisation of the administered interest rates will vitalise the role of the Bank rate. Interest rates have been emerging as instruments of resource allocation and there would potentially be an interest rate channel of monetary

[12] Remember that there are two tiers in SLR; government securities and government-approved (company) securities.

transmission. Then, it is possible that the Bank rate works as a signalling instrument of monetary policy by indicating the interest rate stance to all economic agents, as is the case in developed economies. For example, when India found itself in a severe liquidity position, the RBI reduced the Bank rate in 1999 and this prompted the banks to reduce the Prime Lending Rate.

There are however some fundamental weaknesses remaining in the effectiveness of monetary policies. First, the Indian financial market is disturbed by the existence of two markets, one organised and the other unorganised[13] with the divergence in the structure of interest rates. There are borrowers who are entirely dependent on the unorganised market, especially in rural areas of India. A uniform implementation of monetary policy is difficult in the segmented financial market (Agrawal, 1978). Second, it is a cause of inflationary pressure. To the extent that the pressure is the result of the growth in bank financing, the RBI's general controls will have a positive effect, however, if it comes from the government's deficit financing (or the shortage of goods due to supply shocks), the RBI's control has little effect. It seems that the latter has been the case in India (Datt and Sundharam, 2000). Third, the overall effect of monetary policy via credit may be weak in India due to the relatively high currency-deposit ratio: the credit creating capacity is limited. Fourth, India was often confronted with a dilemma of conflicting objectives; the need to restrict money supply, but at the same time the need to provide funds to certain sectors for the economic growth of the country. Accordingly, the conflicting policy measures of direct credit control (contractionary policy) and the reduction of lending rates (expansionary policy) were often implemented.

3.1.8 Concluding Remarks

Some noticeable impacts of financial liberalisation are summarised as follows. On the negative side financial liberalisation is exacerbating the fiscal deficit due to increased

[13] The PSBs and the Indian joint stock banks, etc. referred to as organised, have reasonable uniformity in respect of their practice, whereas indigenous banks and money lenders referred to as unorganised, practice banking business or only money lending with no uniformity.

interest rate payments as government securities' yields rise as they became market-related. This is also causing the banking sector's holdings of government debt to rise. Thus a tighter monetary policy means more holdings of government debt in relation to other assets in the banking sector. Eventually large interest rate payments and additional debt holding must be met by issues of high powered money, leading to higher inflation rates than otherwise (Sargent and Wallace, 1993). Besides, an unanticipated surge in capital inflows in the post-reform period contributed to a higher rate of inflation. From this point of view, the financial liberalisation has worsened the macroeconomic situation. In the wake of the occurrence of the large fiscal deficits in 1993-94, a recourse to money-financing of the deficit was called for (Sen and Vaidya, 1997). The positive side is observed in the financial sector: First, financial savings in the household sector have been encouraged, recording an impressive growth from 6.9% of GDP in 1988-89 to 11.1% in 1994-95 (National Account Statistics; Central Statistics Organisation). This can be attributed to the improved interest rate structure (a positive real rate of return), increased financial intermediation and development of the financial system. Second, financial liberalisation creates an environment in which sectors are able to switch from one source of funds to another relatively easily, reflecting an emergence of competitiveness in financial markets. This, coupled with the increase in the saving in the household sector, widened the investment opportunities in the industrial sector. Finally, the reforms have not encompassed a reduction in the priority sector lending requirements, hence a large contraction of credit to the vulnerable sectors has been avoided.

3.2 Flow of Funds Matrix in India

3.2.1 Introduction

The RBI has published articles covering the flows of funds since 1967 in the Reserve Bank of India Bulletin as cited by Green, Murinde, Suppakitjarak and Moore (2000). So far, there are 10 such articles covering detailed flow data sector-wise and instrument-wise from 1951-52 to 1993-94 with the financial year starting 1st April and ending 31st March. It is surprising to find that there is a comprehensive detailed presentation of flow data available in India, since such data are believed to exist only in statistically advanced countries (Ruggles, 1987).

This section investigates the published flow data, and based on the data a flow of funds matrix is constructed. This section is divided into three points. First, informal sector that is relevant to the household sector and the India-specific property of the financial intermediaries are analysed following the brief accounts of the published flow data. Second, the quality and limitation of the published data are examined. Third, a flow of funds matrix is compiled and the three representative matrices are presented with the comments.

3.2.2 Flow of Funds Accounts in India

In the original accounts of a flow of funds, the Indian economy is largely divided into six broad sectors of 1) banking, 2) other financial institutions (OFIs), 3) private corporate business (PCB), 4) government, 5) Households and 6) rest of the world (ROW). The first four sectors are further divided into sub-sectors. Throughout the period of 1951-52 and 1993-94, the government and PCB sectors were deficit sectors, whereas the household and the ROW were surplus sectors. Table 3.5 shows the sub-sectors and the composition where appropriate.

The major instruments through which financial flows have taken place in India are: Currency, Deposits, Government securities, Company securities, Loans and Advances, Insurance and Provident funds and Foreign assets.

Table 3.5 Six disaggregated economic sectors in the published flow account in India

Sectors	Sub-sectors	Composition
Banking	-RBI -Commercial banks -Co-operative banks and credit societies	
OFIs	-Financial corporations and companies -Insurance sector -Non-government provident funds	-Term lending institutions (e.g. IDBI and ICICI) -Investment institutions (e.g. mutual funds, provident funds)
PCB	-Private non-financial companies -Co-operative non-credit societies[14]	-All non-government public and private limited companies -Branches of foreign companies
Government	-Central government -State government -Local authorities -Government non-departmental commercial undertakings[15]	
Household	No sub-sectors	-All individuals -Non-government, non-corporate enterprises of farm and non-farm business -Non-profit institutions
ROW	No sub-sectors	-Residents outside India -Governments of foreign countries -International organisations (e.g. IMF)

IDBI=Industrial Development Bank of India, ICICI=Industrial Credit and Investment Corporation of India

3.2.3 Informal sector

India is said to be a dualistic economy with a formal, modern sector existing side by side with a lower productivity informal sector (Datt and Sundharam 2000). There is tremendous heterogeneity in what falls in this informal sector. It is argued that the informal sector can embrace a whole range of economic activities that lack legal status;

[14] Co-operative non-credit societies have been developed as an integral part of a co-operative movement. The main purpose is to promote returns to the producers and raise their economic conditions. Most of the societies function at national, state, central and primary levels. The first three societies (apex societies) have financial transactions to a large extent among themselves, hence the magnitude of a flow of funds of this sub-sector against other sectors is small. In general, the operations of co-operative non-credit societies are similar to those of non-financial companies, so that they are categorised in the PCB sector.

[15] Non-departmental commercial undertakings consist of limited companies in which the government's share participation is 51% or more (RBI, 1967).

some of these activities may be unorganised and irregular, some survivalist, and some even criminal (Dasgupta 2003, p52). In the current study, the informal sector may be linked with the priority sectors in the household sector, as these sectors embrace farmers, the self-employed and small businesses, which feature in the informal sector [16].

The share of the formal and informal sectors in total employment have remained constant at 10% and 90% respectively. For example, in 1995, the formal sector accounts for only 27.53million workers, whereas the rest of the 312 million workers are engaged in agriculture as wage labourers, or self-employed in the informal sector (Datt and Sundharam, 2000). The majority is in agriculture; for example, about 82% of the workforce was engaged in agriculture in 1972-73, and its share has come down to about 74% in 1987-88.

The available data by the Central Statistical Organisation reveal the share of the agricultural sector in total GDP in 1950-51 at 55.4%, in 1970-71, 44.5% and 1990-91, 30.9%. Although, there is a tendency to fall over the period, agriculture contributes a major share of the national income of India.

Other than agriculture, the informal sector comprises mainly self-employed in manufacturing, construction, small transport and services, in which, due to the lack of capital, skill and technology, most of the employment continues to be low level. Dasgupta (2003) argues that in India, urban informal employment as a proportion of total employment is estimated to be 44.2 per sent. In particular, the informal services, such as the petty traders, street vendors, barbers are said to be the biggest employment generator in the urban India (Dasgupta, 2003 and Todaro, 1997).

While the informal sector exerts a significant impact in terms of employment and GDP, it has a disadvantage in terms of obtaining loans. The organised credit institutions were

[16] The discussion concentrating on the urban informal sector comprising a large number of small-scale production and service activities is beyond scope of this thesis.

extremely rigid in their requirement for security and margins were too high for the majority of small borrowers. The indigenous banks (including moneylenders), which are organised in the form of family or individual businesses, therefore play a dominant role in providing loans to the informal sector. Recently (exact date not known), they were estimated to meet at least 90% of the financial requirements of the informal sector, though the rates of interest charged by the indigenous bankers were very high.

There is a need to strengthen the availability of resource in this sector in order to improve the formation of capital, technology and skill, so that productive employment yields a higher level of income. It also has an important implication in mitigating the problems of poverty in India.

3.2.4 Financial Institutions in India

The major commercial banks were nationalised in 1969. This was to promote the banking facilities available in remote areas and provide credit under the provision of 'priority sector lending requirements' as discussed in Section 3.1. This led to quite appreciable progress not only in the expansion of rural branches, but also in diverting an increasing share of bank funds to such sectors as agriculture and small scale industries (Agrawal, 1978 and Sen, Roy, Krishnan and Mundlay, 1996). However, despite these developments, regional imbalances have been large and persistent as the bank service has tended to concentrate on prosperous regions. The inadequacy of the banking facilities in the backward areas makes the role of co-operative banks and credit societies distinct from that of commercial banks.

Co-operative banks and credit Societies were set up by the co-operative movement of India with the objective of promoting thrift and saving by farmers and offering credit to them at low rates of interest. In India, the agricultural sector, though accounting for a significant proportion of the national product, has had difficulty in obtaining adequate support from institutional finance. Traditionally, the bulk of their credit needs have been met by money lenders, who it is often argued, can exploit their monopoly position as the provider of credit. Co-operative banks and credit societies are, therefore, of special relevance to India as financial institutions for economic development of the disadvantaged (Datt and Sundharam, 2000) with implications for taking over the activities hitherto carried out by money lenders.

OFIs cover all non-banking financial institutions. Peculiar to India is that the majority of the institutions are government-owned. They are functionally divided into two types; term lending institutions and investment institutions. The former have some resemblance in their functions to commercial banks.

Among the term lending institutions, the largest in size and influence are IDBI (Industrial Development Bank of India) and ICICI (Industrial Credit and Investment Corporation of India)[17]. They not only subscribe to the equity of firms, but also supply direct term-loans to firms in the same way as commercial banks. The main financial sources of the term lending institutions have been obtained by issuing government-approved securities (i.e. bonds, shares and debentures), against which commercial banks involuntarily provide funds under the provision of SLR. These funds are then directed mainly toward the PCB sector. In a deregulated financial environment, these subsidised and captive sources have contracted and the government's support has declined, implying that they have to raise resources directly from the market. This suggests that the distinction between commercial banks and term lending institutions is further blurred in that they have to compete with each other to obtain funds, whereby sharing the role of interest rate determination and regulatory requirements (Sen and Vaidya, 1997).

The investment institutions, which include Mutual funds, Unit Trust of India (UTI), life insurance companies (LIC) and non-government provident funds, obtain funds in the main from the household sector. After the deregulation of the capital market, the growth of mutual funds and UTI were prominent. LIC and non-government provident funds hold a

[17] ICIC is privately owned.

significant share in the total source of funds in the OFI sector. In India, there are substantial compulsory insurance schemes, under which the insurance and provident funds are used as a captive market for the government as such; i) the main uses of LIC's investable resources are government securities and loans and advances (each approximately sharing the total flows), ii) the contributions of the provident funds are invested predominantly in the form of government securities (around 80% of the total funds as per the government's guidelines), small savings[18] and bank deposits (RBI, 1967, p.268).

3.2.5 Qualification and Limitation of the Published Flow Data

An example of the published flow accounts in India is shown in Appendicies 3.1 and 3.2; those of commercial banks as a sub-sector of the banking sector, in which sources (Appendix 3.1) and uses (Appendix 3.2) are recorded for the period between 1990-91 and 1993-94.

In general, the data sources for government, banking and OFIs sectors are based on the balance sheets of their own accounts, though the sectoral break-down of the flow data is not necessarily obtained from their own accounts. The break-down for a financial instrument is usually obtained through ownership surveys, but in the absence of such surveys, it is estimated based on the accounts of the investing sectors or the borrowing sectors (RBI, 1988). Sometimes, flow data themselves are derived from adding the sectoral break-down data, as is the case for bonds in the government non-departmental companies, which are not shown in their consolidated balance sheet, so the amount of borrowing through bonds has to be collected from the accounts of other sectors. In the earlier years, due to the data deficiency in many respects, crude assumptions were taken such as, 'paid-up capital' in commercial banks which were assumed to be held only by the household sector (RBI, 1967).

[18] Small savings comprise mainly post office saving deposits and national saving certificates.

The construction of the PCB sector requires much collaboration in its compilation. First, the assembly of basic financial data for PCB does not exist, therefore, the flow-of-funds accounts of PCB are based on the blown-up data of the sample companies, in other words, the data that are collected from the sample companies are adjusted for populations of the companies using the total paid-up capital of these companies (RBI, 1988). Second, sectoral break-down of any items like 'paid-up capital' and 'debentures' are not available, and so they are derived by using the information reported by the asset holding sectors. Third, the accounting year is not uniform for all the companies; studies cover all companies, which close their accounts on any date during the period from 1st April to 31st March.

The accounts for the household sector are derived from other sectors either as residual by netting the accounts of other sectors, or by using the benchmark ratios of the various surveys of financial instruments (RBI, 1988). The accounts of ROW are based on the balance of payments, published by the RBI in the form of credits or debits, that are constructed from the stand-point of India, hence for a flow of funds account, they are converted into the ROW.

Over the period, since the first publication of the flow data, the methodology has undergone several revisions as the financial system develops and the availability of data improves. All the same, the flow of funds accounts in India are subject to a number of limitations as the construction requires diversified sources of data that accounting identities would not normally hold. The main drawbacks in the flow data in India are as follows.

i) Non-reporting and under-coverage: some entries reported as sources are not reported as the uses or vice versa. For example, the survey on local authorities was discontinued after 1968-69, so it is in the flow accounts as well, but other sectors may report their transactions with local authorities, a discrepancy would then arise for the instrument in question, leading to statistical discrepancies (RBI, 1980). Another example is in the PCB sector that in the earlier period between 1951-52 and 1954-55, the available data is only that of public limited companies, hence the data for private limited companies and foreign companies are assumed to be zero. Dawson asserts that this is the main reason for inconsistency (Dawson 1991a).

ii) Lack of proper identification in linking the sectors issuing claims with the sectors holding these claims (RBI, 1980): hence the origin/destination of sectors involved in a given transaction cannot necessarily match.

iii) Lack of uniform classification of various instruments by the issuing sectors and the holding sectors: for example, in India IMF loans to government are seen as loans in the ROW accounts, however, as deposits in RBI accounts.

iv) Differences in timing of recording the entries: accounting periods of all sectors do not correspond over the same period. The financial year for RBI, commercial banks, Government and ROW runs from April to March and in respect of co-operative banks and credit societies and UTI, from July to June. In the case of the insurance sector, a calendar year (end of December) is used (RBI, 1967). In particular, the balance sheets of different PCBs are drawn at different points of time, so that when all the balance sheet data are pooled together for compilation, the matching of the total sources and uses in instruments is impossible (RBI, 1988).

v) Valuation differences: in principle, revaluations are not considered as transactions in the flow of funds accounts, nonetheless, discrepancies in the valuation of financial assets arise between sectors. In the case of 'paid-up capital' in the PCB sector, the issuer of the claim records it at face value, meanwhile, the holder of the claim records it at the cost of acquisition (market value) (RBI, 1980). In estimating the holdings of government securities, the surveys of ownership of government debt show the face-value, whereas the holding sector's accounts pertain to book values.

vi) The information sources change over time.

Consequently, the consolidated form, which is derived from putting together all the individual sector accounts is plagued with large statistical discrepancies. See the example of the financial year 1993-94 in Appendix 3.3, which records a discrepancy of Rupees

(Rs.) -28,504 crore in total; 1 crore = 100 lakh = 10,000,000.

3.2.6 Construction of a Flow of Funds Matrix

In the wake of such large inconsistencies and discrepancies in the flow accounts, a relatively aggregated approach (i.e. by the sector), rather than a specific manner (i.e. not by the sub-sector) is taken place in constructing a flow of funds matrix, except for the banking sector. The banking sector is decomposed by sub-sector: RBI, commercial banks and the cooperative banks and credit societies. It is obvious that RBI is functionally different from commercial banks. The commercial banks also distinguish themselves from the cooperative banks and credit societies due to a large difference in financial regulatory framework; besides, it would be particularly valuable to be able to trace how funds are provided in rural or agricultural sectors through these institutions (Green *et al.*, 2000). Sectors are then disaggregated into eight of 1) government, 2) RBI, 3) commercial banks, 4) co-operative banks and credit societies, 5) OFIs, 6) PCB, 7) household and 8) ROW.

The main financial instruments are disaggregated into nine. See Table 3.6. High-powered money is disaggregated into 'currency' and 'bank reserves', since each has different sensitivity from policy instruments, e.g. the Bank rate as a tool of monetary policy is likely to exert more impact on bank reserves affecting credit flows in India. The government issues securities, small savings and deposits in order to finance the deficit and they are all classified as 'long-term government debt'. In the case of PCB, not only equities and debentures, but also fixed deposits are classified into 'company securities' as they are capital market instruments (RBI, 1991). Sector-oriented instruments such as provident, life and pension funds, are separately classified as 'provident funds' (Dawson, 1991b).

Next, the method of entering the data in the matrix is explained. In order to show the inter-sectoral relationship in a flow of funds system, flows originating in one sector must be consistent with flows recorded in the counter-sector (International Monetary Fund Institute, 1981). This is consistent with the specific instruments of 'bank reserves', 'Treasury Bills' and 'provident funds', but other broadly classified instruments need careful attention. In the case of 'currency' and 'deposits' all flow data and the sectoral break-downs are collected from the issuing sectors, and, in the case of 'loans and advances', from lending sectors. These data are entered in the flow of funds matrix. With respect to 'government debt' and 'company securities', the government deficit financing in the government sector and the capital financing in each sector as sources of funds are considered as data sources, since an investment category as uses of funds does not tell us the type of investment: whether 'paid-up capital', 'bonds' or 'debentures'.

Table 3.6 Financial Instruments for a Flow of Funds Matrix

Instruments	Composition
Currency	Notes issued by RBI, Coins and one rupee notes issued by government
Deposits	Deposits (demand and time) of RBI, commercial banks, co-operative banks and credit societies and OFIs [19]
Bank reserves	Balance with the RBI in commercial banks
Long-term government debt	Government securities, Government deposits, Small savings
Short-term government debt	Treasury bills
Company securities	Paid-up capital, Bonds and debentures, Unit Trust capital, Fixed deposits of PCB
Loans and advances	All sectors' loans and advances
Provident funds	Non-government provident, life and pension funds, Government provident funds
Foreign assets	Securities of foreign countries, Cash balances and fixed deposit with foreign banking sector, etc

With this methodology, for example, in the case of commercial banks, the total flow and break-down data of 'Paid-up capital' (as company securities) and 'Deposits' (as bank deposit) in sources in Appendix 3.1 and 'Balance with RBI' (as bank reserves) and 'Bank credit' (as loans) in uses in Appendix 3.2 enter in the compiled matrix.

[19] The deposits with the OFIs are those received under the Companies deposit scheme, 1976 of IDBI.

The advantages of our methodology are that first, statistical discrepancy is avoided (though the problem of unidentified sectors remains), and second, the financial flow data are mainly picked up from the statements of government, banking and OFIs sectors, whereas data collection from PCB, household and ROW sectors is minimized or avoided. This is consistent with the assertion that the domestic and international reporting requirements on government and banking sectors generate better quality of data than other sectors (Green *et al.* 2000).

3.2.7 Comments on the Flow of Funds Matrix

Table 3.7a is the matrix of 1967-68 (1967 hereafter): this is before the nationalisation in the commercial banks in 1969. Table 3.7b is for 1989-90 (1989 hereafter) depicting the pre-financial liberalisation, and Table 3.7c is for 1993-94 (1993 hereafter) the post financial-liberalisation. These tables show the sources and uses for each sector for a financial instrument. The high-lighted cells indicated the origin of the data base[20]. Tables 3.8a, 3.8b and 3.8c show the net transactions respectively.

By comparing 1967 with 1989 and 1993, the effect of the nationalisation of the commercial banks and the credit rationing can be examined, while with 1967 and 1989 *versus* 1993, the effect of the financial reforms. However, it needs to be noted that the numerical magnitude of 1967 is so different from 1989 and 1993. Also since we only picked up a representative year from the different regimes, this may involve some bias. This caveat needs to be borne in mind.

We start with the salient features drawn from the *net transactions* flow of funds matrix. See Tables 3.8a, 3.8b and 3.8c.

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[20] For example, the currency data of 13903 (line 2 of RBI) in Table 3.7c and the sectoral break-down are collected from the RBI statement, such that the data of uses in counter-sectors are ignored.

a) In general, it is particularly disconcerting that unidentified accounts in loans and advances are so large; they are attributed to the unidentified sector in the loans from the government and PCB sectors, due to a lack of break-down data (this is shown in sources and uses matrix in line 15 and 20 in Tables 3.7a, 3.7b and 3.7c).
b) Sector surplus/deficit in the last line of the table indicates that for all three time periods the government and PCB sectors are deficit sectors with a negative sign, whereas the household and ROW sectors are surplus sectors with a positive sign. 1989 and 1993 reveal the substantial increase in the flow of funds over the four years in the PCB and household sectors. The effect of the financial liberalisation seems to be apparent.
c) The sector surplus/deficit line also reveals that in 1989 and 1993, the household sector plays a major role in financing the government and PCB sectors, whereas in 1967 the role is shared with the ROW sector. It illustrates the dependence on the foreign sector for funds in the earlier years in India.
d) In the line of Foreign Assets, there is little outflow in 1967 and 1989, though in 1993 there is some (Rs. 8,358 crore) from the RBI. It can be said that strict exchange controls restricted the holding of foreign assets in the pre-reform period.
e) The comparison of 1989 and 1993 reveals that the dependence of the government on the RBI for funds was drastically curtailed in the post-reform period. The total of long- and short-term government debt falls from Rs. 14,122 crore in 1989 to Rs. 1,712 crore in 1993.

The *sources and uses* flow of funds matrix permits us to analyse the movement of funds in more specific manner than that in the net transactions flow of funds matrix. See Tables 3.7a, 3.7b and 3.7c.

a) The effect of the Priority Sector Lending Requirements stipulated in 1969 is featured in the bank credit to the household sector (line 17). In 1967, in the main the bank credit (Rs. 338.2 crore) is forwarded to the PCB sector (Rs. 238.8 crore) and rarely to the household sector (Rs. 15.3 crore). This situation reverses in 1989 and 1993, in which approximately 46-47 % of bank credit flows to the household sector. This reflects the increased credit toward the priority sectors from 1969 onwards. At the same time, a similar pattern in the pre-reform (1989) and post-reform (1993) indicates that the deregulation programme in the post-reform period did not affect the bank credit towards the vulnerable sectors.

b) In comparing 1989 and 1993, there is a remarkable increase in the volume of deposits in commercial banks and OFIs from the household sector, from Rs. 16,347 crore in commercial banks and Rs. 1,537 crore in OFIs in 1989, to Rs. 30,712 crore and Rs. 9,276 crore respectively in 1993 (line 4 and 6). This is perhaps due to the improvement in the real interest rate or the financial intermediation after liberalisation.

c) However, the substantial proportion of the increase in deposits in commercial banks is absorbed by long- and short-term government debt, reaching Rs. 29,551 crore in 1993 from Rs. 6,143 crore in 1989 (total figures in line 8 and 9). It seems that the market-related government securities' yields and the prudential measures of the post-liberalisation period have contributed to this (RBI, 1995).

d) While government debt soars in uses of the commercial banks in the post-reform, it emerges that the proportion of loans and advances in the total uses falls from 50.5 per cent in 1989 to 27.3 per cent in 1993 (line 17).

e) The sources and uses flow of funds matrix provide insight into competitiveness amongst financial institutions. The ratio of bank credit to OFIs' credit towards the PCB sector has been drastically reduced: 4.21 in 1967, 1.14 in 1989 and 0.37 in 1993 (calculated based on figures in line 17 and 19). The ratio of bank deposits to OFIs' deposits as sources has also declined: 11.96 in 1989 and 4.02 in 1993[21] (based on figures in line 4 and 6). The ratio of banks' obtaining funds through the capital market to that of OFI's has increased in the post-reform period: 0.03 in 1967, 0.04 in 1989 and 0.54 in 1993 (based on figures in line 11 and 13). It is interesting to discover that the distinction between banks and OFIs is blurred, in particular the role of banks as major lending institutions to the PCB sector may be losing their prime position to the OFIs.

f) Loans and advances have remained the main sources for filling the resource gap in the

[21] The OFI's deposit as sources in 1967 is zero; in the earlier period there are little deposit liabilities in this sector.

PCB sector, yet the proportion of company securities in sources (line 14) to the sector's total sources has been rising: 17.29 % in 1967, 33.68 % in 1989 and 35.48 % in 1993. In particular, in comparing 1989 and 1993 the PCB witnesses more than a three-fold increase in company securities as a source of funds. The increased issue of new shares in this sector reflects the effect of loosening the tight controls in the stock market.

g) The sharp increase in the total financial inflows from abroad from Rs. 1,515 crore in 1989 to Rs. 14,248 crore in 1993 (line 21), probably owing to the liberalisation in the foreign sector, helped to finance the deficit sectors, in particular, the government sector.

3.2.8 Conclusion

The broad pattern of the compiled flow of funds appears to reflect the financial system in India described in Section 3.1. In particular, the compiled flow of funds seems to reflect the regulated financial sector in 1967 and 1989 and the de-regulated financial sector in 1993. This study proves that a detailed presentation of a flow of funds is able to provide quantitatively a greater insight into how the nation's financial sector functions across sectors over the period in question.

Table 3.7a Flow of Funds Matrix 1967 (1967-1968) (Rs. crore=10 million rupees)

		Government		RBI		Commbercial Bank		Cooperative banks & Credit Societies		OFIs		PCB		Household		ROW		Unident -ified	Total
		S	U	S	U	S	U	S	U	S	U	S	U	S	U	S	U		
1	Currency	5.5			0.9		-0.1		0.1		0.1		0.3		4.2			0.0	0
2			9.6	179.3			2		2.5		1.2		5.1		158.9			0.0	0
3	Deposits		-10.9	67.8					0.8		1.1						58.4	18.4	0
4			31.6			430.1			-4.9		55.7		5.5		336.4		5.8	0.0	0
5								68.2					5.7		62.5			0.0	0
6										0								0.0	0
7	Reserves			3.7			3.7											0.0	0
8	LT Gov't Debt	402			66.1		69.6		8.9		149.7		-0.4		101.8		6.3	0.0	0
9	ST Gov't Debt	118			85.1		25.1				-5.7						16.1	-2.6	0
10	Comp. Sec.	0																0.0	0
11						0.5					0.5							0.0	0
12			31.4		4.6		20.6	101.1			14.1		0.5		29.9			0.0	0
13			1.4				2.3		0.5	19.4			0.1		15.1			0.0	0
14			7.7				3.3		5.4		35	78.9			11.9		15.6	0.0	0
15	Loans & Adv.		245.3							34		20.2		85.2		20.3		-77.2	0
16		39			30.2	-38.9		26.1		4								0.0	0
17		88.2					338.2	-6.6		2.5		238.8		15.3				0.0	0
18									195.2			41.4		153.8				0.0	0
19		38.8				-4.4					127.6	67.4		27.8		-2		0.0	0
20													9.2	9.2				0.0	0
21		618.8		0		0		0		5.4		9.6					633.8	0.0	0
22	Prov. Funds	116.7													116.7			0.0	0
23			4.6							305.5			8		295.2		-2.3	0.0	0
24	Foreign Assets		0		0.8		0		0		-1.4		0			-0.6		0.0	0
	Total	1427	320.7	250.8	187.7	387.3	464.7	197.2	208.5	370.8	377.9	456.3	34	291.3	1132.6	17.7	733.7	-61.4	0
	Sector Surpluc/Deficit		-1106.3		-63.1		77.4		11.3		7.1		-422.3		841.3		716	-61.4	0

LT=long term, ST= short terms

High-lighted cell: Origin of flow data and break-up

Sources: Flow data in the RBI Bulletin

Table 3.7b Flow of Funds Matrix 1989 (1989-1990) (Rs. crore=10 million rupees)

		Government		RBI		Commbercial Bank		Cooperative banks & Credit Societies		OFIs		PCB		Household		ROW		Unident -ified	Total
		S	U	S	U	S	U	S	U	S	U	S	U	S	U	S	U		
1	Currency	56					-29				5		2		78			0	0
2			-77	8062			147		62		182		171		7577			0	0
3	Deposits		-459	-491			0		18		-88						79	-41	0
4			3582			26820			548		710		1975		16347		3658	0	0
5			121					1466					137		1208			0	0
6			12				357			2242			298		1537			38	0
7	Reserves			6541			6541											0	0
8	LT Gov't Debt	26,518			3000		6006		470		10817				7263			-1038	0
9	ST Gov't Debt	11136			11122		137										-123	0	0
10	Comp. Sec.	3514					626				368				339		-29	2210	0
11			96			356												260	0
12			44				28	457			316		20		49			0	0
13			562		-19		2211		165	9296			2769		3184		602	-178	0
14			236				312				3383	6172			2178		63	0	0
15	Loans & Adv.		6006			0		57		503		740		732		635		-3339	0
16		341			1494	-112		11		1244		4		5				-1	0
17		3456					16739	8		25		5362		7888				0	0
18									2426			499		1927				0	0
19		2148				2322		539			10990	4707		1029		162		-83	0
20													4019	302				-3717	0
21		-99				59		0		711		844					1515	0	0
22	Prov. Funds	4157													4157			0	0
23			34							9889			67		9763		25	0	0
24	Foreign Assets		0		-217		13		0		-1		-7			-212		0	0
	Total	51227	10157	14112	15380	29445	33088	2538	3689	23910	26682	18328	9451	11883	53680	585	5790	-5889	0
	Sector Surpluc/Deficit		-41070		1268		3643		1151		2772		-8877		41797		5205	-5889	0

LT=long term, ST= short terms

High-lighted cell: Origin of flow data and break-up

Sources: Flow data in the RBI Bulletin

Table 3.7c Flow of Funds Matrix 1993 (1993-1994) (Rs. crore=10 million rupees)

		Government		RBI		Commbercial Bank		Cooperative banks & Credit Societies		OFIs		PCB		Household		ROW		Unident -ified	Total
		S	U	S	U	S	U	S	U	S	U	S	U	S	U	S	U		
1	Currency	89					-35				-3		-16		143			0	0
2			297	13903			-453		626		-59		267		13225			0	0
3	Deposits		-378	2319					541		101						1682	373	0
4			8772			45780			-1260		304		4123		30712		3129	0	0
5			191					5963					98		5674			0	0
6							420			11380			1723		9276			-39	0
7	Reserves			16116			16116											0	0
8	LT Gov't Debt	49365			-5332		28558		420		14898				6626			4195	0
9	ST Gov't Debt	8402			7044		993				150						215	0	0
10	Comp. Sec.	4739					1387				318				672		8	2354	0
11			6454		707	8131									820			150	0
12			726				87	2363			1398		69		28			55	0
13			547		80		1074		197	15145			3603		9056		319	269	0
14			373				1602				8893	18154			6037		1249	0	0
15	Loans & Adv.		1584			0		-40		1371		1096		710		-216		1337	0
16		-22			-4825	-4259		-125		-432		2		11				0	0
17		3450					18715	6		28		6468		8763				0	0
18									12798			3883		3198				-5717	0
19		1827				199		-52			22638	17243		1630		183		-1608	0
20													10938	-8				-10946	0
21		8417		618		-243				1132		4324					14248	0	0
22	Prov. Funds	8305													8305			0	0
23			56							19692			111		19491		34	0	0
24	Foreign Assets		-230		8358		-6				-203		53			7972		0	0
	Total	84572	18392	32956	6032	49608	68458	8115	13322	48316	48435	51170	20969	14304	110065	7939	20884	-9577	0
	Sector Surpluc/Deficit		-66180		-26924		18850		5207		119		-30201		95761		12945	-9577	0

LT=long term, ST= short terms

High-lighted cell: Origin of flow data and break-up

Sources: Flow data in the RBI Bulletin

Table 3.8 Flow of Funds Matrix in net transactions (Rs. crore=10 million rupees)

a) 1967 (1967-1968)

	Gov't	RBI	Com. Bk	Coop. Bk	OFIs	PCB	House	ROW	Unidenti -fied	Total
Currency	4.1	-178.4	1.9	2.6	1.3	5.4	163.1	0	0.0	0
Deposit	20.7	-67.8	-430.1	-72.3	56.8	11.2	398.9	64.2	18.4	0
Reserves		-3.7	3.7						0.0	0
LT Gov't Dt	-402	66.1	69.6	8.9	149.7	-0.4	101.8	6.3	0.0	0
ST Gov't Dt	-118	85.1	25.1	0	-5.7	0	0	16.1	-2.6	0
Comp.Sec.	40.5	4.6	25.7	-95.2	30.2	-78.3	56.9	15.6	0.0	0
Loans & Adv.	-539.5	30.2	381.5	167.3	81.7	-368.2	-291.3	615.5	-77.2	0
Prov. Funds	-112.1				-305.5	8	411.9	-2.3	0.0	0
Foreign Asset	0	0.8	0	0	-1.4	0	0	0.6	0.0	0
Sector surplus/deficit	-1106.3	-63.1	77.4	11.3	7.1	-422.3	841.3	716	-61.4	0

b) 1989 (1989-1990)

	Gov't	RBI	Com. Bk	Coop. Bk	OFIs	PCB	House	ROW	Unidenti -fied	Total
Currency	-133	-8062	118	62	187	173	7655	0	0	0
Deposit	3256	491	-26463	-900	-1620	2410	19092	3737	3	0
Reserves		-6541	6541						0	0
LT Gov't Dt	-26518	3000	6006	470	10817	0	7263	0	-1038	0
ST Gov't Dt	-11136	11122	137	0	0	0	0	-123	0	0
Comp.Sec.	-2576	-19	2821	-292	-5229	-3383	5750	636	2292	0
Loans & Adv.	160	1494	14470	1811	8507	-8137	-11883	718	-7140	0
Prov. Funds	-4123				-9889	67	13920	25	0	0
Foreign Asset	0	-217	13	0	-1	-7	0	212	0	0
Sector surplus/deficit	-41070	1268	3643	1151	2772	-8877	41797	5205	-5889	0

c) 1993 (1993-1994)

	Gov't	RBI	Com. Bk	Coop. Bk	OFIs	PCB	House	ROW	Unidenti -fied	Total
Currency	208	-13903	-488	626	-62	251	13368	0	0	0
Deposit	8585	-2319	-45360	-6682	-10975	5944	45662	4811	334	0
Reserves		-16116	16116						0	0
LT Gov't Dt	-49365	-5332	28558	420	14898	0	6626	0	4195	0
ST Gov't Dt	-8402	7044	993	0	150	0	0	215	0	0
Comp.Sec.	3361	787	-3981	-2166	-4536	-14482	16613	1576	2828	0
Loans & Adv.	-12088	-5443	23018	13009	20539	-22078	-14304	14281	-16934	0
Prov. Funds	-8249				-19692	111	27796	34	0	0
Foreign Asset	-230	8358	-6	0	-203	53	0	-7972	0	0
Sector surplus/deficit	-66180	-26924	18850	5207	119	-30201	95761	12945	-9577	0

LT=long term, ST=short term, Coop Bk=Co-operative banks and credit societies
Sources: Flow data in the RBI Bulletin

Appendix 3.1

STATEMENT 1.2 : COMMERCIAL BANKS (reproduced) (Rs. Crore)

Reserve Bank of India Bulletin *January 1998*

Sources	1990-91	1991-92	1992-93@	1993-94@
1. Paid-Up Capital	**1,229**	**912**	**680**	**8,131**
a) Banking	128	0	0	707
i) Reserve Bank of India	128	0	0	707
b) Other Financial Institutions	0	0	0	0
i) Insurance	0	0	0	0
c) Government	1,371	846	628	6,454
i) Central Government	1,369	846	625	6,452
ii) State Governments	2	0	3	2
d) Households	0	0	0	820
e) Others	-270	66	52	150
2. Deposits	**30,523**	**38,227**	**37,825**	**45,780**
a) Banking	518	-1087	1,254	-1,260
i) Co-operatives	518	-1087	1,294	-1,260
b) Other Financial Institutions	1,544	789	3,964	304
i) Financial Corporations	1,359	780	3,861	-235
ii) Insurance	296	82	93	251
iii) Provident Fund	-111	-73	10	288
c) Private Corporate Business	-502	8,438	-3,753	4,123
i) Companies	-524	8,599	-4,786	3,830
ii) Non-Credit Societies	22	-161	1,033	293
d) Government	2,649	-1,267	583	8,772
i) Central & State Governments	845	109	-247	1,902
ii) Local Authorities	636	-62	114	3,385
iii) Commercial Undertakings	1,168	-1,314	716	3,485
e) Rest Of the World	10,295	16,863	8,766	3,129
f) Households	16,019	14,491	27,011	30,712
3. Borrowings	**5,998**	**-5,421**	**5,050**	**-6,753**
a) Banking	4,018	-5,635	2,326	-3,917
i) Reserve Bank of India	3,993	-5,521	2,263	-3,844
ii) Co-operatives	25	-114	63	-73
b) Other Financial Institutions	1,676	56	744	-2,593
i) Financial Corporations	1,676	56	744	-2,593
c) Rest Of the World	304	158	1,980	-243
4. Bills Payable	**-82**	**2,929**	**-272**	**3,566**
a) In India	-85	2,929	-272	3,525
b) Outside India	3	0	0	41
5. Other Liabilities	**4,807**	**0**	**0**	**0**
6. Branch adjustment with offices outside India	**-78**	**0**	**122**	**271**
7. Due to Branches/Parent Offices Abroad	**-9,823**	**-6,686**	**-4,330**	**4,588**
TOTAL	32,574	29,961	39,075	55,583

@ Provisional Estimates

Appendix 3.2

STATEMENT 1.2: COMMERCIAL BANKS (reproduced) (Rs. Crore)

Reserve Bank of India Bulletin *January 1998*

Uses	1990-91	1991-92	1992-93@	1993-94@
1. Cash In Hand	**417**	**563**	**345**	**-888**
a) RBI Notes	410	558	340	-864
b) One Rupee Notes and Coins	7	5	5	-24
2. Balances with RBI	**3,109**	**5,865**	**-5782**	**16,116**
3. Investments	**10,932**	**16,315**	**15,757**	**24,196**
a) Banking	16	-1	23	-67
i) Co-operatives	16	-1	23	-67
b) Other Financial Institutions	1,398	715	-1,097	41
i) Financial Corporations	1,398	715	-1,097	41
c) Private Corporate Business	-32	745	289	1,601
i) Companies	-32	745	289	1,601
d) Government	9,554	14,837	16,546	22,627
i) Central Government	5,935	10,132	11,445	22,453
ii) State Governments	2,009	2,731	1,974	1,281
iii) Commercial Undertakings	1,105	780	2,440	711
iv) Local Authorities	630	-74	51	-580
v) Other Government Securities	-125	1,268	636	-1,238
e) Rest of the World	-4	19	-4	-6
4. Bank Credit	**14,856**	**9,300**	**25,772**	**18,715**
a) Banking	2	17	10	6
i) Co-operatives	14	17	10	6
b) Other Financial Institutions	4,222	17	30	28
c) Private Corporate Business	57	4,659	8,190	6,468
i) Non-Credit Societies	4,165	456	145	463
ii) Companies	3,836	4,203	8,045	6,005
d) Government	151	1,446	7,472	3,450
i) State Governments	3,480	-319	555	420
ii) Commercial Undertakings	205	1,930	6,335	3,396
iii) Quasi-Government Bodies	6,782	-165	582	-366
e) Households	1,610	3,161	10,070	8,763
5. Branch Adjustment	**1,610**	**2,389**	**-623**	**4,093**
a) With Offices outside India	0	2,389	-623	4,093
6. Other Assets	**0**	**-351**	**-22**	**375**
TOTAL	**30,924**	**34,081**	**35,447**	**62,607**

@ Provisional Estimates

Appendix 3.3

STATEMENT 8: FINANCIAL FLOWS – INSTRUMENT WISE (1993-94) (reproduced) (Rs. Crore)

Reserve Bank of India Bulletin *January 1998*

Instrument/Sector	Banking		Other Financial Institutions		Private Corporate Business		Government*		Rest Of The World		Households		Total		Discre-pancy
	Sources	Uses	Sources	Uses	Sources	Uses	Sources	Uses	Sources	Uses	Sources	Uses	Sources	Uses	(Sources -Uses)
1993-94 @															
1. Currency and Deposits	68,512	100	11,380	20,874	2,050	7,555	9,724	1,193	316	2,546	0	61,400	91,982	93,668	-1,686
2. Investments	9,700	35,042	15,312	19,128	16,104	6,539	45,714	7,897	27,520	13,522	0	15,115	114,350	97,243	17,107
a. Central & State Governments' Securities	0	25,402	0	7,141	0	1,200	40,976	0	0	239	0	175	40,976	34,157	6,819
b. Other Government Securities	0	-988	0	5,313	0	0	4,738	0	0	0	0	672	4,738	4,997	-259
c. Corporate Securities	0	1,643	0	8,516	16,104	0	0	373	0	13,283	0	4,364	16,104	28,179	-12,075
d. Bank Securities	9,700	0	0	580	0	36	0	6,981	0	0	0	848	9,700	8,445	1,255
e. Other Financial Institutions' Securities	0	166	15,312	0	0	5,082	0	1,100	0	0	0	9,056	15,312	15,404	-92
of which															
i) Mutual Funds (including units of UTI)	0	0	10,595	0	0	0	0	0	0	0	0	1,272	10,595	1,272	9,323
f. Foreign Securities	0	8,352	0	-73	0	53	0	0	27,520	0	0	0	27,520	8,332	1,91,988
g. Others	0	467	0	-2,349	0	168	0	-557	0	0	0	0	0	-2,271	2,271
3. Loans and Advances	-2,682	30,867	8,085	22,875	23,317	10,938	8,115	1,584	-164	5,071	14,541	0	51,212	71,335	-20,123
4. Small Savings	0	0	0	706	0	0	7,157	0	0	0	0	6,541	7,157	7,157	0
5. Life Fund	0	0	8,643	0	0	0	939	0	0	34	0	9,548	9,582	9,582	0
6. Provident Fund	0	0	10,882	0	0	0	7,366	0	0	0	0	18,248	18,248	18,248	0
7. Compulsory Deposits	-8	0	0	0	0	0	0	0	0	0	0	-8	-8	-8	0
8. Trade Debt or Credit	0	0	492	0	-1,682	0	687	2,922	0	0	0	-1,190	-503	1,732	-2,235
9. Foreign claims not elsewhere classified	0	20,204	15	0	0	0	0	54	-8,551	-926	0	0	-8,536	19,332	-27,868
10. Other Items not elsewhere classified	6,587	7,704	5,979	3,953	4,378	-842	1,669	1,497	0	0	0	0	18,613	12,312	6,301
TOTAL	82,109	93,917	60,788	67,536	44,167	24,190	81,371	15,147	19,121	20,247	14,541	1,09,54	3,02,097	3,30,601	-28,504

* Excludes Local Authorities except Port Trusts

Notation

BSE (Bombay of Stock Exchange)

CDs (Certificate of Deposits)

CRAR (Capital to Risk-weight Assets Ratio)

CRR (Cash Reserve Ratio)

CS (Company Securities)

ER (Excess Reserves)

FIIs (Foreign Institutional Investors)

GD (Government Debt)

LA (Loans & Advances)

LIC (Life Insurance Companies)

OFIs (Other Financial Institutions)

OMOs (Open Market Operations)

PCB (Private Corporate Business)

PLR (Prime Lending Rate)

PSBs (Public Sector Banks)

RBI (Reserve Bank of India)

ROW (Rest of the World).

SEBI (Securities and Exchange Board of India)

SLR (Statutory Liquidity Ratio)

UTI (Unit Trust of India)

Chapter 4 Data, Model Specification and Econometric Methodology

4.1 Data

A theoretical flow of funds model is presented in a general equilibrium framework for India, in which behavioural equations and market clearing endogenous variables are determined for empirical application. Then, based on the compiled flow of funds matrix in the previous chapter, we deploy the derivation of the stock data for the sample period from 1951-52 to 1993-94. This is followed by the presentation of the whole list of variables used for estimation.

4.1.1 Theoretical Flow of Funds Model

A theoretical flow of funds model in a general equilibrium framework is presented in Table 4.1 in which each column represents disaggregated sectors and each row represents different categories of assets and liabilities. The table presents 7 sectors and 8 financial assets that cover the period from 1951-53 to 1993-94. There are two points, which are different in its construction from a flow of funds matrix in the previous chapter. First, in the theoretical model, the RBI is consolidated in the government sector: in general, the RBI is seen as an agent of the government in India (e.g. the government issues securities to the RBI for monetization), so that it is treated as part of the government sector in the model. Second, Government debt implies only long-term. Treasury Bills (or short-term government debt) are not considered in the theoretical flow of funds model on the grounds that Treasury Bills in the RBI will be reflected in the quantity of currency, and also Treasury Bills in uses in other sectors are negligible. Thus there is no market for short-term liquid assets in the model. In developed economies, the immediate impact of any monetary policy changes is felt in the money market and normally transmitted to the other related markets. Yet, in the underdeveloped money markets in developing economies, similar effects are weak. From this aspect, the omission of the Treasury Bills market will not distort the broad picture of the financial system in India.

Table 4.1 Theoretical flow of funds in Financial and Real Sectors in India

	Gov't (G)	Banks (B)	Coop (CO)	OFIs (OFI)	PCB (PCB)	Household (H)	ROW (ROW)	Within-period Endog. variables
Financial Sector: surplus (+), deficit (–)								
Currency (CUR)	$-\Delta G_{CUR}$					$+\Delta H_{CUR}$(.)		=0
Bank Reserves (R)	$-\Delta G_{R}$	$+\Delta B_{R}$ (.)						=0 ΔG_{R}
Deposit (DEP)		$-\Delta B_{DEP}$	$-\Delta CO_{DEP}$		$+\Delta PCB_{DEP}$(.)	$+\Delta H_{DEP}$(.)		=0 Δ DEP
Gov't Debt (GD)	$-\Delta G_{GD}$	$+\Delta B_{GD}$(.)	$+\Delta CO_{GD}$	$+\Delta OFI_{GD}$(.)		$+\Delta H_{GD}$ (.)		=0 ΔG_{GD} or GSY
Company Sec. (CS)		$+\Delta B_{CS}$(.)	$-\Delta CO_{CS}$	$-\Delta OFI_{CS}$(.)	$-\Delta PCB_{CS}$(.)	$+\Delta H_{CS}$ (.)		=0 RS
Loans & Advances (LA)		$+\Delta B_{LA}$(.)	$+\Delta CO_{LA}$	$+\Delta OFI_{LA}$(.)	$-\Delta PCB_{LA}$(.)	$-\Delta H_{LA}$ (.)		=0 LR
Provident funds (PF)				$-\Delta OFI_{PF}$		$+\Delta H_{PF}$ (.)		=0 ΔPF
Foreign Reserves (FR)	$-\Delta G_{FR}$						$+\Delta ROW_{FR}$	=0
(1) Net worth	(–)	0	0	0	(–)	(+)	(+)	=0
Real Sector: inflow (+), outflow (–)								
Tax (T)	+ G(T)					– H(T)		=0
Wage (W)					– PCB(W)	+ H(W)		=0
Goods	–GE				+ PCB(Y) – PCB(I)	– H(C)		=0
(2) Net position	(–)	0	0	0	(–)	(+)		=0
(1) – (2) =	0	0	0	0	0	0		

Bank Reserves=Total Reserves, Gov't=Government + RBI, Banks=Commercial banks, Coop=Cooperative banks and credit societies
GSY=Government securities yields, RS=Return on shares, LR=Lending rate
GE=Government Expenditure, Y=Gross National Product, I=Investment, C=Consumption

In any cell in the financial sector, $(\pm)\Delta J_i$ refers to the J'th sector's net purchases (+) or net sales (-) of the i'th asset during the unit time period of one year. The endogenous variables in the cells which are assumed to be explained by an asset demand and/or supply function is denoted by $(\cdot)$. This implies that the $(\pm)\Delta J_i(\cdot)$ represents the desired net acquisition of i'th assets or liabilities by sector J.

We have selected financial assets (i.e. $(\pm)\Delta J_i$) that comprise the major elements in each sector's portfolio and also with a view to studying the effect on the financial flows in changes in policy variables. A flow of funds in the cooperative banks and credit societies and the ROW sectors are considered as an exogenous variable, since it is relatively too small to be explained by the demand functions. The empty cells imply either the transaction is none or the transaction is small enough to be ignored, so that they are also treated as being exogenous.

In the columns, the net worth in the financial sector is the NAFA (net acquisition of financial asset) which is to equal the net position of the real sector, hence (1) - (2) = 0. In the rows, the row-sum zero presents the market clearing conditions. With an assumption of the exogenous sectoral NAFAs, an N-market flow of funds matrix determines N-1 endogenous variables (Backus *et al.* 1980 and Green 1984). Currency (CUR) has its nominal yield fixed at zero and that currency is typically thought of the Nth or the residual market.

Each financial market is cleared as follows:

i) The bank rate and deposit rates are set by the authorities and financial institutions, hence bank reserves (ΔG_R) and deposits (ΔDEP) are demand-determined[1]. We also assume that provident funds (ΔPF) are demand-determined. Therefore in the bank reserves, deposits and provident funds markets, quantities rather than the interest rates make the within-period adjustment.

ii) With respect to government debt (GD), before the financial liberalisation government securities yields were manipulated by the authorities, the flow of government debts are therefore determined by the asset-choice of investors, that is,

[1] The central bank accepts all reserves, and banks accept all deposits placed with them at the current rate of interest, which they change from time to time.

government debts are infinitely supply elastic (Green, 1982). After the financial reforms in the early 1990s, government securities yields have been set at market-related rates, thus it may now be more reasonable to solve the model for the level of interest rates. Hence we consider both (in simulation): one is to endogenise government debt (ΔG_{GD}), and the other is to endogenise government securities' yields (GSY)[2].

iii) In the Company Securities and Loans and Advances markets, the interaction of the sectoral asset demand and supply will determine the equilibrium values of the return on shares (RS) and the lending rate (LR). In respect to the latter, although lending rates are regulated to some degree, against the subsidised rates to particular sectors, there are compensating lending rates toward corporate sector that are assumed to be determined by the market.

The table provides insight into the mechanism linking the financial sector to the real sectors. The sector surplus/deficit is linked to the real sector in a simple chain-like path. PCB sector is assumed to produce the entire income (Y), carries out investment (I) for replacement and net investment, and sells consumption (C) and government expenditure (GE) to household and government sectors respectively. The PCB sector's deficit, that is the excess of investment over saving, is financed through issuing company securities, borrowing or withdrawing internal funds. Wages (W) are paid to households for labour from PCB. The household sector's surplus is their savings from their wages after tax (T) and consumption (C), and this is distributed in the financial sector. The government collects tax (T) and purchases goods (GE). The budget deficit is financed either by issuing securities, printing high-powered money or borrowing from ROW (Backus, Brainard, Smith and Tobin, 1980). The real sector variables are assumed to be exogenous in this model.

Balance Sheet Identity

The balance sheet account for each sector is outlined in the following contexts and the detailed discussion of balance sheet identities for banks, OFIs, PCB and household

[2] However, for econometric estimation, the government securities' yields are treated as exogenous, since a large part of the sample period belongs to the period, in which the government controlled the level of the yields.

sectors are left in the subsequent sector-study chapter.

The **government**'s budget constraint is defined as $GE - G(T) = \Delta G_{CUR} + \Delta G_{R} + \Delta G_{GD} + \Delta G_{FR}$[3]. It is assumed that the government does not attempt to influence the supply of currency but issues legal tender to meet the requirements of firms and individuals (Datt & Sundaharam, 2000). Hence, narrow money is determined by demand functions here. There are however two conflicting views on the determination of money stock. One is a standard approach that the money supply is an exogenous policy instrument. This is based on the assumption of a definite multiple relationship between the stock of money and the liabilities of the central bank[4]. The other view is that the quantity of money is endogenous reflecting the economic behaviour of banks and other private economic units and also the growth of nominal income (Hester and Tobin 1967, Mayes and Savage 1983 and Owen 1986). Sen and Vaidya (1997) comment that in a repressed financial system, one should not expect great variation or instability in the money multiplier, supporting the view that the money supply is exogenous. Notwithstanding this, if the reserve ratio is mandatory, the bank would hold fluctuating amounts of excess reserves for precautionary reasons and the multiplier would not be stable (Cobham, 1991). Moreover, in the period of fixed exchange rates, it is more plausible that the money stock is treated as demand determined (Mayes and Savage, 1983). On these grounds, our approach, that money is demand-determined may be appropriate. Similarly, government securities are determined by investors' asset choice in the pre-reform period. The implication is that no allowance was made for the authorities' debt management operations, or in other words, the government's obligations were not used as an independent shift-variable in the model structure. In India, in order to accommodate the changes in the government deficit, the SLR was used as a policy instrument, by which a certain proportion of government securities were obtained as pre-emption. It can be seen from the level of SLR; it reached its highest level of 38 % in 1988 when government was experiencing a substantial budget deficit (Chapter 3). In the post-reform period, as the government securities' yields became market-related, there has been more scope in ΔG_{GD}, not entirely depending on SLR, in debt management.

[3] Interest payments on government debt are subsumed in government expenditure.
[4] It is argued that so long as the central bank can change the level of a penal rate on their loans to banks, it can control its own liabilities, hence the stock of money can be controlled.

The **banks** balance sheet identity is Deposits = Bank Reserves + Government Debt + Company Securities + Loans and Advances. Other sources of bank funds are assumed to be exogenously given. The **OFIs** balance sheet identity is Company Securities + Provident Funds = Government debt + Loans and Advances. **PCB** as a deficit sector holds liabilities in the form of company securities and loans and advances. The PCB's holdings of deposits may be seen as internal funds. The **Household** sector holds five financial assets of currency, government debt, company securities, provident funds and bank deposits and one liability of loans and advances. Following the view of Dawson (1991a), it is postulated that the wealthy population sector has a large financial surplus which is placed into various financial assets responding to interest rate levels and differentials, whereas the large poorer group, farmers and small business owners, account for the bulk of borrowing from banks for farming or business.

4.1.2 Flow and Stock data for Econometric Estimation

The estimation sample period consists of 43 annual observations for the period 1951-52 to 1993-94. The financial year begins on 1st April and ends on 31st March. The financial stock data for the whole time series are not available. Therefore, based on the compiled flow of funds matrix in Chapter 3, we have derived the stock data for behavioural equations. Using the end-of-year stock data 31st March 1951 as a benchmark position, the subsequent stock data are constructed by incrementing the flow data collected from the net transactions flow of funds matrix such as in Table 3.8a, 3.8b and 3.8c in Chapter 3.

Table 4.2a shows the stock data on the 31st March 1951. The stock data of government, banking, OFIs and PCB sectors are collected from various official publications. For the household sector, such publications are not available, therefore the benchmark stocks are broadly approximated in such a way that elements in the matrix satisfy market clearing conditions. Table 4.2b presents the flow data for the period 1st April 1951 to 31st March 1952. By adding both figures in Table 4.2a and 4.2b, the stock data on 31st March 1952 are obtained and they are presented in Table 4.2c. Repeating this process up to March 1994 generates series of end-of-year stocks

Table 4.2 Flow/Stock data for behavioural equations

a. Stock data on 31st March 1951 Rs. crore

	Gov't	Banks	OFIs	PCB	Household	Exogenous	Total
CUR	(-1439.0)				1439.0	0.0	0.0
R	(-67.2)	67.2				0.0	0.0
DEP		(-819.0)		59.5	696.2	63.4	0.0
GD	(-732.6)	263.1	292.3		175.4	1.8	0.0
CS		35.0	-40.0	-265.4	283.5	-13.1	0.0
LA		488.8	299.8	-54.0	-840.1	105.5	0.0
PF			(-508.5)		563.7	-55.2	0.0
Net Worth	-2238.8	35.0	43.6	-259.8	2317.6	102.4	0.0

b. Flow data during 1st April 1951 to 31st March 1952 Rs.crore

	Gov't	Banks	OFIs	PCB	Household	Exogenous	Total
CUR	(117.4)				-116.7	-0.7	0.0
R	(13.5)	-13.5				0.0	0.0
DEP		(33.0)		-1.7	-28.2	-3.1	0.0
GD	(-49.0)	-60.6	32.7		-4.8	81.7	0.0
CS		-1.0	2.2	-56.3	7.0	48.1	0.0
LA		-22.0	16.1	-34.3		40.2	0.0
PF			(-39.6)		43.9	-4.3	0.0
Net Worth	81.9	-64.1	11.4	-92.3	-98.8	161.9	0.0

c. Stock data on 31st March 1952 Rs. crore

	Gov't	Banks	OFIs	PCB	Household	Exogenous	Total
CUR	(-1321.6)				1322.3	-0.7	0.0
R	(-53.7)	53.7				0.0	0.0
DEP		(-786.0)		57.8	668.0	60.3	0.0
GD	(-781.6)	202.5	325.0		170.6	83.5	0.0
CS		34.0	-37.8	-321.7	290.5	35.0	0.0
LA		466.8	315.9	-88.3	-840.1	145.7	0.0
PF			(-548.1)		607.6	-59.5	0.0
Net Worth	-2156.9	-29.1	55.0	-352.1	2218.8	264.3	0.0

- Rs. crores = 10 million rupees
- The figures in Table 4.2 b come from the net transactions flow of funds matrix such as table 3.8a-c in Chapter 3.
- CUR=Currency, R=Bank reserves, DEP=Deposit, GD=Government debt, CS=Company securities LA=Loans and advances, PF=Provident funds.
- 'Exogenous' includes quantities that are treated as being exogenous, negligible and unidentified.
- ( )= Demand determined
- Stock data sources
  Government: RBI Bulletin various issues
  Banks: Balance sheets of the aggregated commercial banks
  OFIs: RBI Bulletin various issues
  PCB: Combined balance sheets of selected medium and large public limited companies
  Household: The stock data are approximated given market clearing conditions.

without any gaps, with the data in Table 4.2c being the first observation of the sample period[5]. The total wealth (or net worth) for each sector is constructed by adding such stock data. By treating the data for the cooperative banks and credit societies and ROW, and also the data for the negligible and the unidentified as being exogenous the zero-row sum is accomplished and a complete and consistent flow of funds data-base is generated for econometric estimation and subsequent simulation.

The following points should be noted: First, debentures, bonds and fixed deposits (in PCB sector) are classified in Company Securities (CS) in the compiled flow of funds matrix of Chapter 3, however they are consolidated in Loans and Advances (LA) for the empirical study[6]. The main reason for this is that debentures, bonds and fixed deposits are less risky assets as compared with shares, therefore it can be argued that the lending rate is more appropriate as their own interest rate, rather than is the return on shares. Further, evidence is proved by preliminary estimations in that the lending rate explained these assets more appropriately than did the return on shares. Second, the revaluation for CS is not specified. It is important to distinguish transactions from changes as a consequence of revaluation because it is transactions, which reflect the portfolio decisions of economic agents, not revaluations (Bain, 1973). The original flow accounts in the Reserve Bank of India Bulletin themselves are, however, ambiguous about revaluation. As noted in the previous chapter, there are discrepancies in the valuations of financial assets among sectors. In addition, incorporating revaluations in estimating a long-run model leads to totally unacceptable results in the Company Securities equation[7]. Therefore it is assumed that revaluations are already incorporated in the published flow data, i.e. the figures in Table 4.2b incorporate the flow of assets and the capital gains/losses in CS.

We also present the stock data on 31st March 1994 (the last observation) in Appendix 4.1. The stock data of currency, deposits, bank reserves and government debts are also

[5] Friedman (1977) constructed the series of stock data by decrementing the flow data from the stock data of the last observation.

[6] Hence in Table 4.2, LA incorporates loans and advances, debentures, bonds and fixed deposits, whereas CS consists of paid-up capital and unit trust.

[7] The formula used for revaluation in the test run is: $A_t = P_t / P_{t-1}(A_{t-1} + F_t / 2) + F_t / 2$, where A_t = the market value of the asset at the end of time period t, F_t = the normal flow into the asset during period t, P_t = the market price of the asset at time t.

available in IFS, hence they can be compared to each other (though for other financial assets, there is no such comparative data available). Table 4.3 shows both stock data of these financial instruments: one from Appendix 4.1 and the other from the IFS.

It is evident that the two sets of figures are remarkably close to each other. In this respect, there are good grounds to be confident about the methodology taken for the compilation of the flow of funds matrix in Chapter 3 and the subsequent derivation of the stock data The stock data presented in this section may be regarded as being unbiased as a data set for the empirical study.

Table 4.3 Comparison of the Stock data Rs. crore

Financial assets	Data based on the compiled flow of funds matrix (Appendix 4.1: 31st March 1994)	Financial assets	IFS (1993 from the year book)
Currency	83,554	Currency (line 14a)	78,330
Deposits	318,157	Time and demand Deposit (line 24+25)	313,210
Bank Reserves	47,758	Reserves (line 20)	48,390
Gov't Debt	398,812 *	Gov't Debt (line 88a)	406.070

- Rs. crores = 10 million rupees
- * Gov't Debt includes, not only debt (273,900), but also loans (75,183) and provident funds (49,729), though loans and provident funds in the government sector are consolidated as exogenous in Appendix 4.1.

4.1.3 Behavioural Equations, Interest Rates and Other Data

Table 4.4a lists the behavioural equations (denoted by (.) in Table 4.1) together with the corresponding interest rates and other relevant explanatory variables used for estimation. The detailed discussion of the explanatory variables are left to each sector study. These variables are categorised either as exogenous or endogenous in Table 4.4b. Table 4.5 lists the data source of the interest rates and other explanatory variables. Table 4.6a and 4.6b present the mean, variance and correlation of the nominal interest rates.

Table 4.4a **The behavioural equations, interest rates and other explanatory variables**

Sector	Behavioural equations (-) deficit (+) surplus	Own interest rates	Other explanatory variables common to each behavioural equation in a sector
Banks	(+) Excess Reserves * (+) Government debt (+) Company Securities (+) Loans & Advances	Bank rate Government Securities Yields Return on Shares Lending rate	Y, CRR, SLR, Dummy 90, Sector wealth
OFIs	(+) Government debt (-) Company Securities (+) Loans & Advances	Government Securities Yields Return on Shares Lending rate	Y, Dummy 69 and 90, Sector wealth
PCB	(-) Company Securities (-) Loans & Advances (+) Deposit	Return on Shares Lending rate Deposit rate	Y, SLR, Dummy 69 and 90, Sector wealth
Household	(+) Currency (+) Deposit (+) Government debt + Provident Fund ** (+)Company Securities (-) Loans & Advances	Inflation rate (negative sense) Deposit rate Government Securities Yields Return on Shares Lending rate	Aggregate Expenditure, Real Exchange rate, Dummy 69 and 90, Sector wealth

* Excess reserves, rather than total bank reserves are estimated.
** The provident funds share equation will be consolidated with the government debt share equation; the detail will be found in the household sector in Chapter 8. Y=aggregate income
Dummy 69 = 0: 1951-68 and 1: 1969-93; Nationalisation of major commercial banks in 1969.
Dummy 90 = 0: 1951- 89 and 1: 1990-93; Financial liberalisation in 1990.

Table 4.4b Exogenous and Endogenous Variables

	Variables
Exogenous variables	CRR, SLR, Bank rate, Government securities' yields, Deposits rates, Aggregate income (Y), Aggregate expenditure, Exchange rate, Dummy 69, Dummy 90 and Sector wealth (i.e. NAFA)
Endogenous variables	15 shares of holding financial instruments, Return on shares and Lending rate

In deriving the return on shares, the rate of growth in share prices is used (see Table 4.5); dividend yields are not available for part of the data period. In India, the total return is dominated by the capital appreciation component over the period of 1980-97; the components of capital appreciation account for three-fourths or more of the total returns (Gupta and Chowdhury, 2000). Garg, Verma and Gulati (1996) also argue that, in general, dividends on shares tend to be low in a developing economy. Hence, the assumption that the decision of the portfolio in favour of equity depends mainly on the rate of growth in share prices may be perhaps plausible in India. The return on shares however exhibits extremely high variance of 374.22 in Table 4.6a, indicating the volatile movement of the share prices in India. The lending rate is somewhat volatile, whereas the deposit rate is the least volatile among other interest rates. With respect to correlation in Table 4.6b, except the return on shares, the other four interest rates tend to show high a correlation to each other, indicating the high likelihood of multicollinearity in a system of equations.

Table 4.5 Data sources of the variables

Variables (1951-93)	Source	Note
Bank rate	IFS	
Government securities yields	IFS for 1951-85 Report on currency and finance for 1986-93	
Return on shares	IFS (share prices)	The rate of growth in share prices
Lending rates	Statistical Abstract of the India Union for 1951-71 Handbook of Statistics on Indian Economy for 1971-1993	SBI's (State Bank of India) discount rate for 3 month commercial bills for the period 1951-52 and 1956-57 and SBI's advance rate for the rest of the sample period
Deposit rate	Statistical Abstract of the India Union for 1951-71 Handbook of Statistics on Indian Economy for 1971-1993	Bank deposit rate for 1 to 3 years
Inflation rate	IFS (CPI)	The rate of change in CPI
Aggregate income (Y)	IFS (GDP at factor cost)	
CRR	Handbook of Statistics on Indian Economy	This is proportionally calculated for the financial year based on the effective date.
SLR	Handbook of Statistics on Indian Economy	This is proportionally calculated for the financial year based on the effective date.
Real exchange rate	IFS (e, p^* and p)	Real exchange rates are expressed as ep^*/p, where e = the number of national units of currency per US dollar, p^* = US CPI, and p = India CPI.
Aggregate Expenditure	IFS (constant price consumer spending)	

Table 4.6a Mean and variance of the nominal interest rates

(%)

	Mean for the sample period	Variance
Bank rate	7.06	8.05
Lending rate	10.49	29.20
Deposit rate	6.18	7.21
Gov't Sec. Yields	6.63	8.77
Return on shares	8.74	374.22

Table 4.6b Correlation of the nominal interest rates

	Bank rate	Lending rate	Deposit rate	Gov't Sec. yields	Return on shares
Bank rate	1				
Lending rate	0.9873	1			
Deposit rate	0.9604	0.9507	1		
Gov't Sec. Yields	0.8886	0.8673	0.9175	1	
Return on shares	0.4125	0.4116	0.4485	0.5030	1

4.1.4 Structural break

The inclusion of dummy 69 and 90 in Table 4.4a as explanatory variables may be explained as follows.

It is argued that parameter instability is a common phenomenon when time-series data span a long time horizon, as it is more likely for the underlying data-generating mechanism to be disturbed by various factors (Bai, 1996). This may be the case for the sample period for estimation. The Indian financial sector has experienced two major shifts in the post-independence period; one is the nationalisation of the commercial banks in 1969, and the other, the financial reforms in 1990 (Chapter 3). The failure to take into account these shifts, given their presence, may lead to incorrect policy implications. In order to examine these shifts, a breakpoint test (though in an ad-hoc manner) is conducted. Given the sample period from 1951 to 1993 (43 observations), four potential break points are chosen for the test; 1960, 1969, 1980 and 1990[8]. The test is conducted by including all the regressors listed in Table 4.4a (based on the AIDS model specification explained in the next Section 4.2). Bai (1996) argues that the maximum point is where the statistic test is rejected in the highest significance among other potential breakpoints. Table 4.7 presents the test results. The balance of results indicates that at 1969 and 1990 there appears to be the evidence of structural breaks, hence the inclusion of dummy 69 and 90 in the model specification may be appropriate. These dummies are however again subject to *t*-statistics hypothesis test in a system of equations in a single sector study. However in general, the point at 1980 tends to indicate a significant break point, and for the OFIs sector the share equations tend to be significant at all breakpoints. Yet without a suitable economic theory, and also in order to maintain the degree of freedom, the dummy is not applied for 1980 (and also for 1960 in the case of the OFIs sector).

In the current study, the dummy is limited to be the intercept, as the observation of the estimated slope coefficients does not in particular exhibit a large difference over these breakpoints, in comparison with the intercept coefficients.

[8] With Chow's breakpoint test, each subsample requires at least as many observations as the number of estimated parameters. In the current study the test at the point 1990 is unobtainable, therefore Chow's forecast test is utilised. The whole sample period (T observations) is split into two at each point, then the first T_1 observations are used for estimation and $T_2 = T - T_1$ observations are used for testing and evaluation. It estimates the model for the first T_1 observations. This estimated model is then used to predict the values of the dependent variables in the remaining $T_2 = T - T_1$ observations.
The Chow's forecast F-statistic is computed as

$$F = \frac{(RSS_T - RSS_{T_1}) / T_2}{RSS_{T_1} / (T_1 - k)}$$

where RSS_T is the residual sum of squares when the equation is fitted to the whole sample period, RSS_{T_1} is the residual sum of squares for the T_1 observations and k is the number of estimated coefficients. The statistic follows F-distribution. If the null is rejected, then there is a structural break at the chosen point.

Table 4.7 Breakpoint tests

Behavioural Equations	1960 F-stat. [Prob.]	1969 F-stat. [Prob.]	1980 F-stat. [Prob.]	1990 F-stat. [Prob.]
Banks				
Excess Reserves	10.33 [0.09]	27.90 [0.00]	5.54 [0.00]	12.42 [0.00]
Gov't Debt	7.39 [0.13]	0.73 [0.74]	1.67 [0.14]	4.52 [0.00]
Comp. Securities	8.31 [0.11]	8.45 [0.00]	1.75 [0.12]	2.55 [0.05]
Loans and Adv.	3.22 [0.26]	0.56 [0.87]	0.53 [0.88]	0.65 [0.62]
OFIs				
Gov't Debt	131.64 [0.00]	9.91 [0.00]	3.26 [0.01]	0.43 [0.78]
Comp. Securities	55.30 [0.00]	56.84 [0.00]	31.00 [0.00]	3.20 [0.02]
Loans and Adv.	187.62 [0.00]	43.23 [0.00]	8.31 [0.00]	1.33 [0.27]
PCB				
Comp, Securities	3.87 [0.10]	1.14 [0.42]	2.55 [0.03]	6.32 [0.00]
Loans and Adv.	5.15 [0.06]	1.34 [0.31]	2.67 [0.02]	4.99 [0.00]
Deposit	2.05 [0.26]	2.76 [0.04]	1.71 [0.12]	5.05 [0.00]
Household				
Curency	5.24 [0.33]	6.08 [0.00]	4.15 [0.00]	0.34 [0.84]
Deposit	97.27 [0.08]	18.51 [0.00]	5.76 [0.00]	8.54 [0.00]
Gov't Debt	4.13 [0.37]	3.78 [0.02]	1.38 [0.24]	0.24 [0.91]
Comp. Securities	245.67 [0.05]	2.81 [0.04]	5.70 [0.00]	2.52 [0.06]
Loans and Adv.	6.96 [0.17]	10.66 [0.00]	3.59 [0.01]	11.88 [0.00]

- The sample period: 1951 to 1993.

Critical value at 5% (df)	1960	1969	1980	1990
Banks	19.5 (33, 2)	2.90 (25, 9)	2.20 (14, 20)	2.69 (4, 30)
OFIs	5.75 (33, 4)	2.51 (25,12)	2.13 (14, 23)	2.69 (4, 33)
PCB	8.62 (33, 3)	2.61 (25, 11)	2.15 (14, 22)	2.69 (4, 32)
Household	250 (33, 1)	2.90 (25, 9)	2.20 (14, 20)	2.69 (4, 30)

4.1.5 Summary

A regulated financial sector in India is specified in a theoretical flow of funds model, being consistently linked with the real sector, in which behavioural equations and market clearing endogenous variables are determined.

In sum, there are 15 behavioural equations and 5 market clearing identities, which determine 20 endogenous variables. We have arrived at the manageable size of a system-wide flow of funds model largely avoiding becoming too large and cumbersome, to which flow of funds models are prone.

4.2 AIDS Model Specification

With respect to our conclusion in the survey of the demand function in Chapter 2, in modelling a system of equations for each sector we utilise the AIDS model. The derivation and application of the AIDS share equation are spelled out in this sector[1]. Further Seemingly Unrelated Regression techniques and likelihood ratio tests that are used for estimation and hypothesis test respectively are also made clear.

4.2.1 Derivation of the AIDS

The AIDS model is derived using duality (Gravell and Rees, 1992). The primal problem for a consumer is that of maximising utility subject to budget constraints:

Max $u = u(q_1, \ldots\ldots q_n)$ (4.1a)

subject to $\sum_{i=1}^{n} p_i q_i = W$ (4.1b)

This yields a Marshallian demand system. The dual problem is that of minimising cost function to attain a specific utility level at given prices:

Min $C(p, u)$ (4.2a)

subject to $u = \bar{u}$ (4.2b)

where

u = utility

q_i = quantity of good i

p_i = price of good i

W = budget or wealth

C = total nominal expenditure

This generates a set of Hicksian demand functions.

In this study, the AIDS share equations are derived via the dual problem. That is, given a 'well-behaved' cost function, which is concave and homogenous of degree one in prices hence satisfying the axioms of rational choice (i.e. the existence of consistent

[1] Since the AIDS model is introduced in the survey in Chapter 2, there is inevitably a repetitive discussion involved in this section.

preferences), an indirect utility function can be derived. The problem is then stated without any particular information about the original utility function. The AIDS model is a particular parameterisation of the cost function.

The AIDS model belongs to the PIGLOG class preference, which is represented via the cost function as given by (Deaton and Muellbauer, 1980a):

$$\ln C(u,p) = (1-u)\ln\{a(p)\} + u\ln\{b(p)\} \tag{4.3}$$

where u lies between 0 (= subsistence) and 1(= bliss).

The AIDS cost function is an example of a flexible functional form, hence it possesses enough parameters; at any single point its derivatives can be equal to those of an arbitrary cost function. It can be written:

$$\ln a(p\ ) = \alpha_0 + \sum_i \alpha_i \ln p_i^r + \frac{1}{2}\sum_i \sum_j \gamma^*_{ij} \ln p_i^r \ln p_j^r \tag{4.4a}$$

$$\ln b(p) = \ln a(p) + \beta_o \Pi p_i^{\beta_i} \tag{4.4b}$$

where

α and γ = parameters

Following Weale (1986), Barr and Cuthbertson (1991a), Adam (1999) and Prasad (2000), we implement the augmented AIDS model by including conditional variables. The equation (4.4a) can be re-written:

$$\ln a(p) = \alpha_0 + \sum_i \alpha_i \ln p_i^r + \frac{1}{2}\sum_i \sum_j \gamma^*_{ij} \ln p_i^r \ln p_j^r + (\sum_k \delta_{ik} z_k)\ln p_i \tag{4.5}$$

where δ = parameters, z_k = k'th other determinant

A number of other determinants, z, which influences the demand for a particular financial instrument, are included as part of the baseline holdings. They are conditional variables in a sense that if they were not included, then the model could suffer from omitted-variables bias. In our current study, this allows us to include policy variables, real variables and also dummies which can be postulated as the conditional variables.

Substituting (4.4b) and (4.5) into (4.3), the AIDS cost function can be written

$$\ln C(u,p,z) = \alpha_0 + \sum_i \alpha_i \ln p_i + \frac{1}{2}\sum_i \sum_j \gamma^*_{ij} \ln p_i \ln p_j + u\beta_0 \Pi p_i^{\beta_i} + (\sum_k \delta_{ik} z_k)\ln p_i$$

(4.6a)

C(u, p, z) is linearly homogenous in price provided that[2]

$$\sum_i \alpha_i = 1,\ \sum_j \gamma^*_{ij} = \sum_i \gamma^*_{ij} = \sum_j \beta_j = \sum_k \delta_{ik} = 0 \quad (4.6b)$$

The demand function can be derived by Shephards's Lemma (i.e. by differentiating the cost function with respect to p_i)

$$\frac{\partial C(u,p,z)}{\partial p_i} = q_i \quad (4.7)$$

In order to derive shares, we multiply both sides by $p_i / C(u,p,z)$, then we find,

$$\frac{\partial \ln C(u,p,z)}{\partial \ln p_i} = \frac{p_i q_i}{C(u,p,z)} = S_i \quad (4.8)$$

S_i (= the budget share of good *i*) is then defined as

$$S_i = \alpha_i + \sum_j \gamma_{ij} \ln p_j + u\beta_o \Pi p_i^{\beta_i} + \sum_k \delta_{ik} z_k \quad (4.9a)$$

$$\text{where } \gamma_{ij} = \frac{1}{2}(\gamma^*_{ij} + \gamma^*_{ji}) \quad (4.9b)$$

For a utility maximizing consumer, the total wealth, *W* in (4.1b) is equal to *C(u, p, z)* and this equality can be inverted to give utility as a function of *p, z* and *W*, i.e. the indirect utility function, such that (4.6a) can be:

$$\ln W = \alpha_0 + \sum_i \alpha_i \ln p_i + \frac{1}{2}\sum_i \sum_j \gamma^*_{ij} \ln p_i \ln p_j + u\beta_o \Pi p_i^{\beta_i} + (\sum_k \delta_{ik} z_k)\ln p_i \quad (4.10)$$

We define

$$\ln P = \alpha_o + \sum_i \alpha_i \ln p_i + \frac{1}{2}\sum_j \sum_i \gamma^*_{ij} \ln p_i \ln p_j + (\sum_k \delta_{ik} z_k)\ln p_i \quad (4.11)$$

then,

$$\ln W - \ln P = u\beta_o \Pi p_i^{\beta_i} \quad (4.12)$$

Substituting (4.12) into (4.9a), we have the budget shares as a function *p, z* and *W*:

---

[2] It implies that if prices double then the cost of obtaining a given utility level must also double.

$$S_i = \alpha_i + \sum_j \gamma_{ij} \ln p_j + \beta_i \ln(W/P) + \sum_k \delta_{ik} z_k \qquad (4.13)$$

This contains sufficient parameters to be regarded as a first-order approximation to any demand system. Ln*P* may be interpreted as a composite price. If In*P* are reasonably collinear within a group, Deaton and Muellbauer suggested a Stone index of the form:

$$\ln P = \sum_i S_i \ln p_i \qquad (4.14)$$

Given highly collinear interest rates, this is perhaps a plausible approach in our study. With this substitution, the model becomes linear in the parameters, and z_k is now outside financial instruments' prices, i.e. non-price sensitive variables.

The restrictions of (4.6b) and (4.9b) imply restrictions on the AIDS parameters for *n* financial assets (Deaton and Muellbauer, 1980a):

$$\sum_{i=1}^{n} \alpha_i = 1,\ \sum_{i=1}^{n} \gamma_{ij} = 0,\ \sum_{i=1}^{n} \beta_i = 0 \text{ and } \sum_{i=1}^{n} \delta_{ik} = 0 \qquad (4.15a)$$

$$\sum_j \gamma_{ij} = 0 \qquad (4.15b)$$

$$\gamma_{ij} = \gamma_{ji} \qquad (4.15c)$$

Equation (4.15a) implies the adding-up restrictions, i.e. $\sum_i S_i = 1$. The restriction of (4.15b) indicates homogeneity that the shares are homogeneous of degree zero in prices, and (4.15c) satisfies Slutsky symmetry.

Negativity of the Hicksian demand function arises from the concavity of the cost function and can be checked by calculating the eigenvalues of the Slutsky matrix. Deaton and Muellbauer, however, suggest using the eigenvalues of k_{ij} which has the same signs as those of the Slutsky matrix:

$$k_{ij} = \gamma_{ij} + \beta_i \beta_j \ln(W/P) - S_i \delta_{ij} + S_i S_j \qquad (4.16)$$

where δ_{ij} is the kronecker delta. In order to satisfy negativity, the matrix should be negative semi-definite, i.e. all the diagonal elements are non-positive.

4.2.2 Application of the AIDS in a Flow of Funds Model

The AIDS share equation was originally applied in the context of consumer demand theory. The following explains the application to demand for assets.

Suppose that there exists a utility function, which depends on the expected (one period ahead) real value of all financial assets held:

$$u = u(a^{\tau}_{1t+1},\ a^{\tau}_{2t+1},\ldots\ldots\ldots a^{\tau}_{nt+1}) \tag{4.17}$$

This depicts that agents are concerned with the asset consumption at the beginning of $t+1$. The relationship between real assets in adjacent periods is

$$a^{\tau}_{it} = p^{\tau}_{it} a^{\tau}_{it+1} \tag{4.18}$$

The budget constraint here is that real assets sum to real wealth:

$$\sum_i a^{\tau}_{it} = W^{\tau}_t = (W/Z)_t \tag{4.19}$$

Such that the budget constraint becomes,

$$\sum_i a^{\tau}_{it} = \sum_i p^{\tau}_{it} a^{\tau}_{it+1} = W^{\tau}_t \tag{4.20}$$

where a^{τ}_{it+1} = real asset holdings of the ith asset at the end of period $t+1$

W^{τ}_t = real wealth at the end of period t (= W_t / Z_t)[3]

Z_t = good price index

$p^{\tau}_i = \left[(1+r_i)(1-g)\right]^{-1}$

r_i = expected nominal return on asset i, between t and $t+1$

g = expected proportionate rate of goods price inflation, between t and $t+1$

The i'th asset share equation (4.13) can be re-formulated in real terms:

$$S_i = \alpha_i + \sum_j \gamma_{ij} \ln p^{\tau}_{jt} + \sum_k \delta_{ik} z_{kt} + \beta_i \ln(W^{\tau} / P^{*\tau})_t \tag{4.21}$$

where $S_i = a_{it} / W_t$

The equation (4.21) is applied in modelling the flow of funds for each sector.

[3] The current wealth (W_t) is the sum of end-of-last-period wealth, current saving and capital gains or losses.

Expected rates of return

For r_i of $p_i^r = \left[(1+r_i)(1-g)\right]^{-1}$, nominal interest rates presented in Table 4.4 are used. In the model specification, asset demands are functions of *expected* rates of return. We employ a perfect-foresight assumption by proxying the expected returns (except the return on shares) at the beginning of period t by the actual returns realized over the period.

With respect to the expected return on shares, 'naïve expectation', a special case of autoregressive expectations, is utilised: Following Friedman and Roley (1979, p1477), the return on shares at time t is given by,

$$r_t = d_t + g_{t+1} \tag{4.22}$$

where

d = the dividend yields (which is known at time t)

g = the capital gain or loss component of the yield defined as

$$g_{t+1} = \frac{p_{t+1} - p_t}{p_t} \tag{4.23}$$

where p = the share prices

g_{t+1} is not known at time t, such that

$$r_t^e = d_t + g_{t+1}^e \tag{4.24}$$

where the e superscript indicates an expectation as of time t.

Note that the equation (4.24) implies that there is an inverse relationship between the expected return on shares and the expected share prices. The investors' expectations of the one-period capital gain (or loss) is formed from its previous period, such that

$$g_{t+1}^e = g_t \tag{4.25}$$

The expected return on shares are given by substituting (4.25) into (4.24) and with the assumption of no dividend yields, it takes the form of,

$$r_t^e = g_t \tag{4.26}$$

The equation (4.26) is applied to the return on shares. (The same naive expectation is applied to the expected rate of inflation.)

It seems to be reasonable that for the administrative interest rates, the perfect foresight expectation is adapted, whereas for the volatile return on shares, an autoregressive type of expectation is used.

4.2.3 Elasticities

In the AIDS model, the effects of explanatory variables on the dependent variable are measured as elasticities. The elasticities show the responsiveness of the movement of various interest rates on the share of holdings of asset *i* (i.e. $S_i = a_{it} / W_t$) in a precise manner, since elasticities vary at each observation.

The Slutsky equation decomposes the price effect into substitution effect (due to a change in relative price with real wealth held constant) and income effect (due to a change in wealth or cost with relative price constant). The full effect of the price change, or compensated elasticities is specified as given by (Barr and Cuthbertson, 1989 and Collins and Anderson, 1998):

$$E_{ij}(p) = (S_i^{-1})k_{ij} \tag{4.27}$$

In the thesis, the interest rate elasticities are presented by changing the sign on the price elasticities[4], such that

$$E_{ij}(R) = -(S_i^{-1})k_{ij} \tag{4.28}$$

$E_{ij}(R)$ measures the proportionate change in the demand of a particular asset to changes in both its own and the cross interest rates[5]. In order to satisfy negativity, the own interest rate elasticity is expected to be *positive.* With respect to the cross-interest rate elasticities, positive cross-interest rate elasticity indicates complements, and negative cross-interest rate elasticity indicates substitutes for the assets *i* and *j*.

Wealth elasticities are specified:

$$E_w = \beta_i / S_i + 1 \tag{4.29}$$

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[4] This is because that the AIDS prices are the inverse of the real interest rates. Since $\ln p_i^r = \ln[(1+r_i)(1-g)]^{-1}$, and $\ln p_i^r = -\ln[(1+r_i)(1-g)]$, then $\ln p_i^r = -\ln(1+R_i) = -R_i$, where R =real interest rates.

[5] It is defined as; $E_{ij}(R) = 1$: unitary elasticity, $0 < E_{ij}(R) < 1$: inelastic, $1 < E_{ij}(R)$: elastic.

E_w is defined as the proportionate change in the quantity of particular asset from a proportionate change in *W*. In each sector study, the aggregated income or expenditure is incorporated as one of non-price sensitive explanatory variables, and the elasticity is specified as:

$$E_y = \delta_{iy} / S_i \qquad (4.30)$$

All elasticities presented in the thesis are based on the mean portfolio shares[6].

For other variables such as CRR, SLR and dummies, although the estimated parameters of the AIDS model do not have such a direct economic interpretation, we can still draw inferences from the parameters in respect of their signs and statistical significance.

4.2.4 The General to Specific Model

When the share equation (4.21) is applied in a system of equations, there is likely to be a large number of parameters, and it may be difficult to obtain well-determined parameters. Deaton and Muellbauer (1980a, p.315) suggest placing whatever restrictions on γ_{ij} parameters, on a priori grounds, arguing that it is empirically or theoretically plausible without adverse consequences for the properties of the AIDS model. The sign on γ_{ij} has approximately the same sign as that on the compensated price elasticity, and therefore this is useful in providing insight in prior restrictions[7]. This recommendation is taken into account in proceeding from the general to specific model[8]. Likewise, with respect to non-price sensitive explanatory variables, it is not necessarily the case that freely-determined coefficients lead to the economically sensible results. Therefore restrictions on the coefficients (i.e. zero imposition) are imposed where appropriate.

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[6] E_w and E_y are defined as follows: E_w, E_y > 1: luxury, E_w, E_y < 1: necessity E_w, E_y < 0: inferior.

[7] Note that if the coefficient is numerically very small, the sign between the coefficient and price elasticity (and also the eigenvalue of *k* in (4.16)) may not be the same.

[8] Barr and Cuthbertson frequently imposed restrictions of negativity and zeros on price parameters, other than those of homogeneity and symmetry in their AIDS model specification.

The calibration with the data by imposing restrictions is a necessary procedure, not only because of the difficulty of obtaining plausible estimates in asset demand functions, but also because the data themselves are not of good-quality as described in the previous chapter. The restrictions implemented in this thesis are nevertheless far less dramatic than those of other flow of funds researchers; recall that Brainard and Tobin (1968) used 'guesstimated' estimates; the followers of the pitfalls model employed mixed estimates; Bhara, Green and Murinde (1999) calculated the parameters.

The selection of the preferred specific model is reconciled with maintaining the economic sense in estimates, while obtaining plausible simulation results.

4.2.5 Weak Separability

In many empirical demand analyses, the assumption of separability between a consumption decision and the allocation of portfolio decisions is treated as a maintained hypothesis: a consumption decision being taken first followed by a portfolio decision. Such a separability is at the heart of neoclassical demand systems, and it is applied to the AIDS share equation. Specifically, the application of weak separability allows the demand functions within each group to depend only on the prices in the same group. This narrows the focus, and contributes to reducing the data requirements and preserves statistical degrees of freedom in empirical work (Swofford and Whitney, 1987).

Despite this advantage, it is well known that the conditions to satisfy weak separability are quite severe. First, whole groups are either complements or substitutes for each other. Second, it requires a set of consistent group price indices and this kind of price aggregation is possible, if and only if, the utility function is structured either as homothetically separable or as strongly separable. The former implies that doubling the quantity of each good is matched by an equal increase in utility. It imposes unitary expenditure elasticities, that is, budget shares within each group are independent of total group expenditures. However, this contradicts the general tenor of budget studies (Deaton and Muellbauer, 1980a). The latter is more restrictive in that it requires 'additivity' between groups: $u = u_a(q_a) + u_b(q_b) + \dots$. This means that all other prices outside the group in question are required, since the group price indices, say P_a, are given by $P_a = P_a(u_a, p^a)$, and are dependent on u_a, which in turn depends on all other prices outside the group. If preferences are neither homothetic nor strongly separable, one possibility is to assume that the group price indices P_a do not vary much with the group utility u_a, hence most of the explanation of P_a is the sub-set of prices, p^a (Deaton and Muellbaur, 1980b and Barr and Cuthbertson, 1989). Taking this suggestion, weak separability is assumed in the portfolio demand functions.

In this study, the weak separability tests are conducted in an ad-hoc manner by using the available other interest rates outside the group: if the extraneous interest rates are statistically insignificant, weak separability is supported in this respect. We also conduct the homotheticity tests, as these are associated with weak separability. If there are no wealth effects on the holding of assets (i.e. the unitary wealth elasticity), then the utility function is homothetic and weak separability is supported in this respect. But if we find a wealth effect, the share of the financial assets will depend indirectly on the excluded interest rates in a system of equations, since the excluded rates will influence the allocation of total wealth between the sub-groups.

4.2.6 Seemingly Unrelated Regression (SUR) Estimates

For the system of AIDS share equations with the imposition of cross equation constraints on the parameters, Seemingly Unrelated Regression (SUR) developed by Zellner (1962) is employed for the estimation. In SUR, a GLS method is applied to exploit the correlation in the errors across equations, in which the errors are assumed to be independent over time but correlated across equations. This methodology requires a diagonal variance-covariance matrix of the disturbances obtained from running OLS on each equation separately, which is used as a weighting matrix when the model is re-estimated. See Appendix 4.2 for the SUR specification.

It is known that the GLS estimator reduces to OLS, that is, there is no efficiency gain, when i) the contemporaneous error terms are not correlated across equations, and ii) all equations contain the same variables across equations. With respect to the former, it is clear that the disturbances are correlated; with the total shares summing to one and that the error terms sum to zero across equations. For the latter qualification, as we proceed from general to specific model, it is not always the case that each equation contains the same explanatory variables.

Binkley (1982) investigated the efficiency of SUR relative to OLS, and found that there is a gain using SUR when multicollinearity problems are encountered for the following reasons. By accounting for cross-equation error correlation, SUR decreases the variance of the error term (this increases the precision of estimates, mitigating the multicollinearity problem), while increases the predictability of the error terms. The latter is like additional variables to an equation. The additional variables, even if they are highly correlated with those already in the equation, are unlikely to markedly increase the overall multicollinearity if it is already quite high among the original variables. Hence, the more likely is SUR to lead to significant efficiency gain, the greater the multicollinearity within an equation. It was therefore more tempting to employ the SUR technique, as our model tends to suffer from multicollinearity given a set of interest rates as principle regressors in the AIDS framework. We employ the iterated SUR technique[9].

4.2.7 Likelihood Ratio Tests

Hypothesis testing of linear constraints on the parameters of the AIDS model (such as homogeneity, symmetry, weak separability and homotheticity) can be performed using the likelihood ratio (LR) test[10]. The LR test compares the maximized values of the log likelihood functions between constrained and unconstrained models based on the statistic as given by:

$$L = 2(l_u - l_r) \sim \chi^2_{(J)} \tag{4.31}$$

[9] With several test runs, the iterated SUR technique, which iterates until linear models converge (TSP, 1999), proved to be statistically superior to the conventional SUR and also to 3SLS. With respect to the 3SLS, the lagged prices were used as instrument variables. However, there is some difficulty posed in this: Endogeneity is mainly in the prices (i.e. interest rates), but these were varied administratively for much of the estimation period. Treating them predetermined may therefore not be reasonable.

[10] Wald test is also conducted, though the test results are not presented here on the following reasons. It is argued that in a heavily parameterised system the Wald test is more likely to 'over-reject' the null than is the likelihood ratio test. This problem becomes more severe as the number of equations in the system increases or the sample size becomes smaller. See Evans and Savin (1982).

where l_u (l_r) is the log likelihood of the unrestricted (restricted) equation and J is the number of restrictions. L has an approximate $\chi^2_{(J)}$ distribution.

The LR test however is known to be too large in small samples, hence the small sample-adjusted LR test is also carried out. This is given by the product of LR statistic and *(T-K)/T,* where T = No. of observations and K = No. of exogenous variables in each equation, excluding the imposed zero restrictions. The small sample-adjusted LR test is also distributed as $\chi^2_{(J)}$ (Bohm, Rieder and Tintner, 1980).

4.3 Cointegration

4.3.1 Introduction

Any time series data are generated by a stochastic process. The stochastic process is *stationary* if the mean and variance are constant, and covariance does not depend on time but on the time lag between two observations. The stochastic process is *non-stationary* if mean and/or variance are not constant, i.e. it exhibits the time-changing mean and/or variance.

The non-stationary data can be largely classified into two types of data-generating process. One is a linear trend that yields the trend-stationary processes. The other is a random walk, that yields the difference-stationary processes (Mills, 1990). They are also referred as a *deterministic trend* and a *stochastic trend* respectively. The major difference between them is that, given any shock, the impact is temporary in the former case, whereas it is persistent in the latter case by definition[11]. A process with a stochastic trend is known as an integrated process, and this is the one associated with the cointegration argument.

[11] Both trend-stationary and difference-stationary processes exhibit a time-varying mean, however, the latter is also characterised by a variance that is an increasing function of time (Mills 1990).

Explicitly, suppose that a variable y_t is generated by the following process:

$$y_t = \rho y_{t-1} + u_t \qquad u_t \sim IID(0, \sigma^2) \qquad (4.32)$$

where, u_t is independent identically distributed Gaussian error terms.

The variable y_t is stationary if $|\rho| < 1$, and non-stationary if $\rho = 1$[1].

If y is the latter case, it has a stationary representation after differencing once, and it is said to be integrated of order 1, (I(1)). If, in general, y has a stationary representation after differencing *d* times, it is said to be integrated of order *d*, (I(*d*)) (Dolado, Gonzalo and Marmol, 2001).

In the collaborative work by Granger and Newbold (1974), it was reported that two independent integrated time series tended to exhibit apparent relationships in regression: any tendency for both time series to grow leads to correlation reflecting the 'common trends' that are shared between the non-stationary variables, even though each is growing for very different reasons (Harris, 1995)[2]. Such a regression is termed a *spurious regression*. However, for two or more non-stationary processes there may exist linear combinations, which are stationary. In this instance, the results are not spurious, and the two variables are said to be cointegrated.

Engle and Granger (1987) explicitly define cointegration: if the residuals obtained from regressing $y_t \sim$ I(d) on $x_t \sim$ I(d) are of a lower order of integration, I(d-b), where b > 0, then the two (or more) series are cointegrated and form an equilibrium relationship. Cointegration mimics the existence of a long-run equilibrium, in which economic forces are in balance, and the economic system moves towards equilibrium defined by a meaningful long-run relationship. (Dolado, Gonzalo and Marmol, 2001, p.637 and Harris, 1995, p.22)

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[1] If $|\rho| > 1$, the process is explosive.

[2] This phenomenon tends to be accompanied by high R-squared and highly autocorrelated residuals as is indicated by very low DW (close to zero) (Granger and Newbold 1974). Moreover, the distributions of the *t*-statistics diverge as *t* becomes larger, so there are no asymptotically correct critical values for the test (Granger, 2001).

Given the finding of spurious regression and cointegration with respect to the non-stationary nature of time series, it seems to be almost mandatory to conduct some form of cointegration analysis. In this section, we examine first of all a unit root test, which determines whether a variable is generated by an integrated process or not. Then, the two most commonly used cointegration tests are discussed: one is the single-equation framework of the Engle-Granger (EG) approach and the other one is the system-based Johansen approach.

4.3.2 Unit Root Test

We conduct the popular Dickey-Fuller (DF) test for a unit root[3]. The DF test amounts to estimating the above equation (4.32), but by reformulating the model as given in a general form with an intercept (μ) and a deterministic trend (t):

$$\Delta y_t = \mu + \gamma t + (\rho - 1)y_{t-1} + u_t \qquad u_t \sim IID(0,\sigma^2) \qquad (4.33)$$

and $H_0 : (\rho - 1) = 0$, $H_1 : (\rho - 1) < 0$

When the null is not rejected, the variable is said to contain a unit root (or an integrated process). The DF test presents a first-order autoregressive process of the series y_t. This can be augmented by allowing a pth order autoregressive process in y_t to take account of serial correlation in the error terms referred to as the augmented Dickey-Fuller (ADF) test:

$$\Delta y_t = \mu + \gamma t + (\rho - 1)y_{t-1} + \sum_{i=1}^{p-1} \psi_i^* \Delta y_{t-i} + u_t \qquad u_t \sim IID(0,\sigma^2) \qquad (4.34)$$

If $(\rho - 1) = 0$ against alternative $(\rho - 1) < 0$, then y_t contains a unit root. Given the small sample size of 43 and also the use of annual data, we arbitrary set the lag length of 2 for ADF and present the results together with those of the DF test. With ADF(2),

[3] There are other unit root tests. Among others, the Phillips Perrons (PP) test of Phillips (1987) is relatively popular. The PP test is a variant of DF/ADF based on the Z-test. While the Dickey-Fuller procedure retains the validity of tests based on white-noise errors in the regression model, the PP test involves a non-parametric correction to the test statistic to account for the serial correlation in residuals, and produces statistics that are robust to heteroskedasticity (Banerjee, Dolado, Galbraith and Hendry 1993). It has been however known that although it generally has higher power, the PP test has more severe poor-size properties. Hence, we do not pursue this alternative test.

white noise error is almost ensured[4].

In DF and ADF tests, it is important to note whether the data generating process for the variables contains deterministic variables of intercept and trend or not. Without a constant, it implies that the overall mean of the series is zero, and this is unlikely, hence the constant is adhered to in the unit root test. In respect of a deterministic trend, this is closely related with the drawback of a unit root test. It is argued that the unit root test often suffers from poor sample size and power properties (Blough, 1992). Any unit root process (but close to stationary around a deterministic trend) can be approximated by a trend-stationary process, especially when the sample size is small, hence there is a tendency to over-reject the null hypothesis of a unit root. On the other hand, in finite samples any trend-stationary process (but close to having a unit root) can be approximated by a unit root process, therefore there is a tendency to under-reject the null[5]. Therefore, in part to alleviate this limitation (in particular the under-rejection of the null), we arbitrarily include a trend in the DF and ADF regressions. If it is not significant, we conduct the unit root test without a time trend, and if significant, with a time trend.

In the DF and ADF tests, a *t*-test of the null hypothesis of non-stationarity is not based on the standard *t*-distribution, but on the non-standard Dicky-Fuller distribution. Further depending on the deterministic variables, the critical values differ. In testing unit root, we use the Davidson and MacKinnon's asymptotic critical values. This has some advantages over the Dicky-Fuller critical values; i) they can be read off for any sample size, and ii) they do not require either normality or homoskedasticity in error terms, whereas the finite-sample critical values depend upon the assumption of white noise error terms (Davidson and Mackinnon, 1993, p.708).

In conducting a unit root test, there are two points to be noted. First, there is a

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[4] In 17 out of 63 cases (total number of the unit root and cointegration tests presented in the thesis) in the DF test, residuals exhibit serial correlation at the 5 % significance level by the LM test, and it will be reduced to 9 cases at the 1% level. In the case of ADF(2), 10 out of 63 cases indicate the serial correlation at the 5% level, and only 2 cases at the 1% level.

[5] This follows from the closeness of the finite sample distribution of any statistics under a trend-tationary process and under a difference-stationary process (Harris, 1995, p.39).

theoretical problem in that asset shares are bounded, and that they cannot be a random walk, since such a series is unbounded[6]. However, none of the share series in our current study approaches the bound, neither the upper nor the lower, i.e. none of them are I(0), hence we carry out cointegration analysis. Second, it is associated with the breakpoint in the time series. Perron (1989) argued that standard tests of the unit root hypothesis are not consistent against 'trend stationary' alternatives where the trend function contains a shift in the level or the slope. He advocated the unit root test, referred to as Perron's model, by allowing both the null and alternative hypothesis for the presence of a one-time change in the level or in the slope of the trend function. This may be relevant to the current study, since there are possible structural changes in 1969 and 1990 in the Indian financial system (see Chapter 3). Hence the Perron's unit test is conducted by incorporating the trend, post-break constant dummy and the post-break slope dummy. Refer to Appendix 4.3 for the detailed model specification. There are however some limitations in applying Perron's unit root test. The fact that the structural change is exogenous implies that the results are conditional. That is, conditional upon the presence of a change in the trend function, the fluctuations are transitory. Next, it contains only one break in Perron's model, though there are two possible structural breaks of 1969 and 1990 over the sample period of 1951-93. But this can be mitigated by concentrating on the structural break at 1969, since, when the break point is close to the beginning or the end of the sample period, the results are similar to those of the Dickey-Fuller test. Finally, Perron's model focuses on determining the existence of a unit root, rather than determining the order of integration of the variables, and the latter is the most interesting in the current study. Perron (1989) reconciles that a rejection of the null hypothesis does not imply acceptance of a particular alternative hypothesis. For these reasons, though Perron's unit root test is relevant to the shift in the Indian financial sector, the test results are presented in an appendix in each single sector study. (As a whole, the results turn out to be broadly consistent with those of the Dickey-Fuller test, while some variables exhibiting statistically significant post-break dummies.)

[6] See Barr and Cuthbertson (1991a, p.868 in footnote) and Adam (1999, p.106).

4.3.3 EG Cointegration Test (Single-Equation Approach)

The EG test is a single equation approach for the cointegration test. In the context of our study, the long run parameters of the AIDS model are used to construct the residuals which are then subject to the DF and ADF tests for stationarity. Explicity, the residuals are

$$e = S - \hat{\Pi}X \qquad (4.35)$$

where S = the share of holding financial assets, $\hat{\Pi}$ = long run parameters estimates and X = the matrix of variables.

However, the calculated e is based on the estimated cointegrating parameters, the variance of the residuals is therefore minimized, and this prejudices the testing procedure toward finding stationarity (Dolado, Gonzalo and Marmol, 2001). Hence, larger (in absolute value) critical levels than the standard critical values for unit root are needed. Further, the distribution of the test statistic under the null is affected by the number of endogenous regressors (n) included in the AIDS model: as n increases, the critical value increases.

The rejection of the null hypothesis means that the residuals are stationary, and that cointegration exists in the regression. Then a long-run stationary relationship is established between the integrated dependent variable and the regressors. Moreover once cointegration is established, the estimates are said to be 'super-consistent'[7].

4.3.4 Johansen Cointegration Test (System-Based Approach)

In the current study, the potential I(1) endogenous variables (n) in each equation are the share of holding financial assets, lending rates, returns on shares and the AIDS wealth $(W^{\tau} / P^{*\tau})$[8] (see Section 4.1). This implies that each long-run model would consist of up to $n = 4$.

7 The estimators with non-stationary variables converge to its true values at a much faster rate than do the usual estimators with stationary variables (Stock, 1987).

8 Although the sector wealth is exogenous, the AIDS wealth is endogenous since $P^{*\tau}$ varies with the lending rate and return on shares.

So far, we have confined the analysis to the case where there is, at most, a single cointegrating vector in a single equation framework. This is quite restrictive when we are analyzing the cointegrating properties of a $n > 2$ dimensional vector of I(1) variables, in which up to n-1 linearly independent cointegration vectors are possible[9]. Besides, in the EG approach the cointegration regression may suffer from small-sample bias (Banerjee, Dolado, Galbraith and Hendry, 1993). All these suggest that EG test is not sufficient, and there is a need of supplementary tests. Hence we conduct the Johansen cointegration test.

The Johansen approach involves a maximum likelihood estimation procedure based on the so-called reduced rank regression method, which is compatible for the case $n > 2$. The Johansen approach can be explained by modelling a vector Z_t as an unrestricted vector autoregression (VAR) with k-lags,

$$Z_t = A_1 Z_{t-1} + ... + A_k Z_{t-k} + u_t \qquad u_t \sim iid(0,\Sigma) \qquad (4.36)$$

where

Z_t : (n x 1) endogenous I(1) variables

A_i: (n x n) matrix of parameters

Σ : symmetric positive-definite matrix

Johansen and Juselius (1990) explain that this can be reformulated into a vector error-correction:

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + ... + \Gamma_{k-1} \Delta Z_{t-k+1} + \Pi Z_{t-k} + u_t \qquad u_t \sim iid(0,\Sigma) \qquad (4.37)$$

where

$\Gamma_i = -(I - A_1 - .... - A_i)$ $\quad$ (i = 1, ..., k-1)

$\Pi = -(I - A_1 - ...... - A_k)$

This contains information on both the short- and long-run adjustments to changes in the variables in the model via the estimates of $\hat{\Gamma}_i$ and $\hat{\Pi}$ respectively.

[9] Dickey, Jansen and Thornton (1994) comment that it is better to have many cointegrating vectors. Cointegration vectors may represent constraints on the movement of the variables in the system in the long-run. Consequently, the more cointegrating vectors there are, the more stable the system is, and it is desirable to be stationary in as many directions as possible.

Since all ΔZ_{t-i} are I(0), for $u_t \sim$ I(0), ΠZ_{t-k} must be stationary[10]. $\Pi Z_{t-k} \sim$ I(0) occurs when there exists up to n-1 cointegration relationships (r). Then, it can be specified as $\Pi = \alpha\beta'$, where α represents the speed of adjustment to equilibrium, while β is a matrix of long-run coefficients. The long-run relationships of β can be decomposed into stationary and non-stationary: r columns of β form r linearly independent combinations of the variables in Z_t, each of which is stationary, while the remaining $(n - r)$ columns of β form unit root combinations termed 'common trends' and are non-stationary vectors. Only the cointegration vectors in β enter (4.37), which implies that the last $(n - r)$ columns of α are effectively zero. Testing for cointegration amounts to finding the number of r linearly independent columns (or rank) in Π.

Partial Version of the VECM

A single equation in our system of AIDS share equations would potentially consist of not only I(1) but also I(0) variables, further I(1) is divided into exogenous and endogenous variables. Hence, a partial version of VECM, which takes into account of heterogeneous variables, is applied. This is given by:

$$\Delta Y_t = \Gamma_o \Delta X_t + \Gamma_1 \Delta Z_{t-1} + ... + \Gamma_{k-1} \Delta Z_{t-k+1} + \Pi Z_{t-k} + \psi D_t + u_t \qquad u_t \sim iid(0,\Sigma) \qquad (4.38)$$

where

Y = vector of endogenous I(1) variables

X = vector of weakly exogenous I(1) variables

$Z = Y, X$

D = vector of exogenous I(0) variables (e.g. dummy)

The weakly exogenous variables remain in the long-run model. This implies that Y is conditional on X. Conditioning on these variables will usually ensure that the system determining ΔY_t has better stochastic properties in terms of the residuals[11]. As equation (4.38) implies, the short-run behaviour of the weakly exogenous variables is not modelled. This is due to the fact that since the exogenous variable equation

[10] The sum of an I(1) process and an I(0) process is always I(1) (Dolado *et al.* 2001).

[11] The distribution of the test statistic will not be invariant to X (Dickey *et al.* 1994, p.20).

contains no information about the long-run β, there is no loss of information from not modelling these variables (Harris, 1995).

Given that there is no cointegration vector and that α = zero in the exogenous variable equation, the weakly exogenous variables are defined as given by:

$$\Delta X_t = \Gamma_1 \Delta Z_{t-1} + \ldots + \Gamma_{k-1} \Delta Z_{t-k+1} + \psi D_t + v_t \qquad v_t \sim iid(0, \Sigma) \tag{4.39}$$

Notice that (4.39) allows for feedback from ΔY to ΔX, but does not allow for level feedback (Pesaran and Pesaran, 1997). In the current study, it is assumed that the administered interest rates, policy variables and the real variables belong to the weakly exogenous variables. This is perhaps economically plausible.

Tests, Lag-length and Deterministic Components

Reduced rank regression provides *n* eigenvalues of $\hat{\lambda}_i$ (*i*= 1, ..., *n*). The magnitude of $\hat{\lambda}_i$ is a measure of how strongly the cointegration relationships are correlated with the stationary part of the model. Eigenvalues of $\hat{\lambda}_i$=0 for *i* = *r*+1,…*n*, are associated with the non-stationary part of the model. Thus to test the null hypothesis that there are at most *r* cointegration vectors and (*n*-*r*) unit root amounts to:

$$H_o : \lambda_i = 0 \qquad i = r{+}1, \ldots .n$$

where only the first *r* eigenvalues are non-zero.

The test can be conducted using either of the following two test statistics.

Trace statistic: $\lambda_{trace} = -2\log(Q) = -T\sum_{i=r+1}^{n}\log(1-\hat{\lambda}_i)$ (4.40)

where Q = restricted maximised likelihood ÷unrestricted maximised likelihood

$H_0 : r = q$, $H_1 : r \geq q+1$

where q =0, 1, 2,….*n*-1

Maximum eigenvalue statistic: $\lambda_{\max} = -T\log(1-\hat{\lambda}_{r+1})$ (4.41)

$H_0 : r = q$, $H_1 : r = q+1$

where q =0, 1, 2,….*n*-1

Note that if $\hat{\lambda}_i$ s and $\hat{\lambda}_{i+1}$ are close to zero, the statistics will be small, as ln(1) = 0.

It is argued that the power of the trace test is lower than the maximum eigenvalue test (Johansen and Juselius, 1990), besides if there are deterministic variables in the model, critical values of the trace test are only indicative. However, it has an advantage over the maximum eigenvalue test, in that the trace test is more robust in terms of skewness and excess kurtosis in the residuals. Both, however, have the problem of a small sample size. Hence we conduct both to support the choice of *r*.

The Johansen approach requires the residuals to be 'white noise'. This involves setting the appropriate lag-length. In our study, this is determined in the following process: Given an arbitrarily chosen maximum value of lag=4, the VAR is modelled then the appropriate order of augmentation is selected by Schwarz Bayesian Criterion (SBC) and Akaike's Information Criterion (AIC), while checking that the residuals satisfy white noise . If conflicting results emerge between them, choose the lower lag in order to avoid over-parameterisation[12].

The test of whether there are deterministic components in VECM or not, is undertaken simultaneously with the test for the reduced rank. There are five cases ranging from the most restricted model to the least restricted model. See Table 4.8.

In the current study of the AIDS model, wealth and some real variables exhibited a deterministic trend in the levels of the data, while other underlying variables were non-trended. We therefore present the results of Model 3 for all sectors. In choosing the model, Johansen (1992) suggests a so-called 'Pantula principle', that is to test from the most to the least restrictive model, and stop the first time the null hypothesis is not rejected in the trace or maximum eigenvalue test. The 'Pantula principle' approach is also supportive for Model 3[13].

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[12] It turns out that the order of VAR=1is found for 20/25 cases, VAR=2 for 4/25 cases and VAR=3 for 1/25 cases in the Johansen tests presented in this thesis.

[13] Out of total 25 Johansen test results presented in the sector study, the Pantula principle (excluding Model 1 in Table 4.7) chooses Model 2 for 13 cases, Model 3 for 10 cases and Model 4 for 2 cases.

Table 4.8 Johansen tests

Models	Notes
Model 1: without trend, nor intercept in the short-run and in the long-run	This is unrealistic as the intercept needs to account for the units of measurement of the variables in Y_t.
Model 2: without trend but with restricted intercept	If there are no linear trends in the levels of the data (long-run), then the first-differenced series (short-run) has a zero-mean. Hence, the intercept is restricted to the cointegration space or long-run.
Model 3: without trend but with unrestricted intercept	If there are linear trends in the levels of the data, then the model can be specified with an intercept.
Model 4: with restricted trends and with unrestricted intercept	If there is some long-run linear growth, which the model can not account for, then a linear trend should be in the cointegration vectors.
Model 5: with both unrestricted trends and intercept	This allows for linear trend in the short-run and thus quadratic trends in the cointegration vectors.

Sources: Harris (1995)

4.3.5 Concluding Remarks

Given a relatively small sample size against not a small number of explanatory variables, and the system of the share equations being imposed of restrictions, the application of unit root and cointegration tests to our study will be conducted in the somewhat restricted manner. There are other points to be noted in applying cointegration techniques to the AIDS model.

As discussed in the partial version of VECM, cointegration is present when there is a mix of different order series of I(0) and I(1) in the model[14]. I(0) variables might play a key role in establishing a long-run relationship between I(1) variables, in particular, if theory a priori indicates that such I(0) variables should be included (Harris, 1995,

[14] It is also possible that two I(2) variables cointegrate, and this will form another cointegration with I(1) variable, referred to as multicointegration (Dolado *et al.* 2001).

p.80). In the Johansen approach, however, the inclusion of I(0) variables increases the number of cointegration vectors, *r*. Since each I(0) variable is stationary by itself, it forms a linearly independent column in Π. This is borne in mind when we draw inference from the Johansen cointegration test.

In a multivariate model, the EG test is applicable when there is a single cointegration vector, and when all the explanatory variables are weakly exogenous with respect to the dependent variable. Otherwise, a potential inefficiency problem arises, because information is lost unless each endogenous variable appears on the left hand side of the estimated equations (Harris, 1995). In this respect, Johansen seems to be superior to EG. However, Gonzalo and Lee (1998) show that in some situations mis-specification of deterministic components and an inclusion of a 'near' I(1) variable[15] as an I(1) process in the cointegration test, can hurt the Johansen test more than EG. In this setting, Johansen's likelihood ratio tests tend to find spurious cointegration[16]. This is due to the fact that they have different loss functions: EG looks for the linear combination of integrated variables with minimum variance, whereas Johansen looks for the linear combination of integrated variables with maximum correlation. The latter is more affected by these situations.

As a robustness check, we apply both cointegration tests. The analysis of portfolio behaviour, however, has to resort to the cointegration vector based on the Engle-Granger approach, rather than that based on the Johansen approach on the following ground: The AIDS system of equations are estimated by SUR technique with each equation subject to cross-equation restrictions. It is possible to conduct the EG cointegration test directly on the single equation without breaking the restrictions. In the case of Johansen, each equation in the system is subject to a system of equations, and the restrictions imposed on each equation become meaningless[17]. Further, in the VAR model to produce Johansen test, the short-run adjustments are implicit, though the data are not reliable enough to analyse the dynamic model.

[15] This is a stochastic unit root variable, that is not constant but stochastic and varying around unity.
[16] This is different from spurious regression, in that spurious cointegration is not detected by the cointegration test.
[17] The Johansen test has not been developed for a set of equations subject to cross-equation restrictions (Barr and Cuthbertson, 1992a)

Banerjee *et al.* (1993, p.285), however, report that when there is one cointegrating vector and a common factor error representation is valid, then the Engle-Granger two-step method is asymptotically equivalent to the Johansen method. Further in the empirical study of Dickey *et al.* (1994) the cointegration vectors derived from the EG approach are found to be numerically very close to those derived from the Johansen approach[18]. These suggest that irrespective of the component of the dynamic model in the VAR model, the long-run model of the EG and that of the Johansen approach may share some common features. The Johansen test can be used to identify the number of cointegration vectors and to supplement the results of the EG test[19].

[18] The empirical comparative study on the cointegrating vector between the Johansen and the EG approach was conducted using three I(1) variables by Dickey *et al.* (1994, p.34). They found that the estimated cointegrating vectors obtained from the Johansen and Engle-Granger are almost identical when both indicate cointegration, though this is not formally proved.

[19] Hence, we do not deal with the cointegration vector found in the Johansen approach. We are, however, aware that where coefficients have counter-intuitive signs we could check the other cointegrating vectors to see if the signs are better, but this does not help estimation under restriction.

Appendix 4.1

Stock data for behavioural equations on 31st March 1994

Rs. crore

	Gov't (G)	Banks (B)	OFIs (OFI)	PCB (PCB)	Household (H)	Exogenous	Total
CUR	(-83554.0)				77581.1	5972.9	0.0
R	(-47758.3)	47758.3				0.0	0.0
DEP		(-318157.7)		19788.1	253054.8	45314.9	0.0
GD	(-273900.5)	96476.9	102463.5		61602.5	13357.6	0.0
CS		25909.0	-23295.6	-28493.2	83767.7	-57887.9	0.0
LA		156252.7	99543.8	-151361.1	-130237.7	25802.3	0.0
PF			(-124074.4)		172388.7	-48314.3	0.0
Net Worth	-405212.8	8239.1	54637.3	-160066.1	518157.0	-15754.5	0.0

- CUR=Currency, R=Bank reserves, DEP=Deposit, GD=Government debt, CS=Company securities LA=Loans and advances, PF=Provident funds.
- 'Exogenous' includes data for the cooperative banks and credit societies, ROW, negligible and unidentified.
- ( )= Demand determined

Appendix 4.2

SUR specification

A system of N equations with T observations can be specified as given (Fiebig, 2001),

$$Y_i = X_i\beta_i + u_i \qquad i = 1,\ldots..N \tag{A4.1}$$

where Y_i and u_i are of dimension (T x 1), X_i is (T x K_i) and β_i is (K_i x 1).

Note that each equation does not have to have the same number of explanatory variables (K). Stacking all N equations yields,

$$\begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_N \end{bmatrix} = \begin{bmatrix} X_1 & 0 & \cdots & 0 \\ 0 & X_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & X_N \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_N \end{bmatrix} + \begin{bmatrix} u_1 \\ u_2 \\ \vdots \\ u_N \end{bmatrix} \tag{A4.2}$$

This can be alternatively written as

$$Y = X\beta + u \tag{A4.3}$$

The dimensions of Y, X, β and u are, respectively, (NT x 1), (NT x K), (K x 1) and (NT x 1), with $K = \sum_{i=1}^{N} K_i$.

For the NT x 1 vector of stacked disturbances, it is assumed that E(u) = 0 and the NT x NT covariance matrix consists of N^2 blocks of $E(u_i u_j^{'}) = \sigma_{ij} I_T$ where I_T is a T x T identity matrix. The covariance matrix for the complete error vector can be given by $\Omega = \Sigma \otimes I_T$ where Σ is the N x N contemporaneous covariance matrix and $\otimes$ denotes the kronecker products:

$$\sum \otimes I_T = \begin{bmatrix} \sigma_{11} I_T & \sigma_{12} I_T & \cdots & \sigma_{1N} I_T \\ \sigma_{21} I_T & \sigma_{22} I_T & \cdots & \sigma_{2N} I_T \\ \vdots & \vdots & & \vdots \\ \sigma_{N1} I_T & \sigma_{N2} I_t & \cdots & \sigma_{NN} I_T \end{bmatrix} \tag{A4.4}$$

The elements of Ω is obtained from the residuals by running OLS on each equation separately.

The implication is that the T disturbances in each of the N equations have zero mean, equal variance and are uncorrelated, but covariances between contemporaneous disturbances for a pair of equations are nonzero.

The GLS applies to the stacked model, and since $\Omega^{-1} = \Sigma^{-1} \otimes I_T$ the GLS estimator is defined as (Greene, 2000):

$$\begin{aligned} \hat{\beta} &= \left[X'\Omega^{-1}X\right]X'\Omega^{-1}Y \\ &= \left[X'(\Sigma^{-1} \otimes I_T)X\right]^{-1} X'(\Sigma^{-1} \otimes I_T)Y \end{aligned} \tag{A4.5}$$

The covariance matrix is given by,

$$Var\left[\hat{\beta}\right] = \left[X'(\Sigma^{-1} \otimes I_T)X\right]^{-1} \tag{A4.6}$$

Appendix 4.3

Perron's Unit Root test

Given a series $\{y_t\}_0^T$ that is a realisation from a process characterised by the presence of a unit root and possibly a non-zero drift, the approach allows a one-time change in the structure occurring at a time $T_B(1 < T_B < T)$. Three different models are considered under the null hypothesis. One that permits an exogenous change in the level of the series, one that permits an exogenous change in the rate of growth, and one that allows both changes. The hypothesis can be parameterised as follows:

Null hypothesis:

Model (A) $\quad y_t = \mu + dDTB_t + y_{t-1} + e_t \quad$ (A4.7)

Model (B) $\quad y_t = \mu_1 + y_{t-1} + (\mu_2 - \mu_1)DU_t + e_t \quad$ (A4.8)

Model (C) $\quad y_t = \mu_1 + y_{t-1} + dDTB_t + (\mu_2 - \mu_1)DU_t + e_t \quad$ (A4.9)

$DTB_t = 1$ if $t = T_B + 1$, 0 otherwise;

$DU_t = 1$ if $t > T_B$, 0 otherwise;

and where e_t is taken to be of the ARMA (*p, q*) type. T_B refers to the time of break, i.e. the period at which the change in the parameters of the trend function occurs.

Perron considers the following alternative hypothesis:

Alternative hypothesis:

Model (A) $\quad y_t = \mu_1 + \beta t + (\mu_2 - \mu_1)DU_t + e_t \quad$ (A4.10)

Model (B) $\quad y_t = \mu + \beta_1 t + (\beta_2 - \beta_1)DT_t^* + e_t \quad$ (A4.11)

Model (C) $\quad y_t = \mu_1 + \beta_1 t + (\mu_2 - \mu_1)DU_t + (\beta_2 - \beta_1)DT_t^* + e_t \quad$ (A4.12)

where $DT_t^* = t - T_B$ if $t > T_B$ and 0 otherwise.

Model (A) describes the 'crash' model. The null hypothesis of a unit root is characterised by a dummy variable which takes the value one at the time of break. Under the alternative of a trend stationary system, Model (A) allows for a one-time change in the intercept of the trend function, the magnitude of this change being $\mu_2 - \mu_1$.

Model (B), the 'changing growth' model, specifies under the null that the drift parameter change from μ_1 to μ_2 at time T_B, which under the alternative, a change in the slope of the trend function of magnitude $\beta_2 - \beta_1$, without any sudden change in the level, is allowed.

Model (C) allows both effects to take place simultaneously, i.e. a sudden change in the level followed by a different growth path.

In the current study, (since it is not known whether the effect of the institutional shift or the financial reforms cause a shift in the level or the slope of the trend function of the variables,) the cautious approach, that is, Model (C) is chosen.

Perron (1989) generalises the models by assuming that y_t responds to a shock in the trend function in the same way as it reacts to any other shock, i.e. the inclusion of a kth autoregressive process in y_t (we arbitrary test both k =0, without augmented autoregressive process, and $k = 2$ to be consistent with ADF test).

The critical values are larger (in absolute value) than their Dickey-Fuller counterparts, which depend not on T, but on the time of the break relative to the sample size, i.e. on the ratio $\lambda = T_B / T$ with the largest value occurring when the break is in mid-sample. The critical values of the statistics are smallest when λ is close to 0 or 1; the critical values are identical to those of Dickey-Fuller when λ =0, 1.

The procedure is to estimate the regression:

$$y_t = \mu + \theta DU_t + \beta t + \gamma DT_t^* + \varsigma DTB_t + \phi y_{t-1} + \sum_{i=1}^{2} \delta_i \Delta y_{t-i} + e_t \qquad \text{(A4.13)}$$

and rewrite as

$$\Delta y_t = \mu + \theta DU_t + \beta t + \gamma DT_t^* + \varsigma DTB_t + \rho y_{t-1} + \sum_{i=1}^{2} \delta_i \Delta y_{t-i} + e_t \qquad \text{(A4.14)}$$

where $\rho = \phi$-1.

Under the null hypothesis of a unit root, $\rho = 0$ (or $\phi = 1$) and $\theta = \beta = \gamma = 0$, whereas under the alternative hypothesis of a trend stationary process, $\rho < 0$ (or $\phi < 1$) and θ, β, $\gamma \neq 0$. These parameters imply the coefficients for the constant ($\hat{\mu}$), the post-break constant dummy ($\hat{\theta}$), the trend ($\hat{\beta}$), and the post-break slope dummy ($\hat{\gamma}$) and the break dummy ($\hat{\varsigma}$).

Chapter 5 A Flow of Funds Model for the Banking Sector[1]

5.1 Introduction

Regulations imposed on the banking sector, such as administered interest rates, mandatory high reserve requirements (both for cash and liquid assets) and a directed credit programme are closely associated with fiscal devices, and they have repressed the banking sector in India with respect to its efficiency and profitability. The banking sector is however believed to be the principal institution for providing loanable funds to non-financial private sectors, and bank financing is a prime external source of funds for them, due to the under-developed securities market and the costliness of moneylenders in India. Therefore the study of the asset choice (or a flow of funds) in commercial banks will bring out crucial policy implications for economic activities. In this chapter, a flow of funds model for the banking sector is estimated for the long-run static model. By modelling the flow of funds, the sensitivity to interest rates and policy variables in the portfolio behaviour in the banking sector is revealed, and thereby investigate the policy implications.

The model proposed and implemented in this chapter departs from the seminal flow of funds study on India presented by Sen, Roy, Krishnan and Mundlay (1996). Sen *et al.* utilised a 'general disequilibrium' framework of the Brainard-Tobin (1968) type. Their study for the banking sector, however, has the following limitations in scope. First, the sample period is only 20 years, from 1970-71 to 1989-90. Second, the estimated financial assets are only those of excess reserves and loans. Third, there is a narrow scope in data used for estimation; the data used for loans in commercial banks are only those for the private corporate sector, assuming that those for other sectors are all policy-determined. Moreover, banks hold government debt and other financial institutions' (OFIs') securities subject only to the liquidity ratio. The model presented here is more consistent and

[1] This chapter is a revised version of the paper by Moore *et al.* (2001), which was presented at the Finance and Development conference, Nairobi, Kenya, 10-11 July, 2001.

extensive in scope. First the sample period consists of 43 observations from 1951-52 to 1993-94. Second a broader array of financial assets is considered, namely, excess reserves, government debt, company securities and loans. Third, the data used for estimation is based on net transactions of all uses and sources of the flow data.

There are some specific implications in applying the AIDS model to the banking sector (and also to the OFIs sector). If shares are thought to be increasing in own returns and decreasing in cross returns, one is left with the property that, for example, a rise in the rate of return on government securities yields will yield an increase in their portfolio share (Weale, 1986). This may be particularly asserted to the case in the financial institutions in pursuit of profitability, especially, in the banking sector the funds at their own discretion are reduced by the regulatory framework. However, there are no theoretical grounds for believing that this is the case in the pitfalls type model. Developments made in the analysis of the allocation of wealth have led to allocation procedures of a more sophisticated manner, founded on utility maximization. The mean-variance model introduced the theory in the portfolio balance model, yet, this approach fails to explain the capital-certain assets (Chapter 2). The financial institutions hold capital-certain assets, or risk-free assets, because of a number of regulations being imposed on them, such as CRR, SLR and CRAR (capital to risk weight asset ratio). Hence this approach is also not applicable to financial institutions. The consumer theory approach allows an analysis of holdings of not only capital uncertain assets, but also capital-certain assets. In particular in the AIDS model, it is possible to include a number of policy variables as conditioning variables, or as part of subsistence level, into the system of demand equations, which will capture the influence of other attributes besides price in determining portfolio behaviour.

This chapter is organised as follows: Section 5.2 deals with a balance sheet constraint clarifying the financial assets for estimation. The other explanatory variables are specified in Section 5.3. Estimation procedures and the results are presented in Section 5.4. Section 5.5 draws inference from the results. The conclusions are found in Section

5.6.

5.2 Balance Sheet and Financial Assets

Uses and sources for the commercial banks can be expressed as given:

ΔTotal Reserves + Δ Government Debt + Δ Company Securities + Δ Loans & Advances = ΔDeposits + Δ Share capital (5.1)

The left hand side (LHS) indicates assets, while the right hand side (RHS), liabilities. This can be re-adjusted by separating the total reserves into excess reserves and required reserves, and also by consolidating share capital into company securities, such that:

ΔExcess Reserves + Δ Government Debt + Δ Company Securities(-Δ Share capital) + Δ Loans & Advances = ΔDeposits - Δ Required Reserves (5.2)

The financial instruments on LHS are to be determined in the banking sector, whereas the instruments on RHS are assumed to be determined outside the banking sector, since deposits are postulated to be demand-determined and required reserves are policy-determined.

The financial instruments to be modelled are then the following four assets in Table 5.1a. The mean shares for the stock of asset categories over the sample period are also presented in the table. The interest rates (r_i, $i = 1, 2, 3, 4$) used for the AIDS prices ($\ln p_i^r$, $i = 1, 2, 3, 4$) are in Table 5.1b.

Table 5.1a Financial instruments for the banking sector

Financial instruments with notations		Mean shares
ER	Excess Reserves	3.1 %
GD	Government debt (government securities, government deposit, small savings)	25.8 %
CS	Company Securities (company securities deducted of share capital)	7.0 %
LA	Loans and advances (loans and advances, bonds and debentures)	64.0 %

The mean shares are derived by, e.g. ER/W for excess reserves, where W=ER+GD+CS+LA.

Table 5.1b The interest rates used for the AIDS prices

AIDS prices with notations	Interest rates
$\ln p_1^{\tau}$ = PER (Price of ER)	Bank Rate
$\ln p_2^{\tau}$ = PGD (Price of GD)	Government securities yields
$\ln p_3^{\tau}$ = PCS (Price of CS)	Return on shares
$\ln p_4^{\tau}$ = PLA (Price of LA)	Lending rate

In the model, Bank rate is used as being equivalent to the return on the excess reserves for the following reason: The bank rate is the central bank's rediscount rate, or in other words, the borrowing rate for banks at RBI (Reserve Bank of India). The rate can be, therefore, seen as a penal rate, i.e. banks are penalised equivalent to the bank rate, if they do not hold enough excess reserves faced with the need of short-term funds due to such as an increase in CRR. This will probably hit hard in the operation of the banking practice in India, since the money markets are underdeveloped and that the substitutes for the short-term liquidity is limited. Hence, it is hypothesized that banks are more willing to hold excess reserves as the bank rate rises.

5.3 Non-Price Sensitive Explanatory Variables

In the share equations, other than the AIDS prices ($\ln p_i^{\tau}$) and the AIDS real wealth ($\ln(W^{\tau} / P^{*\tau})$), non-price sensitive determinants can be added to the model as part of baseline holdings, namely, aggregate income (ln(Y/W) = Log of GDP at factor cost deflated by W [2]), CRR, SLR and Dummy 90.

The influence of the aggregate income on asset choices is a causal link from the real sector to the financial sector. CRR is primarily to capture the policy effect on the holding of the excess reserve. Dummy 90 is added so as to take account of the effects of financial liberalisation: dummy 1 for 1990-1993 (post-financial liberalisation) and dummy 0 otherwise.

The property of SLR is to force commercial banks to invest in government securities (issued by the government) and/or government approved securities (issued by other financial institutions). Sen *et al.* argues that approximately 70% of SLR of bank deposits was invested in the government sector while the rest, about 30% of SLR, in other financial institutions (OFIs) during their sample period 1970-89. They then postulate that the banks hold government debt and OFIs' securities subject only to the SLR.

However, the proportions 70% and 30% and the effect of SLR are not so clear as they claimed. Table 5.2 presents the proportion of government debt and company securities in OFI (both invested by the banking sector) in the total SLR of bank deposits, constructed using the flow data for the same period 1970-71 and 1988-89. From the table, it can be argued that, first, 70 % of SLR to the government and 30% of SLR to the OFIs does not seem to be supported, as the proportion significantly varies year by year, and, second, if the banking sector invests in the government sector and OFIs sector subject only to the SLR, then the total proportion should be close to 100%, but this is not the case. The total

[2] This is to avoid multicollinearity between $\ln(W^{\tau} / P^{*\tau})$ and lnY.

varies from 50.9% to 127.9%, implying that banks may be investing voluntarity to these two sectors in the case where the figure is above 100%, and SLR may not be fulfilled in the case where the figure is below 100%.

It proves that quantifying the policy determined flow of funds is very difficult. Therefore, in this study, prior claim by SLR is not excluded from the data source for estimation. It is assumed that the SLR variable captures the policy-determined level of the government securities and government-approved securities in the holding of assets for the banking sector.

Table 5.2 The Proportion of the SLR of Bank Deposits Allocated to Government and OFIs Sectors Between 1970-71 and 1988-89

Year	Government	OFIs	Total
1970-71	64.0%	7.4%	71.4%
1971-72	90.0%	10.0%	100.0%
1972-73	113.4%	14.5%	127.9%
1973-74	41.2%	9.7%	50.9%
1974-75	73.9%	12.7%	86.6%
1975-76	54.7%	15.9%	70.6%
1976-77	62.6%	19.9%	82.5%
1977-78	70.0%	23.0%	93.0%
1978-79	66.6%	22.7%	89.3%
1979-80	76.5%	24.8%	101.3%
1980-81	65.6%	32.8%	98.4%
1981-82	59.0%	33.8%	92.8%
1982-83	45.4%	24.7%	70.1%
1983-84	60.8%	23.9%	84.7%
1984-85	60.8%	23.9%	84.7%
1985-86	87.3%	31.6%	118.9%
1986-87	90.7%	20.7%	111.4%
1987-88	90.8%	29.2%	120%
1988-89	72.3%	24.9%	97.2%

The proportions are constructed as given by
Government = government debt ÷(SLR x bank deposits)
OFIs = company securities in OFIs ÷ (SLR x bank deposits)

Data Source : RBI Bulletin various issues

The priority sector lending requirement regulates banks to provide loans to the priority sectors (mainly the household sector which include such as agriculture and small industry) to approximately 40 % of their resources after the reduction of CRR and SLR. Sen *et al.* assumed that all bank loans to the household sector are exogenously given under this stipulation. We considered using dummy 69 to capture the credit controls (this regulation was established since the major commercial banks were nationalised in 1969); dummy 0 for 1951-1968 and dummy 1 for 1969-1993, however the estimates of the dummies in the share equations were all statistically insignificant at the lower level, hence the dummy is excluded from the model. This is probably due to the fact that the total loans to other sectors may remain the same over the sample period, and it is the distribution of the loans to sectors that has changed since 1969.

5.4 Estimation and Result of the Long-Run Model

5.4.1 Estimation Procedures

Estimation is conducted from general to parsimonious specific model. In the process, statistically and/or economically insignificant variables are deleted, if the deletions improve the overall result. The priority is however placed on economic significance: this means that even though some variables are statistically significant, if it does not make any economic sense or intuitively implausible, on a priori grounds, the variables may be deleted. (This principle applies to all other sectors.) This is perhaps justified on the following grounds: In the general model, where there is a high likelihood of multicollinearity among the AIDS prices, and all the non-price sensitive explanatory variables automatically enter in each equation, some explanatory variables may spuriously pick up the relationship with the dependent variables without any economic sense. Further in later chapters when we simulate the policy variables, intuitively implausible coefficients are likely to lead to volatility in the simulated solutions.

Prior to estimation unit root tests for dependent and independent variables are conducted. Then for the system of AIDS share equations, SUR is utilised for the long-run model. The overview from a general to preferred long-run specific model is depicted. We then conduct the tests of cointegration, stability and axioms of rational choice for the specific model.

5.4.2 Unit Root Tests

The results of the unit root tests for variables are shown in Table 5.3. The vector of prices seems to be rather stationary than non-stationary in the DF test in levels. However the ADF test statistics are below the critical value at a 5% significance level for PGD, PCS and PLA, and at a 1 % level for PER. We take the ADF result as an indication of a unit root for the prices[3]. For other variables, a unit root is found in levels in both DF and ADF tests at a 5% level. In the DF tests for the differenced series all the variables reject the null of a unit root at 5% significance level. It may therefore be reasonable to assert that all the variables are integrated of order one[4]. The Perron's unit root test is found in Appendix 5.1. With respect to the estimated coefficient $\hat{\rho}$, the results almost replicate those of DF and ADF tests.

Following the unit root test, the dependent and independent variables are categorised in the following manner.

I(1) endogenous variables: ER, GD, CS, LA, PCS, PLA, $\ln(W^{\tau} / P^{*\tau})$

I(1) exogenous variables: PER, PGD, CRR, SLR, ln(Y/W)

I(0) variable: dummy 90

In determining endogenous or exogenous in variables, let us recall the following: PCS (or

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[3] The LM autocorrelation test for residuals supports the ADF test results: in the DF tests for PER, PGD and PLA, the residuals suffer from serial correlation at the 5% or 10% significance level, while in the ADF tests, the residuals are whitened.

[4] Note that a deterministic trend is found to be significant at a 5% level for $\ln(W^{\tau} / P^{*\tau})$ and CRR in levels as indicated by (t), therefore for both variables the test results are based on the specification with the trend.

return on shares) and PLA (or lending rate) are assumed to be determined in the market clearing conditions in the company securities and loans markets respectively, such that they are endogenous variables. This implies that $\ln(W^{\tau} / P^{*\tau})$ should be endogenous. PGD (or government securities' yields) is determined by the authorities in India. PER (or bank rate), CRR and SLR are the policy variables. A real variable of ln(Y/W) is assumed to be determined outside the financial sector, hence it is exogenous.

Table 5.3 Order of Integration of the variables

	Level		Differenced	
	DF	ADF	DF	ADF
S_1 (ER)	-2.45	-1.71	-6.97 *	-2.91 *
S_2 (GD)	-1.09	-0.65	-4.88 *	-4.57 *
S_3 (CS)	-1.76	-1.90	-3.31 *	-1.95
S_4 (LA)	- 0.08	-0.25	-5.43 *	-3.43 *
$\ln p_1^{\tau}$ (PER)	-3.71 *	-2.99 *	-6.06 *	-4.09 *
$\ln p_2^{\tau}$ (PGD)	-3.84 *	-2.84	-5.77 *	-3.79 *
$\ln p_3^{\tau}$ (PCS)	-3.41 *	-2.40	-5.49 *	-4.39 *
$\ln p_4^{\tau}$ (PLA)	-3.43 *	-2.30	-5.71 *	-3.80 *
$\ln(W^{\tau} / P^{*\tau})$	-2.67 (t)	-1.90 (t)	-6.49 *	-4.00 *
ln(Y/W)	-1.43	-1.74	-4.93 *	-3.05 *
CRR	-1.67 (t)	-1.18 (t)	-6.51 *	-4.10 *
SLR	-0.80	-1.20	-3.91 *	-2.60

- * Significant at the 5% level

- ADF is modelled as $\Delta X_{it} = \alpha + \beta\ X_{t-1} + \sum_{i=1}^{2} \delta_i \Delta X_{t-i} + e_t$. (t): a deterministic trend is specified in DF and ADF tests as the trend is statistically significant at a 5% level.

- Critical value τ_c (constant, no trend): -3.43 (1%), -2.86 (5%), -2.57 (10%)

  Critical value τ_{ct} (constant, trend): -3.96 (1%), -3.41 (5%), -3.13 (10%)

  by Davidson and MacKinnon, p708, 1993

5.4.3 Overview of the General to Specific Model

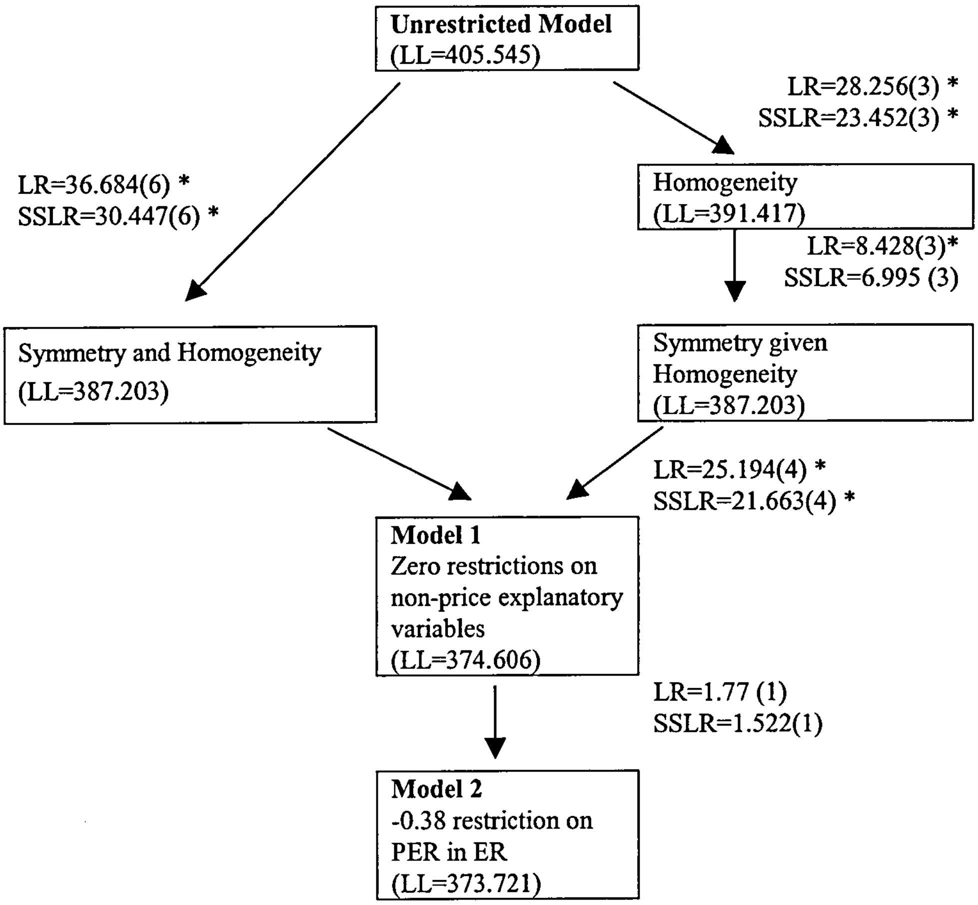
Figure 5.1 presents the overview of the unrestricted general to specific model. The figure presents the log likelihood of each model accompanied with the likelihood ratio (LR) test and small sample-adjusted LR (SSLR) test. The unrestricted model is estimated without homogeneity and symmetry, but maintaining adding-up constraint so that the estimated coefficients satisfy the balance sheet condition. Estimates of the general unrestricted model and residual diagnostics are given in Table 5.4. The 'fit' of the model given by the R-squared is reasonably high. LM residual tests are relatively satisfactory, though there is some evidence of heteroskedasticity and autocorrelation (order=2) in GD share equation at a 1% significance level. The relatively collinear data set seems to suffer from multicollinearity leading to wrongly signed estimates in own prices: the own-price coefficients of ER and LA are statistically insignificant with a wrong positive sign. Overall, the price coefficients as the major determinants of asset choice are poorly-determined. This is contrasted with other explanatory variables that are statistically highly significant.

The constraints of homogeneity and symmetry on the price coefficients are imposed across equations. Figure 5.1 indicates that in SSLR the joint test of 'Symmetry and Homogeneity' is rejected, but the 'Symmetry given Homogeneity' is not rejected at a 5% significance level. We maintain the restrictions since they improve the price coefficients.

Then the coefficients which are statistically or economically insignificant on intuitive grounds are deleted from each equation, namely CRR in GD and CS share equations, SLR in ER share equation and a dummy variable in CS share equation. The zero impositions on these variables are jointly rejected (see Model 1 in figure 5.1), mainly due to the deletion of CRR in CS equation, in which CRR has a relatively high t-statistic of 4.43 in the general model. However, it rarely makes economic sense that a rise in CRR (i.e. an indication of a tight monetary policy) increases CS, the most risky asset among others. The deletion of CRR in GD statistically improves the coefficient of PGD and SLR in GD.

Arguing that PGD and SLR should have more relevance to the GD share equation than does CRR, it may justify this deletion. These zero restrictions are also associated with the fact that CRR and SLR are relatively highly correlated (the coefficient correlation is 0.8) potentially leading to multicollinearity; the deletion of CRR in GD and CS share equations renders SLR more sensitive to these share equations that are directly related to this policy variable[5]. Model 1 is the long-run model being imposed by these restrictions and is an improvement on the general model.

Figure 5.1 Overview of the general to specific model



- * Significant at the 5% level.
- LL= Log likelihood, LR=Likelihood Ratio test, ( )= the number of restrictions.
- SSLR=Small sample-adjusted LR
- Critical values: d.f. 1=3.84 (5%), 6.64 (1%), d.f. 3 = 7.82 (5%), 11.34 (1%), d.f. 4 = 9.49 (5%), 13.28(1%), d.f. 6 = 12.59(5%), 16.81 (1%).

[5] Recall that the SLR is associated with government securities (i.e. GD) and government approved company securities (i.e. CS).

Table 5.4 Unrestricted (General) Model

	$\ln p_1^\tau$ (PER)	$\ln p_2^\tau$ (PGD)	$\ln p_3^\tau$ (PCS)	$\ln p_4^\tau$ (PLA)	Constant	$\ln(W^\tau / P^{*\tau})$	ln(Y/W)
1. ER	0.4335 (0.87)	-0.0424 (0.14)	-0.0039 (0.29)	-0.5134 (1.59)	0.6731 (2.80)	-0.0811 (2.80)	-0.1226 (2.66)
2. GD	-0.1077 (0.12)	-0.9835 (1.81)	0.0122 (0.51)	0.7620 (1.33)	2.0698 (4.82)	-0.2015 (3.89)	-0.3184 (3.86)
3. CS	0.2346 (0.99)	0.0324 (0.23)	-0.0188 (2.96)	-0.3279 (2.16)	0.2912 (2.57)	-0.0415 (3.03)	-0.0488 (2.24)
4. LA	-0.5604 (0.59)	0.9934 (1.72)	0.0105 (0.41)	0.0793 (0.13)	-2.0340 (4.48)	0.3240 (5.91)	0.4898 (5.62)

	CRR	SLR	Dummy 90	R-squared	SSR	SE of regression
1. ER	0.0081 (4.62)	0.0008 (0.57)	-0.0471 (3.62)	84.49 %	0.0053	0.0111
2. GD	0.0070 (2.24)	-0.0004 (0.16)	0.0739 (3.18)	75.13 %	0.0171	0.0199
3. CS	0.0036 (4.43)	0.0039 (6.09)	-0.0042 (0.68)	97.27 %	0.0012	0.0053
4. LA	-0.0187 (5.67)	-0.0042 (1.66)	-0.0227 (0.92)	86.88 %	0.0190	0.0210

- t-ratio is in parenthesis.
- No. of observation: 43 (1951-52 to 1993-94), Log Likelihood: 405.545
-Columns may fail to sum to zero due to rounding.
-SSR: sum of squared residuals

Residual diagnostics (chi-square values)

	LM Heteroskedasticity	LM Serial Correlation (Order =1)	LM Serial Correlation (Order =2)
1. ER	0.048 [0.827]	0.386 [0.534]	3.101 [0.212]
2. GD	8.502 [0.004]	3.614 [0.057]	15.099 [0.000]
3. CS	2.566 [0.109]	4.852 [0.027]	8.997 [0.011]
4. LA	0.019 [0.889]	1.021 [0.312]	6.678 [0.035]

[ ] is P-value. One tail tests

Further, in order to derive plausible estimates for price parameters, Model 1 is restricted by imposing –0.38 on the own price coefficient in ER share equation. The –0.38 imposed model is Model 2. We will now look at Model 1 and Model 2 in detail (including how we determine –0.38 in Model 2).

5.4.4 Model 1 and Model 2

The estimates of Model 1 and 2 are found in Table 5.5. Both models are estimated with White's heteroskedasticity-consistent standard error adjusted due to heteroskedasticity. But we do not pursue the correction of the autocorrelation, as it is difficult without violating the portfolio constraints (Hay and Louri, 1989), and our principle concern is to find the economically sensible equilibrium relationship of variables in the long-run. Also, even with some autocorrelation long-run estimates are super-consistent if cointegration is found. Engle-Granger (EG) and Augmented Engle-Granger (AEG) test for the residuals are found in Table 5.6. The Johansen test results are presented in Table 5.7. Since the explanatory variables are the same for both models, so are the Johansen test results.

Engle-Granger and Johansen Cointegration Tests

Critical values for EG and AEG tests depend on the number of I(1) endogenous variables on the right-hand side of the cointegrating regression; each share equation contains four I(1) endogenous variables. With the asymptotic critical values for cointegration by Davidson and MacKinnon (1993), there appears to exist in both models a cointegation vector in ER share equation: the EG and AEG test statistics are significant at a 5% and 10% level respectively. This test result provides some confidence in Model 2, despite the fact that the own-price coefficient for ER is imposed rather than freely-determined. In GD, the AEG test rejects the null of unit root in residuals in Model 2 at the 5% level (in the case of Model 1 at the 10 %) indicating the existence of a cointegration vector also in this share equation. For CS and LA, the null is not rejected. To sum up, Engle-Granger test provides evidence of cointegration in ER and GD equations, but not in CS and LA equations.

Table 5.5 Long run equilibrium model: homogeneity and symmetry imposed (Adjusted White's Heteroskedasticity-Consistent S.E.)

a. Model 1 Log Likelihood: 374.606

	$\ln p_1^\tau$ (PER)	$\ln p_2^\tau$ (PGD)	$\ln p_3^\tau$ (PCS)	$\ln p_4^\tau$ (PLA)	Constant	$\ln(W^\tau / P^{*\tau})$	ln(Y/W)
1. ER	0.3062 (0.61)	0.1000 (0.39)	0.0017 (0.11)	-0.4079 (1.20)	0.1484 (1.39)	-0.0227 (1.74)	0.0361 (1.29)
2. GD		-0.9950 (3.08)	0.0085 (0.31)	0.8865 (2.50)	0.8076 (2.48)	-0.0502 (1.38)	-0.1209 (1.54)
3. CS			-0.0244 (2.73)	0.0143 (0.39)	-0.0289 (0.46)	0.0007 (0.09)	-0.0062 (0.40)
4. LA				-0.4929 (1.10)	0.0728 (0.18)	0.0723 (1.61)	0.1631 (1.67)

	CRR	SLR	Dummy 90	R-squared	SSR	SE of regression
1. ER	0.0075 (5.93)	0	-0.0597 (3.91)	81.29%	0.0065	0.0122
2. GD	0	-0.0029 (1.24)	0.0646 (3.53)	58.98 %	0.0281	0.0256
3. CS	0	0.0037 (6.67)	0	93.29 %	0.0029	0.0083
4. LA	-0.0075 (5.93)	-0.0077 (0.31)	-0.0050 (0.27)	66.32 %	0.0498	0.0340

b. Model 2 (-0.38 imposed) Log Likelihood: 374.721

	$\ln p_1^\tau$ (PER)	$\ln p_2^\tau$ (PGD)	$\ln p_3^\tau$ (PCS)	$\ln p_4^\tau$ (PLA)	Constant	$\ln(W^\tau / P^{*\tau})$	ln(Y/W)
1. ER	-0.38	0.3670 (2.05)	0.0031 (0.17)	0.0099 (0.06)	0.134 (1.18)	-0.0178 (1.37)	-0.0382 (1.31)
2. GD		-1.0866 (4.11)	0.0083 (0.32)	0.7113 (2.34)	0.8109 (2.47)	-0.0526 (1.44)	-0.1188 (1.51)
3. CS			-0.0245 (3.08)	0.0131 (0.46)	-0.0298 (0.47)	0.0006 (0.08)	-0.0059 (0.38)
4. LA				-0.7343 (1.77)	0.0849 (0.22)	0.0698 (1.57)	0.1629 (1.67)

	CRR	SLR	Dummy 90	R-squared	SSR	SE of regression
1. ER	0.0083 (7.24)	0	-0.0600 (4.02)	80.3%	0.0068	0.0126
2. GD	0	-0.0029 (1.26)	0.0634 (3.54)	59.3%	0.0279	0.0255
3. CS	0	0.0037 (6.78)	0	93.3%	0.0029	0.0083
4. LA	-0.0083 (7.24)	-0.0008 (0.34)	-0.0035 (0.20)	86.6%	0.0495	0.0339

t-ratio is in parenthesis. Zeros and –0.38 are imposed. No. of observation: 43 (1951-52 to 1993-94), Columns may fail to sum to zero due to rounding. SSR: sum of squared residuals

Table 5.6 Engle-Granger Cointegration Tests

	Model 1		Model 2 (-0.38 imposed)	
	EG	AEG	EG	AEG
1. ER	-5.67 **	-4.06 *	-5.26 **	-4.01 *
2. GD	-2.78	-4.05 *	-2.78	-4.11 **
3. CS	-2.66	-2.59	-2.66	-2.44
4. LA	-2.30	-2.93	-2.31	-2.95

- ADF is modelled as $\Delta X_{it} = \alpha + \beta X_{t-1} + \sum_{i=1}^{2} \delta_i \Delta X_{t-i} + e_t$.
- Number of I(1) endogenous variables: n=4
- Asymptotic Critical Values for Cointegration Tests: 4.10 (5%), 3.81 (10 %) for n=4 (Davidson and MacKinnon, 1993, p.722).
- ** Significant at the 5% level, * Significant at the 10% level.

Table 5.7 Johansen Cointegration LR test for Model 1 and Model 2 (Order of VAR=1, unrestricted intercept with no trend)

ER

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	56.74 *	39.99	r >= 1	132.01 *	86.42
r <= 1	r = 2	45.22 *	33.63	r >= 2	75.28 *	60.19
r <= 2	r = 3	22.18	26.94	r >= 3	30.06	38.15
r <= 3	r = 4	7.87	19.73	r = 4	7.87	19.73

GD

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	61.10 *	39.99	r >= 1	111.19 *	86.42
r <= 1	r = 2	33.36	33.63	r >= 2	50.09	60.19
r <= 2	r = 3	11.17	26.94	r >= 3	16.73	38.15
r <= 3	r = 4	5.55	19.73	r = 4	5.55	19.73

CS

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	57.34 *	39.99	r >= 1	114.55 *	86.42
r <= 1	r = 2	30.09	33.63	r >= 2	57.21	60.19
r <= 2	r = 3	17.06	26.94	r >= 3	27.12	38.15
r <= 3	r = 4	10.06	19.73	r = 4	10.06	19.73

LA

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	63.94 *	42.68	r >= 1	127.05 *	95.14
r <= 1	r = 2	41.00 *	36.38	r >= 2	63.10	66.94
r <= 2	r = 3	16.17	29.79	r >= 3	22.10	42.73
r <= 3	r = 4	5.93	22.19	r = 4	5.93	22.19

-* Significant at the 5% level
- Order of VAR is determined by SBC or AIC.
- In the partial VECM, variables are categorised as follows.

	I(1) endogenous	I(1) weakly exogenous	I(0)
ER	ER, PCS, PLA, $\ln(W^{\tau} / P^{*\tau})$	PER, PGD, ln(Y/W), CRR	Dummy 90
GD	GD, PCS, PLA, $\ln(W^{\tau} / P^{*\tau})$	PER, PGD, ln(Y/W), SLR	Dummy 90
CS	CS, PCS, PLA, $\ln(W^{\tau} / P^{*\tau})$	PER, PGD, ln(Y/W), SLR	
LA	LA, PCS, PLA, $\ln(W^{\tau} / P^{*\tau})$	PER, PGD, ln(Y/W), SLR, CRR	Dummy 90

In the Johansen test, there is a more clear indication of cointegration. Both maximum eigenvalue and trace tests demonstrate that there exists at least one cointegrating relationship for all share equations at a 5 % significance level, as the null of non-cointegrating vectors is rejected on the LR test. For GD and CS (also LA by the trace test), there is a unique cointegration vector found. The Johansen result demonstrates that the I(1) variables constitute stationary linear combinations in all four share equations.

Estimates of Model 1 (Table 5.5a)

In comparison with the general model, the own price coefficients for GD and LA have statistically improved, in particular with the correct negative sign for that of LA. However in the case of ER, the result is still counter-intuitive; $\ln p_1^r$ is positive, whereas the cross-price effect of $\ln p_4^r$ is negative. This implies that a fall in the price of ER, or an increase in the Bank rate, causes a switch from ER to LA, exhibiting anomalies in price coefficients. The influence on ER, of the Bank rate is a key policy claimed in India: a rise in the Bank rate is aimed at tightening the monetary position in an economy. Further, it could be argued that a rise in Bank rate is interpreted as a signal that the RBI will further tighten monetary policy by a subsequent increase in the CRR. This should lead to a switch from other assets to reserves in the banking sector rather than the other way round[6]. Therefore, further experiments were undertaken to identify the plausible sign and magnitude of this coefficient.

Estimates of Model 2 (Table 5.5b)

It can be seen that the coefficient on PER in ER is statistically poorly determined, therefore a simulation was conducted by imposing a non-positive own price coefficient in the ER share equation. Starting from -0.02, the coefficient was reduced at intervals of -0.02 until reaching –0.38, when the estimates indicated gross substitutes in price

[6] Besides, Sen *et al.* (1996) find the positive relationship between the Bank rate and excess reserves.

parameters. We then imposed –0.38 as the coefficient for $\ln p_1^r$; although this is somewhat arbitrary the restriction is not rejected by the Likelihood ratio test (SSLR=1.35< χ_c^2 = 3.84 (1) in Figure 5.1) in comparison with Model 1, and is therefore consistent with the data.

See Table 5.5b. As compared with Model 1, theoretically and statistically significant improvements are observed, in particular, in the price parameters; i) all the estimated own-price coefficients are negative with relatively high *t*-ratios, ii) all the own-price coefficients are larger than their respective cross-price effects, iii) all cross-price coefficients are positive, and iv) the *t*-ratio of PGD in ER equation has substantially increased from 0.39 to 2.05. In Model 2, the price coefficients are well-determined, showing gross substitutes, which is empirically a rare occurrence. On these grounds, we choose Model 2 as a preferred long-run model, and use this model for simulation experiments. (The detailed interpretation of the results is left in Section 5.5.)

5.4.5 Other Tests for the Long-Run Preferred Model 2

Table 5.8 shows the results of the other tests, taking our preferred model 2 as a maintained model (i.e. the null of a restricted model).

The parameter stability of the model is examined by the Chow tests, splitting the sample period at 1961, 1969 and 1980. Parameter instability is observed in ER equations in all three cases, though it is not severe; at 1969 this is rejected at a 1% significance level. For other share equations the parameters are stable. (CS at 1980 exhibits parameter instability at the 5 % significance level, but this is rejected at the 1 % level.)

Table 5.8 Other tests for the preferred long-run model 2

Chow Tests	1961 (1951-60 and 1961-93)	1969 (1951-68 and 1969-93)	1980 (1951-79 and 1980-93)
ER (df = 9, 25)	3.773 *	2.603 *	6.939 *
GD (df = 9, 25)	0.718	0.341	0.548
CS (df = 8, 27)	0.429	1.998	2.396 *
LA (df = 10, 23)	0.538	2.057	0.747

-Critical value: ER and GD around 2.28 (5%), 3.22 (1%) and CS and LA around 2.27 (5%), 3.21 (1%).
-* Significant at the 5% level

	LR (no. of restrictions)	SSLR (no. of restrictions)	Critical value (at 5% level)
Homogeneity	30.39 (3) *	26.135 (3) *	7.81
Symmetry and Homogeneity	36.09 (6) *	31.037 (6) *	12.59
Symmetry (given Homogeneity)	5.67 (3)	4.876 (3)	7.81
Weak Separability (Money market rate)	14.93 (3) *	12.839 (3) *	7.81
Homotheticity (β_i=0, i=1, 2, 3)	3.82 (3)	3.285 (3)	7.81

- Model 2 as a null of restricted model.
-* Significant at the 5% level

	ER	GD	CS	LA
Eigenvalues	-0.409	-1.264	-0.090	-0.940

LR test for the joint test of symmetry and homogeneity is rejected at the 5% significance level, though the symmetry given homogeneity is not rejected. In the neo-classical consumer demand theory approach, 'services'[7] from the differentiated attributes of the assets are not explicitly modelled and are subsumed in the parameters of the cost function (Barnett, 1980). Hence, the failure of homogeneity and symmetry may imply the change of these attributes (Barr and Cuthbertson, 1991c).

[7] For example, differing degrees of liquidity, different penalties in early withdrawals and perceptions of risk.

The weak separability test is performed in an ad-hoc manner by including the money market rate as an additional explanatory variable. But this is decisively rejected. The joint homotheticity test is not rejected, implying that all the wealth elasticities are unity. This indicates that weak separability is not entirely rejected, since the unitary wealth elasticities mean that the demand function is independent of excluded interest rates.

Eigenvalues are calculated using the mean values of the shares. The matrix of k_{ij} coefficients has all negative eigenvalues indicating that negativity is not rejected.

The overall results are somewhat mixed. Symmetry and homogeneity are rejected, though negativity is not rejected. While weak separability is rejected, homotheticity is not. However, with parameter stability reasonably satisfied, we move on to draw inference from the empirical results.

5.5 Inference

5.5.1 Interest Rate, Wealth and Income Elasticities

Elasticities for the interest rate, wealth and income are derived using the mean values of the shares and presented in Table 5.9a. (Recall that there is an inverse relationship between price and interest rate elasticities; empirically the own price estimates are negative, and that the own interest rate elasticities are positive as shown in the table.) The actual impact in terms of Rs. crore is also presented in Table 5.9b. The salient features are as follows.

i) We have found that all the own-price coefficients are larger than their respective cross-price effects. This is also the case for elasticities, and this is a quite rational behaviour. The own-interest rate elasticities are all above unity, implying that the banking

Table 5.9a Elasticities for the preferred model 2

	R_1	R_2	R_3	R_4	Wealth	Income
1. ER	13.06	-12.14	-0.17	-3.32	0.43	-1.22
2. GD	-1.47	4.90	-0.10	-3.32	0.80	-0.46
3. CS	-0.07	-0.37	1.28	-0.83	1.01	-0.08
4. LA	-0.04	-1.34	-0.09	1.47	0.25	2.33

R = Interest rate

- The interest rate elasticities imply the effect of a one percentage point change in the interest rate (R) on the percentage change in asset holdings, i.e. $(\Delta a_i / a_i)*100$.
- Wealth and income elasticities, i.e. $[\ (\Delta a_i / a_i)(\Delta \ln(W^\tau / P^{*\tau}) / \ln(W^\tau / P^{*\tau}))^{-1}\ ]$and $[\ (\Delta a_i / a_i)(\Delta \ln(Y / W) / \ln(Y / W))^{-1}\ ]$ respectively. (Barr and Cuthbertson, 1991c)

Table 5.9b Long-run Impact of Asset Holdings (Rs.Crore) for the preferred model 2

	R_1	R_2	R_3	R_4	Mean values (1951-93)
1. ER	319.17	-296.54	-4.10	-18.53	2443.64
2. GD	-179.44	597.40	-12.42	-405.54	12197.17
3. CS	-3.65	-18.27	62.46	-40.55	4890.28
4. LA	-9.69	-350.61	-23.84	384.14	16151.09

R = Interest rate, Rs. crore = 10 million rupees.
-This shows the effect of a one percentage point change in the rate of return on the holdings of the assets, calculated using the mean value of stocks for the sample period 1951-93.

sector is sensitive to interest rates in the portfolio choice.

ii) The effect of a one percentage point change in the Bank rate on the percentage change in the share of ER turns out to be a very large at 13.06. But this is somewhat expected in that, before financial liberalisation, there was a lack of substitutes for the short-term liquidity in the banking sector, and commercial banks were very responsive to the Bank rate. The own-interest rate elasticity of GD is also a relatively large at 4.90, as compared with those of CS and LA. In India, government securities are an attractive asset, hence the banking sector is very sensitive to their yields.

iii) The impact of R_1 and R_2 in actual values (Table 5.9b) demonstrates relatively strong substitute effect between the risk-free assets of ER and GD. A rise in R_1 increases ER (by 319.17) while decreasing GD (by -179.44). On the other hand, a rise in R_2 decreases the holding of ER (by -296.54) while increasing GD (by 597.40). The substitute effect between them can be interpreted as a perverse indicator of financial repression for a developing economy. Evidence suggests that even though there is a fall in either R_1 or R_2, the funds in the banking sector are likely to be stagnated in the government sector.

iv) A strong substitution effect is also observed in the actual holdings in Table 5.9b between GD and LA; with an increase in lending rates, banks switch funds from GD to LA and vice versa. This is preferable in that by lowering the government securities' yields the loanable funds will increase.

v) The substitution effects between ER vs GD and GD vs LA indicates that the change in the bank rate may not exert much impact on delivering funds to the private sectors, whereas the change in government securities' yields may do.

vi) The own-interest rate elasticity for CS is the smallest amongst other assets. In the underdeveloped stock market, there is probably a cautious attitude towards the return on shares, particularly of banks, who were regulated for much of the period.

vii) The share of ER, GD and LA appear to be inelastic with respect to wealth given less than a unitary elasticity. In respect to ER and GD, the behaviour is quite reasonable, since this implies that the investment in the risk-free assets is independent to the level of wealth in the banking sector. The wealth elasticity in CS is unity, suggesting that banks will invest in the risky asset equi-proportionally as the wealth increases.

viii) The negative income elasticities in ER and GD imply that they are 'inferior goods': as income falls, banks are more willing to invest in the risk-free assets. On the other hand, the income elasticity in LA is well above unity, suggesting that LA is a 'luxury good'. This is a plausible outcome in that the banks' perception of default on loans will decline as the level of income increases, and lending will become active in the banking sector.

5.5.2 CRR, SLR and Dummy 90 Variables

The following features for policy and dummy variables can be drawn from the coefficients (Table 5.5b for Model 2).

i) The effect of CRR is contractionary in terms of a flow of loanable funds, since an increase in CRR raises ER while reducing LA.

ii) The negative effect of SLR on the share of GD is counter-intuitive, but the own-price coefficient is relatively large with a correct sign. It can probably be interpreted as follows: SLR was originally designed for commercial banks to maintain adequate liquid assets for sound banking practice. It was in the 1980's that the government increasingly used the SLR to finance its rapidly increasing deficits (Sen *et al.* 1996). Therefore, over the sample period in general, the effect of the yields may have outweighed the effect of SLR on the holding of government securities. Alternatively, commercial banks may have voluntarily invested in the risk-free government securities irrespective of the level of SLR. SLR is only statistically significant at a lower than 10% level.

iii) By contrast, SLR exerts a positive significant effect on CS. This indicates that the banking sector is forced to increase investment in government-approved (company) securities as SLR increases. Company securities are risky assets, therefore as opposed to government securities, commercial banks involuntarily invest in CS under SLR.

iv) The effect of SLR on loans is negative, implying that an increase in SLR is contractionary, though the coefficient is statistically and numerically insignificant.

v) The dummy variable for the post-financial reform is intuitively and statistically well-determined. A positive sign on the dummy variable with a relatively high *t*-ratio in the GD share equation is consistent with the experience which commercial banks had after the reform. In 1991 the introduction of market-related interest rates for government securities raised the yields and attracted banks to invest in zero-risk government securities. Also the increased perception of risk prevalent in the banking sector in the 1990s led to a shift of funds in favour of risk-free assets. In the counter-part, the (imposed) zero or insignificant effect of the dummy in CS and LA supports such banks' risk-averse behaviour.

vi) A negative sign on the dummy variable in ER is probably due to the development of the money market in the post-reform period, widening scope for obtaining short-term funds in the banking sector[8], thus the need for holding excess reserves declined. This implies that the direct effect of the change in the Bank rate on the bank reserves should have weakened in the post-reform period.

5.6 Conclusion

Demand functions for financial assets in the banking sector are estimated within a coherent theoretical framework provided by the AIDS model. Some difficulty was experienced in determining prior claims in the financial assets in the banking sector. Common to other developing countries, in India a financial system is characterised by a captive market, complicated with more than one regulatory reserve ratio, and this is combined with credit control. With this situation, it was numerically almost impossible to exclude all the involuntary flow of funds as policy-determined from the banking sector's assets for empirical application. Despite this, the estimated long-run model (Model 2), being imposed of portfolio constraints, provides not only coherent price parameters but also economically plausible parameters of policy variables.

The following are noteworthy: First, a relatively strong impact of own-interest rates is found, hence the change in interest rates may exert a significant reshuffle in the portfolio choice, separately from conventional monetary policy instruments. Second, the study uncovers the fact that ER and GD constitute strong substitutes, suggesting that in order for banks to disinvest in the government sector, both interest rates should come down. With respect to government securities' yields, the lower yields may increase loanable funds in the banking sector. However, this is somewhat ironical; in the post-financial liberalisation

[8] After reforms the market has widened through the participation of non-banking financial sectors and the introduction of CDs.

the yields were raised, making the cost of borrowing expensive with a view to containing the increase in government debt in the government sector. The empirical result then suggests that an increase in yields will attract the banking sector to invest in the government sector. This behaviour is also evident in the effect of the financial reforms through Dummy 90 on GD. The evidence in general warns that the fiscal disciplinary efforts are needed in the government sector, if the target policy is to increase a flow of loans to the private sectors for economic activities. Third, the influence of CRR is contractionary by reducing LA, whereas that of SLR is inconclusive given a statistically insignificant coefficient in LA. Fourth, the risk-averse portfolio behaviour in the banking sector is observed in response to SLR. We find that the influence of the liquidity ratio on government securities and government-approved company securities is the contrary. It appears that banks voluntarily invest in the former (i.e. the risk-free asset), whereas involuntarily in the latter (i.e. the risky asset) under this regulation.

Appendix 5.1

Perron's Unit Root Test

	Perron's Model (C) $k = 0$			DF Level	Perron's Model (C) $k = 2$			ADF Level
	Dummy	$\hat{\rho}$	$t_{\hat{\rho}}$	From Table 5.3	Dummy	$\hat{\rho}$	$t_{\hat{\rho}}$	From Table 5.3
S_1(ER)	3	-0.240	2.563	N	3	-0.212	1.964	N
S_2(GD)	0	-0.189	1.619	N	0	-0.081	0.595	N
S_3(CS)	3	-0.109	2.563	N	3	-0.126	3.027	N
S_4(LA)	1	-0.094	1.219	N	3	-0.088	1.103	N
$\ln p_1^{\tau}$(PER)	0	-0.754	4.088 *	R	0	-1.013	3.354	R
$\ln p_2^{\tau}$(PGD)	0	-0.729	3.983 *	R	0	-0.945	3.177	N
$\ln p_3^{\tau}$(PCS)	3	-0.726	4.013 *	R	3	-1.015	3.457	N
$\ln p_4^{\tau}$(PLA)	0	-0.740	4.029 *	R	0	-0.940	3.172	N
$\ln(W^{\tau} / P^{*\tau})$	1	-0.314	2.597	N	0	-0.237	1.640	N
$\ln(Y/W)$	0	-0.130	1.409	N	0	-0.157	1.544	N
CRR	0	0.024	0.172	N	0	0.122	1.210	N
SLR	1	-0.173	2.268	N	1	-0.216	2.398	N

- * Significant at a 5% level, N= null of unit root is not rejected at a 5% significance level, R= null of unit root is rejected at a 5% significance level.

- Model (C) : $\Delta y_t = \mu + \beta t + \theta DU_t + \gamma DT_t^* + \varsigma DTB_t + \rho y_{t-1} + \sum_{i=1}^{k} \delta_i \Delta y_{t-i} + e_t$

- Null hypothesis: $\rho = 0$ and $\theta = \beta = \gamma = 0$

- Alternative hypothesis of a trend stationary process: $\rho < 0$ and θ, β, $\gamma \neq 0$

- Dummy: The number of significant dummy coefficients out of θ, β and γ.

- $T_B = 1990$, $T = 4$, $\lambda = 4/43 = 0.1$

- Critical Value for $\hat{\rho}$: 3.75 (5%), 4.38 (1%) (Perron 1989, p.1377)

Chapter 6 A Flow of Funds Approach to the Capital Structure for the Private Corporate Business Sector[1]

6.1 Introduction

This chapter models the flow of funds for the private corporate business (PCB) sector for India. The PCB sector is a deficit sector, so that portfolio behaviour in the financial sector amounts to a choice among financial liabilities, which in the main consist of equity and debt. Modelling the flow of funds for the PCB sector is therefore equivalent to a study of capital structure.

With the diversified nature of companies in a world of market imperfections, the theoretical and empirical literature on the determinant of corporate financial structure is extensive (e.g. Bradley, Jarrell and Kim, 1984, Jalilvand and Harris, 1984, Mayer, 1988, Allen and Mizuno, 1989 and Mayer, 1990). Pecking order hypothesis suggests that internal finance is preferred to external finance and debt finance is preferred to equity finance. The hypothesis has originated from the market imperfections; i) the implication of transaction costs is to establish a preference for internal over external finance (Mayer, 1990), ii) a preference of riskless (debt) over risky (equity) finance is suggested by agency costs[2] and information asymmetries[3]. There is some evidence that corporations in developed countries follow this 'pecking order' and in developing economies it is more expected in view of the serious capital market imperfections and high share-price volatility (Singh, 1997). Singh and Weisse (1998) argue that firms in developing countries shun the stock market due to not only asymmetric information,

[1] This is a revised version of the paper by Moore et al. (2002b), which was presented at the Finance and Development conference, Manchester in April,2002.
[2] An increase in leverage increases managers' share of the equity and mitigates the loss from the conflict between managers and shareholders (Harris and Raviv, 1991, p.300).
[3] There are a number of examples; i) if firms finance new projects by issuing equity, underpricing may cause a net loss of existing shareholders leading to a rejection of the new project, but the underinvestment can be avoided if the firm uses internal funds or riskless debt (Harris and Raviv 1991, p.306), ii) debt financing may be seen as signaling device for a higher quality firm (Harris and Raviv 1991, p.311), and iii) Mayer (1990) states that financial intermediaries perform a central function in reducing asymmetries in information in financial markets, hence debt financing is favoured rather than equity financing.

but also poor supervision and rampant insider trading. In addition issuing shares tends to be costly and restricted in an underdeveloped capital market.

The company structure and conditions also affect the capital structure as has been noted; the behaviour of firms of different sizes and in different industries is far from homogenous (Mayer, 1988); the differences in ownership-structure have a profound influence (Booth, Aivazian, Kunt and Maksimovic, 2001)[4]. Chowdhury and Miles (1989) find that the most significant differences in behaviour across companies occurred when the sample was split by reference to company size. In empirical work on India by Cobham and Subramariam (1998), small firms tend to use more equity than large firms, on the grounds that when firms are not listed on stock exchanges, less information asymmetry and less separation of ownership and control are involved.

In developing countries, business groups[5] seem to dominate the economic landscape (Singh and Weisse, 1998) and this is a common feature in India (Manos, Murinde and Green, 2001). This structure may alleviate market imperfections, including information asymmetries, and so equity issuance involves less problems. In the view of Singh (1997), however, family-controlled firms are reluctant to issue equity for fear of losing control.

Harris and Raviv (1991) comment that the nature of the products which firms produce affects capital structure. Furthermore, Spies (1974) argues that there is no reason to expect the parameters of the model to be the same for all manufacturing corporations, or even for all corporations within a particular industry. Hay and Louri (1989) have thus emphasized the disaggregation of different industries in their empirical work, and they find that portfolio effects only emerged as significant at the level of industrial sectors, and not when the data were pooled across all different industries. Bradley *et al.* (1984) also show a strong finding of intra-industry similarities in firm leverage ratios and of persistent inter-industry differences.

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[4] Hay and Louri (1989 and 1991) also point out the different portfolio behaviour between quoted and unquoted firms.

[5] Many of these groups started as a family business and the family keeps control of the business even after the company goes public (Manos, Murinde and Green, 2001).

The other issues in the study of corporate finance include those such as corporate tax, non-debt tax shields, the rate of growth of firms' capital employed, earnings volatility, variability of a firm's value, corporate control contest and profitability (e.g. Bradley *et al.*, 1984, Allen and Mizuno, 1989 and Harris and Raviv, 1991).

Our approach to corporate finance is different from the pre-existing literature. From the theoretical point of view, there is no conventional hypothesis in terms of a capital structure set-up. The expected results are based on the axioms of rational choice from consumer demand theory and the theoretical model derives from the AIDS cost function. In the framework of the AIDS model, the PCB sector will choose financing by reference to the AIDS prices and wealth. Macro-economic variables of aggregate income, a policy instrument, and dummy variables are added as part of the subsistence level in the AIDS cost function. These are, at the same time, postulated to capture the generalised effects of firms' growth, profitability, credit rationing and shifts in government regulations[6]. In terms of data for estimation, generally, the use of disaggregated panel data drawn from individual firms is a common practice in determining corporate structure. However, the estimation reported here is based on: i) aggregate flow data (i.e. time series data) of all non-financial companies in India irrespective of their size, industries and ownership structure, ii) net transactions, i.e. intra-corporate sector transactions are netted out and that external finance means from outside the corporate sector[7]. Thus corporate financial activities between themselves, such as take-overs or mergers, are netted out[8].

The study of capital structure as an integral part of a system-wide flow of funds is therefore viewed as being a macroeconomic problem.

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[6] Dickinson (2000) argues that the agency problems are influenced by macroeconomic variables, such as economic growth, the institutional structure of the financial system, the nature of financial development and the government intervention.

[7] A similar methodology is taken by Mayer (1988) and Cobham and Subhramaniam (1998).

[8] But this can be negligible since such a financial activity may be small in many developing countries (Green, Murinde and Suppakitjarak, June 2001).

In our model, the financing decision is assumed to be independent of the investment decision as discussed in Chapter 4 in relation to the theoretical flow of funds model. This means that the fixed assets are not modelled in this sector. This may be economically reasonable; given profits after tax, a firm decides the level of dividends (that are likely to be sticky) and investment, then the composition of financial deficit is determined. In particular, decisions on the productive activities of companies require more time than do financing decisions (Chowdhury and Miles, 1989)[9]. This is also consistent with the objective of this thesis, which is to model a flow of *financial assets,* obtain the market clearing endogenous variables and conduct simulation policy experiments. Fixed assets is a real use of funds, thereby modelling fixed assets is at odds with the objectives of the current study.

In this respect, there is a strong motivation to utilise the AIDS model among other types of portfolio model. The pitfalls type model does not explicitly imply the separability of the firm's financing and investment decisions, which are inherent with utility maximisation (Prasad, 2000). However, applying the mean-variance hypothesis to the corporate sector has some limitations. First the assumption of a quadratic or a negative exponential utility function may not especially be the case for the behaviour of firms. Second, the mean-variance approach postulates that equity and debt are risky in themselves, however, this study investigates financial liabilities, and there is no risk attached to each liability. In the AIDS model framework, weak separability is implied in utility maximisation, facilitating the separability of the firm's financing and investment decisions. Further, the risk variable is not the hypothesized variable in the AIDS model specification. The advantage of the AIDS model is also that the non-linear price index is approximated by a linear one, hence it readily allows comparison with other empirical studies of the demand for financial liabilities (Prasad, 2000).

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[9] However, Jalilvand and Harris (1984) argue that because of market imperfections, interdependence between different corporate decisions arises. The empirical evidence on the independence of investment and financing decisions is mixed (Chowdhury and Miles, 1989). Chowdhury, Green and Miles (1994) take a different view on separability in their study of the determinants of UK-quoted companies: Chowdhury *et al.* hypothesize that the decisions on investment and long-term financing are made first, hence their empirical work focuses on the short-term financial decisions, referred to as 'Quick Finance', assuming other items are predetermined. A similar approach was taken by Hay and Louri (1996).

This chapter is organised as follows: Section 6.2 clarifies aggregate balance sheets for the PCB sector, thereby financial instruments for estimation. Section 6.3 deals with explanatory variables. The procedures and results of the estimation are found in Section 6.4, and inference is drawn in Section 6.5. Section 6.6 is held for a conclusion.

6.2 Balance Sheet and Financial Instruments

Table 6.1a shows the simplified aggregate balance sheet for the PCB sector in India (similar to that of Taggart, 1977 and Cobham and Subramaniam, 1998). The liability side mainly consists of debt, equity and reserves, whereas the asset side consists of fixed assets, inventories and financial assets. This can be re-arranged as in Table 6.1b.

Table 6.1a Aggregate Balance Sheet 1

Liabilities	**Assets**
Short-term debt	Inventories
Long-term debt	Fixed assets
Equity capital Reserves from retained earnings *	Financial assets (Cash, Deposits, Loans and Advances, Company Securities, Provident funds, Foreign Assets)

* Equity capital and reserves are the total shareholders' funds. Retained earnings are residual after dividends payout and other claims on profits.

Table 6.1b Aggregate Balance Sheet 2

Financial items (Sources)	**Real assets (Uses)**
Short and Long term debt – Loans and Advances	Inventories
Equity capital – Company Securities Reserves from retained earnings	Fixed assets
(–) Deposits	

Table 6.1b separates firms' real uses of funds from financing sources. The holdings of loans and advances and company securities on the asset side are netted from the debt and equity capital on the liability side, respectively. Short term debt (mainly bank

loans) and long term debt (mainly bonds and debentures) are aggregated to derive total debt financing. The holdings of deposits are placed on the left side preceded by the negative sign, since the drawing down of the liquid asset is considered a source of funds (Taggart, 1977). (-) Deposit implies internal financing. Cash, provident funds and foreign assets in the PCB sector are negligible, hence these are deleted for simplicity. If all the debt and equity financing are directed to investment, then the deposits can be seen as part of retained earnings.

Changes in the balance sheet items in any period are constrained by the net acquisition of the financial asset (NAFA)[10], such that,

$$\Delta \text{ Debt} + \Delta \text{ Equity} - \Delta \text{ Deposits} = \text{ Investment} = \text{NAFA} \qquad (6.1)^{11}$$

The aggregate balance sheet is now linked with the theoretical flow of funds model in Table 4.1 (Chapter 4).

It is assumed that the size of the real asset decisions (and also reserves) are exogenous, and that we seek to explain the composition of financing. Financial instruments to be estimated are, then, debt, equity and deposits[12] shown in Table 6.2 together with the mean share values. Not surprisingly, borrowing is the dominant component of the capital structure in India over the sample period[13].

Table 6.2 Financial instruments for the banking sector

Financial instruments with notations		**Mean shares**
CS (Equity)	Equity Capital (Company Securities deducted)	36.0 %
LA (Debt)	Short and Long term debt (Loans and advances deducted)	74.5 %
DEP (-)	Deposits	-10.5 %

[10] Since, the PCB sector is a deficit sector, the NAFA is in a negative sense.
[11] ΔReserves are subsumed in ΔEquity.
[12] In the study by Hay and Louri (1991 and 1989) for UK corporations, equity is not a choice variable, instead the flow concept of investment enters in a system of equations.
[13] Booth *et al.* (2001) also found a high debt proportion of 67.1% during the period 1980-90 for India.

6.3 Explanatory Variables

The interest rates and non-price sensitive explanatory variables are listed in Table 6.3 together with the expected sign where appropriate. The interest rates used to formulate prices in the AIDS model are from the stand-point of investors in other sectors. This means that the interest rates are equivalent to the cost of capital for the PCB sector, and the derived AIDS prices are then conceptually similar to the return on capital employed. Accordingly, the expected sign on the own price coefficients is positive (whereas in other sectors they are negative) as shown in Table 6.3: it states that an increase in the own price is expected to increase the holdings of the financial liabilities. Similarly, in order to satisfy concavity in the cost function (or negativity), all the diagonal elements of the calculated matrix, i.e. the eigenvalues of k_{ij} in (4.16) in Chapter 4 should be positive semi-definite.

Table 6.3 Price and Other Explanatory Variables

Variables	Notes	Expected sign
$\ln p_1^r$ = PCS (Price of CS)	r_1 = The rate of change in share prices	+ CS
$\ln p_2^r$ = PLA (Price of LA)	r_2 = Lending rate	+ LA
$\ln p_3^r$ = PDEP (Price of DEP)	r_3 = Deposit rate	+ DEP (-)
ln(Y/W)	Log of GDP at factor cost deflated by W	
SLR	Statutory Liquidity Ratio	
Dummy 69	0: 1951-68 and 1: 1969-93	– LA
Dummy 90	0: 1951- 89 and 1: 1990-93	+ CS

Under the SLR regulation, banks are required to invest a certain proportion of their aggregate deposit liabilities in government securities or government-approved securities (issued by OFIs). Since the latter is directed toward the PCB sector, SLR is expected to influence corporate finance. Whether the change in SLR affects CS or LA is the question to be addressed in estimation.

With respect to dummy 69, in 1969 the government stipulated bank lending to the priority sectors of agriculture, small industry and business and small transport operations. This is expected to decrease bank lending towards the PCB sector and that the sign on dummy 69 in the share of debt (i.e. LA) is negative. Dummy 90 is associated with financial reforms. With the de-regulation and development of the stock market coupled with the contraction of lending in the banking sector in the post-reform period, it is expected that the share of equity finance would increase, hence the sign on CS is positive.

PCS (Price of Company Securities)

Among others, the price of CS (or equity) may warrant some explanation. The rate of change in share prices is used for the rate of return for company securities, and the expected share prices are inversely related to the expected returns. Then the expected positive sign on the CS share equation in Table 6.3 implies that as the share prices are expected to rise, the corporate sector increases equity finance. This is consistent with the principle of Tobin's Q: as the market value of a firm's equity rises relative to its 'book' value of equity, the cost of issuing equity falls, *ceteris paribus*, then the firm holds more equity (Prasad, 2000). Empirical evidence is in favour of Tobin's Q: it is more likely that when a firm's share price is high relative to it's historical standard, equity is used more for funding remaining financial needs[14].

Yet, there is a different view of the relationship between share prices and issuing new shares. EPS (earning per share) is related to returns both through cash dividends and share price appreciation[15], then an increase in share prices indicates profit growth and firms find it easier to borrow money from banks. Consequently borrowing may outweigh issuing shares when share prices rise.

In the case of developing economies, when the financial market reforms started in the 1980s in many of the developing countries, firms resorted so much to equity (Cobham and Subramaniam, 1998). This is perhaps because an increase in share prices will

[14] See Taggart (1977), Marsh (1982), Jalilvand and Harris (1984) and Homaifar, Joahim and Omar (1994).
[15] Gupta and Chowdhury (2000) observe a direct link between EPS and share prices in India.

dilute the transaction cost of issuing new shares; the associated rise in P/E ratio reduces the cost of capital (Singh, 1997 and Mayer, 1988).

It appears that whether corporations are timing the issuance of equity to coincide with rising stock prices is an *empirical* issue for India (Homaifar, Joahim and Omar, 1994).

6.4 Estimation

A similar procedure is followed as in the case of the banking sector. Starting with unit root tests, the overview of the general to specific model is presented. We then examine the specific models.

6.4.1 Unit Root Tests

The unit root test result is presented in Table 6.4. The table indicates that the null of unit root is rejected for the PDEP and ln(Y/W) in levels at a 5% significance level in DF and ADF tests, and they are stationary of I(0)[16]. For all other variables in levels the null is not rejected in either the DF or the ADF tests at a 5% significance level, and the rejection of the null in the differenced series indicates that these variables satisfy the condition of I(1). The test result suggests that there is a mix of I(0) and I(l) explanatory variables in a regression, but this is not a concern in pursuing a cointegration vector. As discussed in Chapter 4, it is possible that cointegration is present in this situation (Harris, 1995). Using these test results, the variables are categorised as given by:

I(1) endogenous variables: CS, LA, DEP, PCS, PLA, $\ln(W^{r} / P^{*r})$

I(1) exogenous variables: SLR,

I(0) variable: ln(Y/W), PDEP, dummy

The Perron's unit root test is found in Appendix 6.1. The results are in general close to the DF and ADF test results.

[16] With the significant time trend, ln(*Y/W*) exhibits a trend stationary process.

Table 6.4 Order of Integration of the variables

	Level		Differenced	
	DF	ADF	DF	ADF
S_1 (CS)	-2.34	-2.02	-2.24	-3.45 *
S_2 (LA)	-2.76	-2.00	-4.99 *	-3.50 *
S_3 (DEP)	-1.81	-2.15	-10.15 *	-3.72 *
$\ln p_1^r$ (PCS)	-3.41 *	-2.40	-5.49 *	-4.39 *
$\ln p_2^r$ (PLA)	-3.43 *	-2.30	-5.71 *	-3.80 *
$\ln p_3^r$ (PDEP)	-4.03 *	-3.24 *	-5.86 *	-3.92 *
$\ln(W^r / P^{*r})$	-2.43 (t)	-2.28 (t)	-6.31 *	-3.52 *
ln(Y/W)	-4.69 (t) *	-4.73 (t) *	-4.86 *	-2.93 *
SLR	-0.80	-1.20	-3.91 *	-2.60

* Significant at the 5% level.

Note: 1. ADF is modelled as $\Delta X_{it} = \alpha + \beta\ X_{t-1} + \sum_{i=1}^{2} \delta_i \Delta X_{t-i} + e_t$. (t): a deterministic trend is specified as the trend is statistically significant at the 5% level.

2. Critical value τ_c (constant, no trend): -3.43 (1%), -2.86 (5%), -2.57 (10%)

Critical value τ_{ct} (constant, trend) : -3.96 (1%), -3.41 (5%), -3.13 (10%)

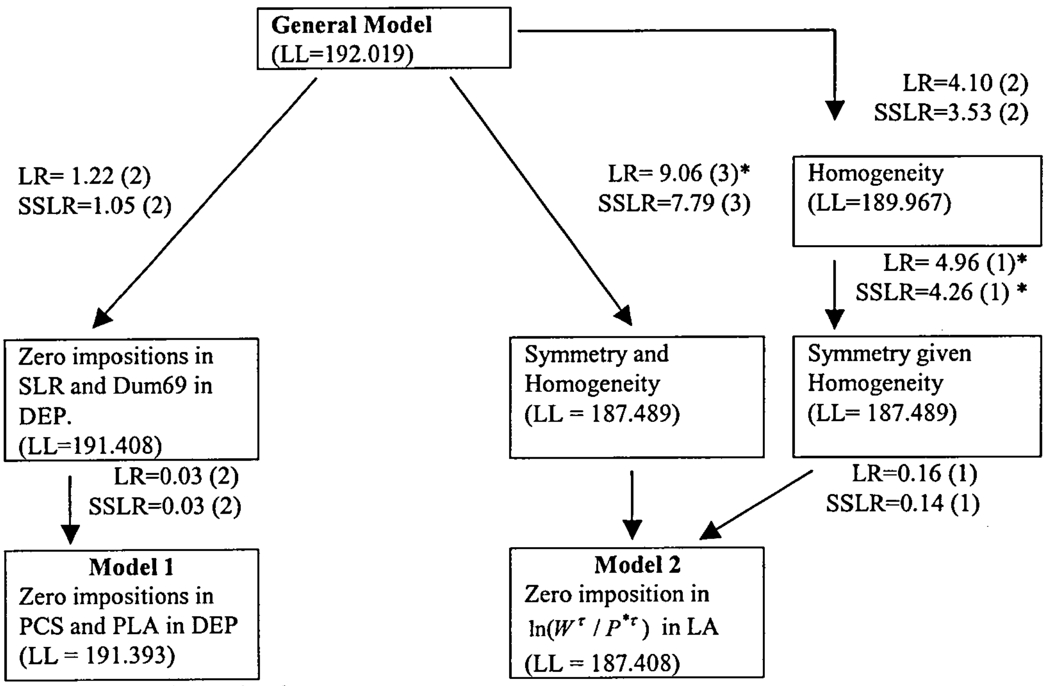
by Davidson and MacKinnon, p.708, 1993

6.4.2 Overview of the General to Specific Model

Figure 6.1 presents the overview of the general to specific model. The unrestricted general model is estimated without homogeneity and symmetry but maintaining adding-up. Estimates of the general model and residual diagnostics are given in Table 6.5.

The conventional measures of goodness of fit are satisfactorily high, suggesting that much of the variance in the regressions is explained by the model. There is no suggestion of heteroskedasticity at a 5% significance level, but there is an indication of serial correlation in the static regression in LA, where the LM test statistics in both first- and second-order are significant at a 1 % level. In price parameters, the own-price coefficients for CS and LA are significant and satisfy the *a priori* expectations with a positive sign. The price coefficients in DEP are, however, statistically and numerically insignificant with a wrong sign on the own price coefficient.

Figure 6.1 General to Specific Model



* Significant at the 5% level

- LL: Log likelihood
- LR: Likelihood Ratio (LR) test: $L = 2(l_u - l_r) \sim \chi^2_{(J)}$

where l_u (l_r) is the log likelihood of the unrestricted (restricted) equation and (J) is the number of restrictions.
- SSLR: The small sample-adjusted LR given by the product of LR and (T-K)/T, where T=No. of observations and K=No. of exogenous regressors in each equation (Bohm, Rieder and Tintner, 1980).
- Critical values: d.f. 1=3.84 (5%), 6.64 (1%), d.f. 2 = 5.99 (5%), 9.21 (1%), d.f. 3 = 7.82 (5%), 11.34 (1%).

Table 6.5 Unrestricted (General) Model

	$\ln p_1^\tau$ (PCS)	$\ln p_2^\tau$ (PLA)	$\ln p_3^\tau$ (PDEP)	Constant	$\ln(W^\tau / P^{*\tau})$	ln(Y/W)
1. CS (equity)	0.1271 (2.29)	-1.3143 (2.17)	1.6105 (2.64)	-1.9876 (2.49)	0.2281 (2.32)	0.7276 (5.46)
2. LA (debt)	-0.1192 (2.11)	1.2971 (2.10)	-1.5185 (2.44)	2.2661 (2.78)	-0.1498 (1.49)	-0.5405 (3.98)
3. DEP (–)	-0.0078 (0.32)	0.0172 (0.06)	-0.0920 (0.34)	0.7216 (2.03)	-0.0783 (1.79)	-0.1871 (3.15)

	SLR	Dummy 69	Dummy 90	R-squared	SSR	SE of regression
1. CS (equity)	-0.0236 (4.44)	-0.0417 (1.39)	0.1029 (3.13)	97.57 %	0.0660	0.0392
2. LA (debt)	0.0237 (4.37)	0.0290 (0.95)	-0.0752 (2.25)	97.17 %	0.0686	0.0399
3. DEP (–)	-0.0001 (0.03)	0.0128 (0.96)	-0.0277 (1.89)	68.51 %	0.0131	0.0175

- t-ratio is in parenthesis.
- No. of observation: 43 (1951-52 to 1993-94), Log Likelihood: 192.019
-Columns may fail to sum to zero due to rounding.
-SSR: Sum of squared residuals

Residual diagnostics (chi-square values)

	LM Heteroskedasticity	LM Serial Correlation (Order =1)	LM Serial Correlation (Order =2)
1. CS	0.447 [0.50]	4.931 [0.03]	7.760 [0.02]
2. LA	0.433 [0.51]	9.109 [0.00]	12.654 [0.00]
3. DEP (–)	2.471 [0.12]	4.524 [0.03]	13.833 [0.00]

[ ] is P-value. One tail tests

After test runs, we arrive at two specific models: Model 1 and Model 2. See Figure 6.1. In Model 1, zeros are imposed on the statistically insignificant variables in DEP share equation. In Model 2, the constraints of homogeneity and symmetry on the price coefficients are imposed across equations. The figure indicates that all these restrictions on both models are almost accepted by SSLR tests at a 5% significance level ('Symmetry given Homogeneity' is rejected at the 5% significance level, but not rejected at the 1% level).

6.4.3 Model 1 and Model 2

Tables 6.6, 6.7 and 6.8 show the estimates, the EG cointegration test and the Johansen cointegration test respectively for Model 1 and Model 2[17]. The parameter stability and other tests are found in Table 6.9.

Table 6.6a Estimates of Model 1

Log Likelihood: 191.393

	$\ln p_1^\tau$ (PCS)	$\ln p_2^\tau$ (PLA)	$\ln p_3^\tau$ (PDEP)	Constant	$\ln(W^\tau / P^{*\tau})$	ln(Y/W)
1. CS (equity)	0.1239 (2.27)	-1.3074 (2.19)	1.5956 (2.66)	-1.9298 (2.45)	0.2215 (2.29)	0.7186 (5.47)
2. LA (debt)	-0.1239 (2.27)	1.3074 (2.19)	-1.5406 (2.57)	2.3519 (2.98)	-0.1597 (1.65)	-0.5539 (4.12)
3. DEP (–)	0	0	-0.0550 (1.11)	0.5780 (4.0)	-0.0618 (4.76)	-0.1647 (6.57)

	SLR	Dummy 69	Dummy 90	R-squared	SSR	SE of regression
1. CS (equity)	-0.024 (4.52)	-0.037 (1.24)	0.105 (3.22)	97.56 %	0.0661	0.0392
2. LA (debt)	0.0237 (4.52)	0.0366 (1.24)	-0.0720 (2.18)	97.16 %	0.0687	0.0400
3. DEP (–)	0	0	-0.0331 (2.94)	67.58 %	0.0135	0.0177

Table 6.6b Estimates of Model 2 (Homogeneity and Symmetry imposed)

Log Likelihood: 187.408

	$\ln p_1^\tau$ (PCS)	$\ln p_2^\tau$ (PLA)	$\ln p_3^\tau$ (PDEP)	Constant	$\ln(W^\tau / P^{*\tau})$	ln(Y/W)
1. CS (equity)	0.0804 (1.65)	-0.0836 (1.74)	0.0032 (0.16)	-0.5613 (3.63)	0.0459 (2.40)	0.4829 (13.87)
2. LA (debt)		0.1573 (0.59)	-0.0737 (0.28)	1.1107 (10.35)	0	-0.3396 (13.76)
3. DEP (–)			0.0705 (0.27)	0.4506 (3.66)	-0.0459 (2.40)	-0.1433 (5.43)

	SLR	Dummy 69	Dummy 90	R-squared	SSR	SE of regression
1. CS (equity)	-0.0102 (3.51)	-0.0630 (1.95)	0.1255 (4.59)	97.00 %	0.0813	0.0434
2. LA (debt)	0.0121 (4.101)	0.0476 (1.48)	-0.0928 (3.46)	96.69%	0.0802	0.0432
3. DEP (–)	-0.0019 (1.13)	0.0155 (1.15)	-0.0327 (2.64)	67.77 %	0.0134	0.0177

Notes:
- t-ratio is in parenthesis. - No. of observation: 43 (1951-52 to 1993-94).
-Columns may fail to sum to zero due to rounding.
-SSR: Sum of squared residuals. -Zeros are imposed.

[17] Model 2 imposed of homogeneity and symmetry looks reasonable, but there are a couple of pitfalls in this model as it will be revealed. Model 1 is chosen as a preferred model and used for simulation.

Table 6.7 EG cointegration tests

Model 1	EG	AEG	Model 2	EG	AEG
1. CS (n = 4)	-5.015 **	-3.946 *	1. CS (n = 4)	3.982 *	3.704
2. LA (n = 4)	-4.778 **	-3.023	2. LA (n = 3)	4.265 **	3.674 *
3. DEP (–) (n = 2)	-5.117 **	-3.746 **	3. DEP (–) (n = 4)	4.797 **	2.957

Notes:

-ADF is modelled as $\Delta X_{it} = \alpha + \beta X_{t-1} + \sum_{i=1}^{2} \delta_i \Delta X_{t-i} + e_t$.

- n: number of I(1) endogenous variables
- Asymptotic Critical Values for Cointegration Tests: 3.34 (5%), 3.04 (10%) for n = 2, 3.74 (5%), 3.45 (10%) for n = 3 and 4.10 (5%), 3.81 (10 %) for n=4 (Davidson and MacKinnon, 1993, p722).
- ** Significant at the 5% level, * Significant at the 10% level.

Table 6.8a Johansen Cointegration LR test for Model 1
(Order of VAR=1 for CS and LA and VAR=3 for DEP, Unrestricted intercept with no trend)

CS

Null	Maximum Alternative	$\lambda_{\max}$	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	177.32 *	30.71	r >= 1	266.92 *	58.63
r <= 1	r = 2	64.27 *	24.59	r >= 2	89.59 *	38.93
r <= 2	r = 3	22.41 *	18.06	r >= 3	25.32 *	23.32
r <= 3	r = 4	2.90	11.47	r = 4	2.91	11.47

LA

Null	Maximum Alternative	$\lambda_{\max}$	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	187.06 *	30.71	r >= 1	285.32 *	58.63
r <= 1	r = 2	70.16 *	24.59	r >= 2	98.26 *	38.93
r <= 2	r = 3	22.91 *	18.06	r >= 3	28.09 *	23.32
r <= 3	r = 4	5.17	11.47	r = 4	5.17	11.47

DEP

Null	Maximum Alternative	$\lambda_{\max}$	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	51.30 *	14.88	r >= 1	56.39 *	17.86
r <= 1	r = 2	5.09	8.07	r = 2	5.09	8.07

Notes: - * Significant at the 5% level
- In the partial VECM, variables are categorised as follows.

	I(1) endogenous	I(1) weakly exogenous	I(0) variables
1. CS	CS, PCS, PLA, $\ln(W^{\tau} / P^{*\tau})$	SLR	PDEP, ln(Y/W), Dummy 69, Dummy 90
2. LA	LA, PCS, PLA, $\ln(W^{\tau} / P^{*\tau})$	SLR	PDEP, ln(Y/W), Dummy 69, Dummy90
3. DEP (–)	DEP, $\ln(W^{\tau} / P^{*\tau})$		PDEP, ln(Y/W), Dummy90

Table 6.8b Johansen Cointegration LR test for Model 2
(Order of VAR=1, Unrestricted intercept with no trend)

CS

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	177.32 *	30.71	r >= 1	266.92 *	58.63
r <= 1	r = 2	64.27 *	24.59	r >= 2	89.59 *	38.93
r <= 2	r = 3	22.41 *	18.06	r >= 3	25.32 *	23.32
r <= 3	r = 4	2.90	11.47	r = 4	2.91	11.47

LA

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	179.60 *	24.59	r >= 1	219.56 *	38.93
r <= 1	r = 2	33.65 *	18.06	r >= 2	39.95 *	23.32
r <= 2	r = 3	6.31	11.47	r = 3	6.31	11.47

DEP

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	185.73 *	30.71	r >= 1	280.54 *	58.63
r <= 1	r = 2	59.55 *	24.59	r >= 2	94.80 *	38.93
r <= 2	r = 3	28.21 *	18.06	r >= 3	35.25 *	23.32
r <= 3	r = 4	7.04	11.47	r = 4	7.04	11.47

Notes: - * Significant at the 5% level
- In the partial VECM, variables are categorised as follows.

	I(1) endogenous	I(1) weakly exogenous	I(0) variables
1. CS	CS, PCS, PLA, $\ln(W^{\tau} / P^{*\tau})$	SLR	PDEP, ln(Y/W), Dummy 69, Dummy90
2. LA	LA, PCS, PLA	SLR	PDEP, ln(Y/W), Dummy 69, Dummy 90
3. DEP (-)	DEP, PCS, PLA, $\ln(W^{\tau} / P^{*\tau})$	SLR	PDEP, ln(Y/W), Dummy 69, Dummy 90

Cointegration Tests

EG cointegration tests in Table 6.7 for Model 1 are indicative of a stable long-run relationship in all three equations, since the null is rejected at a 5% significance level, though in the AEG tests the indication of cointegration is weaker. The EG test for Model 2 also suggests the rejection of the null at a 5 % or at least at a 10 % significance level. The tests are supplemented by a more powerful type of Johansen test in Table 6.8a for Model 1 and Table 6.8b for Model 2. (Note that the test statistics and critical values for CS are the same for both models, as the explanatory variables for this share equation are identical.) The null of $r = 0$ is comfortably rejected in all cases in the maximum eigenvalue and trace tests. It is noticeable that the number of cointegrating vectors is relatively large; it is all n-1 (where n = the number of I(1) endogenous variables). This is perhaps due to the inclusion of I(0) variables of PDEP and ln(Y/W) in the model: each I(0) variable is stationary by itself and it forms a linearly independent column in Π of equation (4.38) in Chapter 4. Given these cointegration test results, we are fairly confident that there exists a stable long-run relationship between I(1) endogenous variables in the system of equations, and that the derived estimates are super-consistent.

Price Parameters for Model 1 and Model 2

The following findings, which are derived from the estimated price parameters in Table 6.6a and 6.6b, are noteworthy, though the impact on the holding of financial liabilities is fully discussed in the form of interest rate elasticities for the preferred model in the next section.

i) With respect to Model 1, the sign on the own price coefficients is the same as in the case of the general model. With the negative sign on the cross-price coefficients between LA and CS, the substitution effects of equity *versus* debt are observed. By imposing zeros on the cross prices and two other explanatory variables in DEP equation, the PDEP in DEP has statistically improved from 0.34 to 1.11 in the t-ratio. Statistical improvement is also seen in other explanatory variables in this share equation.

ii) For Model 2, the major change from the general model is that all the own-price coefficients satisfy the *a priori* expectations with a positive sign. Substitute effects of equity *versus* debt and debt *versus* internal finance (or withdrawing deposits) are observed. However, the overall price coefficients are statistically and numerically insignificant as compared with Model 1. With the weak price effects, the high R-squared probably attributes more to the contribution of the wealth, income and other explanatory variables than to that of the prices.

Parameter Stability and Other Tests

The parameter stability and other tests for both models are shown in Table 6.9. Chow tests are conducted for parameter stability for 1961 (1951-60 and 1961-93), 1969 (1951-68 and 1969-93) and 1980 (1951-79 and 1980-93). In particular, the 1980s were the years that P/E ratios started rising due to the gradual participation of foreign institutional investors in India. The table indicates that parameter stability is not rejected in almost all share equations (for DEP in Model 2 for 1961, it is rejected at a 5% significance level, but only marginally). This is quite an achievement considering the fact that we have used the aggregated data over such a large time span.

Although we find positive own-price coefficients for all three equations for Model 2, it is disappointing that all the eigenvalues are negative, and that the concavity in the cost function is rejected. This is probably due to the numerically small coefficients[18]. Concavity is also rejected in Model 1.

Weak separability conducted in an ad-hoc manner is not rejected with respect to the bank rate and government securities' yields, but with respect to money market rates for Model 1. In the case of Model 2, weak separability is not rejected, implying that the share equations are independent of these interest rates. By contrast, homotheticity is rejected for both models suggesting that wealth elasticities are not unity.

Model 1 as a Preferred Model

In both models, we have found a stable long-run equilibrium relationship by cointegration tests and parameter stability. With respect to price coefficients, all the own-price coefficients show a theoretically expected sign in Model 2. However, given numerically small coefficients, the explanatory power is weak and the concavity of the cost function is rejected. Further, the signs on the price elasticities are not consistent

[18] The eigenvalue is derived by the mean value of shares, and if a price coefficient is numerically very small, the sign between the coefficient and the eigenvalue may not be the same (Chapter 4).

Table 6.9 Parameter stability and other tests for the Model 1 and Model 2

Chow Tests		Model 1 (d.f.)	Model 2 (d.f.)
1961 (1951-60 and 1961-93)	CS	0.985 (9, 25)	1.240 (9, 25)
	LA	1.587 (9, 25)	1.504 (8, 27)
	DEP	1.430 (5, 33)	2.320 * (9, 25)
1969 (1951-68 and 1969-93)	CS	0.544 (9, 25)	1.407 (9, 25)
	LA	1.434 (9, 25)	1.806 (8, 27)
	DEP	2.138 (5, 33)	2.259 (9, 25)
1980 (1951-79 and 1980-93)	CS	1.03 (9, 25)	1.458 (9, 25)
	LA	2.08 (9, 25)	2.042 (8, 27)
	DEP	1.39 (5, 33)	1.821 (9, 25)

- Critical values at a 5% significance level for df (9, 25)= 2.28, df(8, 27)= 2.30 and df (5, 33)= 2.50.
- * Significant at the 5% level.

Negativity (Eigenvalues)	CS	LA	DEP (-)
Model 1	0.108	1.230	- 0.132
Model 2	- 0.141	-0.033	- 0.015

- An expected sign to satisfy negativity is positive in this sector.

	Model 1		Model 2	
	LR	SSLR	LR	SSLR
Weak Separability (No. of restrictions = 2)				
Bank rate	0.790	0.671	1.620	1.344
Gov't securities yields	0.000	0.000	2.470	2.050
Money market rate	12.494 *	10.869 *	2.708	2.328
Homotheticity				
Model 1 (β_i=0, i=1, 2)	21.880 *	19.035 *		
Model 2 (β_i=0, i=1)			5.424 *	4.664 *

-Critical values: d.f. 1 = 3.84 (5 %), 6.64 (1%), d.f. 2 = 5.99 (5%), 9.21 (1%)
- * Significant at the 5% level.

with those on the price estimates[19]; all the own-price elasticities are wrongly-signed on a priori grounds. On the other hand, in the case of Model 1, without the constraints of homogeneity and symmetry, statistically and numerically significant price coefficients are obtained; changes in absolute prices appear to play a major role in explaining the capital structure of Indian companies[20]. There is no conflict in the signs between the own-price estimates and elasticities, maintaining a theoretical expected sign on the own-price elasticities in CS and LA. Arguing that the elasticities rather than the estimated parameters are more meaningful in the AIDS model in terms of the economic concept (Barr and Cuthbertson, 1991a), Model 1 is preferred to Model 2. Moreover, another limitation in Model 2 is that of the poor performance in a system-wide simulation; historical simulation that evaluates a estimated model turns out be inferior by using Model 2 as compared with that of Model 1[21]. For these reasons, we choose Model 1 as our preferred long-run model.

6.5 Inference for Model 1

6.5.1 Interest Rate, Wealth and Income Impact

Table 6.10a presents the elasticities with respect to interest rates (this is equivalent to cost of capital), wealth and income. Table 6.10b shows the impact of changes in the interest rates on the actual holdings of assets.

i) The own-interest rate elasticity in equity finance is negative. This means that a fall in the cost of equity capital (i.e. lower R_1) increases equity issues. Similarly, a fall in the cost of debt capital (i.e. lower R_2) increases debt financing. These satisfy the priori expectations.

ii) Besides, a fall in the cost of equity capital implies a rise in share prices, and that the result is consistent with the Tobin's Q hypothesis. It could be due to the fact that

[19] In 7 out of 9 cases, signs are different between the price estimates and elasticities.

[20] Without imposition of homogeneity it implies that the demand for financial liabilities is explained by absolute rather than relative prices.

[21] Among others, the Theil's U in solving PCS is 0.26 with Model 1 and it shoots to 0.41 with Model 2 (see Chapter 11 for the definition of Theil's U).

the transaction costs of issuing new shares, which tend to be high in developing economies, will be reduced as the share prices rise.

iii) The impact of R_1 on the actual holdings is however very small. The cross-interest rate elasticities (i.e. R_2 and R_3), on the other hand, appear to exert a significant influence on equity financing. The weak effect of R_1 (or share prices) appear to reflect some developing country-specific features in equity financing. As Singh (1997) points out the share prices in emerging markets may be expected to fluctuate more than in well-developed markets, and the high degree of variability has a detrimental influence on a stock market: i) to the extent that it discourages risk-averse investors, it raises the cost of capital to firms and it may discourage risk-averse firms from raising funds through the stock market (see also Singh and Weisse, 1998), ii) share prices in many emerging markets appear to have deviated considerably from fundamentals in the 1980s. Therefore the finding of the weak role of the share prices as an instrument of resource allocation is plausible in India.

iv) The interest rate elasticities suggest that equity and debt are viewed as alternative sources; an increase in the cost of equity (R_1) leads to a switch from equity to debt, while a rise in the cost of debt (R_2) reduces debt financing and increases equity financing.

v) The effect of R_2 is much larger than that of R_1 on both CS and LA. This demonstrates a relatively strong sensitivity to the lending rates in the capital structure in India, as opposed to that of the cost of equity capital.

vi) The own elasticity of debt finance (-1.651) is larger than that of equity finance (-0.301). A cross effect of R_2 has a greater influence on equity (given the elasticity of 3.314) than a cross effect of R_1 on debt (with the elasticity of 0.014). These suggest that as both the cost of equity capital and the cost of debt captal rise equi-proportionally, there is a net increase in equity financing. This is also clear from the change in actual holdings in Table 6.10b. It could be possible that the debt market is more affected by interest rate restrictions as the lending rate rises.

Table 6.10a Interest rate, Wealth and Income Elasticities for Model 1

	R_1	R_2	R_3	Wealth	Income
1. CS (Equity)	-0.301	3.314	-4.267	1.613	1.995
2. LA (Debt)	0.014	-1.651	1.904	0.785	-0.744
3. DEP (–)	0	0	1.256	0.412	-1.566

- R = Interest rate
- The interest rate elasticities imply the effect of a one percentage point change in the interest rate (R) on the percentage change in asset holdings, i.e. $(\Delta a_i / a_i)$*100.
- Wealth and income elasticities, i.e. $[\ (\Delta a_i / a_i)(\Delta \ln(W^\tau / P^{*\tau}) / \ln(W^\tau / P^{*\tau}))^{-1}\ ]$and $[\ (\Delta a_i / a_i)(\Delta \ln(Y / W) / \ln(Y / W))^{-1}\ ]$ respectively. (Barr and Cuthbertson, 1991c)
-Zeros are imposed.

Table 6.10b Long-run Impact on Asset Holdings for Model 1 (Rs. Crore)

	R_1	R_2	R_3	Mean Value
1. CS (Equity)	- 9.1	100.2	-129.1	3,025.4
2. LA (Debt)	3.1	-346.6	399.9	20,996.6
3. DEP (–)	0	0	29.9	-2,381.3

R = Interest rate
-Zeros are imposed.
This shows the effect of a one percentage point change in the rate of return on the holdings of the assets, using the mean value of stocks for the sample period 1951-93.

vii) The estimation result in the share of deposit equation provides some aspect of the 'pecking order' in the Indian corporate sector. An increase in the deposit rate (or cost of using internal finance) leads to a rise in withdrawing deposits. This is counter-intuitive. It is, however, argued that the net value of deposits (as working capital) is a concern to the managers and the short-term creditors of a firm as an indicator of its ability to meet immediate obligations and to continue operations (Hay and Louri, 1991). Therefore, as Spies (1974) argues the primary reason that most corporations hold liquid assets is to facilitate adjustment between debt and equity. On this ground the drawing down of deposits may be influenced by factors other than the interest rate, (for example income, as we here find a large negative income elasticity). The zero elasticities (the zero imposed coefficients) of R_1 and R_2 in the deposit equation are also consistent with an indication of the pecking order.

viii) Further, a one percent proportionate rise in the deposit rate has a negative influence on the share of equity (with the elasticity of –4.267) and a positive impact on the share of debt (with the elasticity of 1.904) held by firms. This also supports the pecking order.

ix) With respect to wealth and income elasticities, equity is viewed as being a luxury good since both elasticities exceed the unity (1.613 and 1.995 respectively). When the level of wealth or income rises, firms use more equity to meet the shortage of finance. In particular, the stronger income impact on equity financing than that of the own interest rate suggests that Indian non-financial companies behave cautiously, by not directly responding to volatile share prices, but by following the fundamentals (i.e. economic conditions) in issuing new shares.

x) On the other hand, debt finance is viewed as a necessity (i.e. inelastic) with respect to wealth and as an inferior good with respect to income, given the elasticities of 0.785 and –0.744 respectively. This is not an unexpected result. Regardless of the level of wealth, firms rely on borrowing, and when income falls, firms have to rely on borrowing. This reflects the predominant position of debt finance in corporate finance in India over the sample period.

xi) Negative income elasticity (-1.566) is also found for Deposit. This implies that as income falls, it becomes difficult to obtain funds externally, hence the PCB sector has to use their internal finance.

6.5.2 Other Explanatory Variables

In revisiting Table 6.6a for the estimates of SLR and dummies for Model 1, the following general features are of interest.

i) A statistically significant effect of SLR on the PCB sector is found. The positive sign on LA and negative sign on CS indicate that the PCB sector obtains funds under this regulation in the form of corporate debt rather than equity. In this respect, SLR appears to exert the preferable effect in the PCB sector, as debt finance is less risky and less costly than equity finance.

ii) The effect of dummy 69 is positive on LA and negative on CS. This is puzzling. It was expected that the credit rationing in favour of the priority sectors would reduce bank lending to the PCB sector. The only plausible explanation is that the credit rationing may also apply to small industries in this sector.

iii) With respect to dummy 90, a positive sign on equity finance and a negative sign on debt finance variables are found. This symbolises the effect of de-regulation in the capital market by easing the issue of new shares for the corporate sector in terms of cost and regulation, and this is consistent with the experience that the financial sector has had in the post-reform period. Besides, the contraction of bank lending (banks are more attracted to the market-related risk-free government debts in the post-reform period) may force the corporate sector to diversify their sources of funds from bank borrowing more towards the capital markets.

6.6 Conclusion

This chapter presents a simple, but unique model of capital structure by viewing corporate finance as a macroeconomic problem for a developing economy. Although aggregate time series data are used for the estimation of the heterogeneous companies in the current study, evidence of parameter stability and the stable long-run relationship is of significant importance in providing credibility to the approach. In this respect, This chapter sheds light on the time series approach of modelling a capital structure.

In the preferred model without the restriction of homogeneity and symmetry, we have found a number of economically plausible results. The prices have shown influences in determining corporate finance, in which the substitution effect of equity and debt is observed. Although firms exhibit a relatively weak sensitivity to the share prices in determining corporate finance, Tobin's Q is supported. Further, the 'pecking order' is apparent in the share of deposit equation. The loan-dependent firms in India are reflected in the income elasticity. The influence of SLR suggests a relatively strong policy impact on the capital structure in India. The effect of dummy 69 is unexpected, however dummy 90 reveals evidence of financial liberalisation being associated with growth in the capital market.

Appendix 6.1

Perron's unit root test

	Perron's Model (C) $k=0$			DF Level	Perron's Model (C) $k=2$			ADF Level
PCB Sector	Dummy	$\hat{\rho}$	$t_{\hat{\rho}}$	From Table 6.4	Dummy	$\hat{\rho}$	$t_{\hat{\rho}}$	From Table 6.4
S_1 (CS)	0	-0.094	0.881	N	1	-0.322	3.622	N
S_2 (LA)	0	-0.183	1.513	N	2	-0.513	4.815 *	N
S_3 (DEP)	0	-0.651	4.254 *	N	0	-0.732	3.459	N
$\ln p_1^\tau$ (PCS)	0	-0.984	4.301 *	R	0	-1.339	3.427	N
$\ln p_2^\tau$ (PLA)	0	-0.741	3.909	R	0	-0.997	3.129	N
$\ln p_3^\tau$ (PDEP)	0	-0.796	4.149	R	0	-1.168	3.540	R
$\ln(W^\tau / P^{*\tau})$	2	-0.384	3.021	N	0	-0.449	3.169	N
ln(Y/W)	0	-0.133	1.226	R	0	-0.212	1.620	R
SLR	0	-0.162	1.539	N	0	-0.193	1.582	N

- * Significant at a 5% level, N= null of unit root is not rejected at a 5% significance level, R= null of unit root is rejected at a 5% significance level.

- Model (C) : $\Delta y_t = \mu + \beta t + \theta DU_t + \gamma DT_t^* + \varsigma DTB_t + \rho y_{t-1} + \sum_{i=1}^{k} \delta_i \Delta y_{t-i} + e_t$

- Null hypothesis: $\rho = 0$ and $\theta = \beta = \gamma = 0$

- Alternative hypothesis of a trend stationary process: $\rho < 0$ and θ, β, $\gamma \neq 0$

- Dummy: The number of significant dummy coefficients out of θ, β and γ.

- T_B = 1969, T = 18, λ = 18/43=0.44

- Critical Value for $t_{\hat{\rho}}$: 4.21 (5%), 4.85 (1%) (Perron 1989, p.1377)

Chapter 7 Modelling a flow of funds for Other Financial Institutions (OFIs) Sector

7.1 Introduction

Barr and Cuthbertson (1992b) pointed out that obtaining sensible results in non-bank financial institutions for a flow of funds model is extremely difficult. For example, Ryan (1973) finds the counterintuitive effect of own yields in his study for the UK life funds, and also Honohan (1980) faces the statistically poor performance in modelling UK insurance companies.

However, the empirical work of Barr and Cuthberston (1992b), in which other UK financial institutions are estimated using the aggregate data of pension funds, insurance companies, unit and investment trusts and financial houses, the methodology has yielded sensible empirical results with the AIDS model.

In this chapter, the portfolio behaviour of major, non-bank financial institutions in India is examined. In India, there was a rapid development of OFIs over the sample period: soon after Independence, the Government of India set up major financial institutions one by one,[1] and with the share market boom that started in the 1980s, there was a massive shift towards unit and mutual fund products especially in the 1990s (Gupta, 1993).

For this sector, estimation is conducted in two ways. One is by using the data of *net transactions* of sources and uses of funds as is the case for other sectors. The other is by using the data of *uses* only, i.e. assets only. The reason is that the intra-transactions frequently found within the OFIs make it difficult to arrive at a credible and unbiased conclusion with the estimation by using net transactions only, hence estimation is

[1] For example, ICIC (Industrial Credit and Investment Corporation of India) was set up in 1955, LIC (Life Insurance Companies) in 1956, IDBI (Industrial Development Bank of India) in 1964, and UTI (Unit Trust of India) in 1964.

conducted with uses as a complement. For simulation experiments, the model with net transactions is used as it generates better tracking performance.

The rationale in utilising the AIDS model in this sector is similar to that for the banking sector: positive relationship between the holdings of financial assets and the own interest rates is asserted to the case in the financial institutions in pursuit of profitability (refer to the introduction in Chapter 5). In particular, the majority of the OFIs are government-owned, hence the solvency is somewhat protected.

This chapter is organised as follows. Financial instruments and explanatory variables for estimation are clarified in Section 7.2. Section 7.3 deals with the estimation, and inference is drawn in Section 7.4. The conclusion is found in Section 7.5.

7.2 Financial Instruments and Explanatory Variables

Table 7.1a shows the aggregate balance sheet for the OFIs sector, including term lending institutions, insurance companies and unit trusts and mutual funds. There are three major streams of financial transactions with other sectors:

i) The financial sources of the term lending institutions have been for the majority from commercial banks by issuing government approved securities (this is under the provision of SLR); this forms share capital and/or bonds and debentures in sources. These funds are then invested in the PCB sector; this constitutes company securities and/or loans and advances in uses[2].

ii) Since the 1980, when financial assets in the capital market became more popular, especially due to the development of unit trusts and mutual funds, sources are obtained from wider range of sectors. This forms share capital in sources.

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[2] It is not clear from the published flow account, in which financial assets the government approved securities are nominated in the OFIs sector, either share capital or bond and debentures in sources and either company securities or loans in uses. In respect of sources, the empirical evidence in the Banking sector in Chapter 5 indicates that it takes the form of share capital, whereas in the case of uses, the evidence in the PCB sector in Chapter 6 suggests that it takes the form of loans.

iii) Provident, life and pension funds of insurance companies are consolidated into Provident Funds, which are obtained from the household sector. The provident fund constitutes the major sources, more than half of total sources in the OFIs. The majority of the provident fund is directed towards the government sector.

The intra-transactions are mainly held in the form of shares, bonds and debentures: term lending institutions or insurance companies invest in mutual funds and unit trusts.

Table 7.1b is the adjusted balance sheet; share capital and bonds and debentures in sources are netted out from company securities and loans and advances in uses respectively. LHS now consists of only Provident Funds, which is demand-determined.

Table 7.1a Aggregate Balance Sheet for the OFIs

Liabilities (Sources)	Assets (Uses)
Share Capital	Company Securities
Bond and Debentures	Loans and Advances
Provident Fund	Government debt

- The OFIs is comprised of term lending institutions, insurance companies, unit trust and mutual funds.
- Share capital includes paid-up capital and unit trust capital.
- The holdings of cash, deposits and foreign assets are negligible, hence excluded.

Table 7.1b Adjusted Aggregate Balance Sheet for the OFIs

Sources (deducted of share capital and bonds and debentures)	Net transactions of assets
Provident Fund	Company Securities – Share Capital Loans and Advances – Bonds and Debentures Government debt

We model a flow of funds using two different data series: one is from the net transactions of assets (Net uses, hereafter) in Table 7.1b on the right side, and the other is from uses (Gross uses, hereafter) in Table 7.1a on the right side.

Table 7.2a indicates the financial instruments to be modelled together with the mean share values over the sample period 1951 to 1993. Noticeably, the mean value of CS in Net uses is numerically very small (0.2 %). This is due to the intra-ssector transactions. CS is maintained in the system of equations on the grounds that not only is CS one of the major financial instruments in the OFIs, but also the exclusion of the CS out of the system results in statistically inferior estimates than otherwise would be the case.

Although the mean value of CS in Net uses is a positive, we will pursue the properties of CS in the source side with negative sign of (–) on the following reason. The share value ranges from – 17% to 0.8%, and in the last 10 years of the sample period, the share starts rising in negative terms. It may be therefore more plausible to treat CS in Net uses as a liability.

Table 7.2b presents the derivation of the stock data used for estimation (a similar methodology as in Chapter 4). The benchmark stock data on 31st March, 1951 are incremented with the annual flow data to arrive at the stock data on 31st March, 1952. By repeating this process, we derive the whole time series for the stock data. The figure in Net uses is reproduced for the OFIs in 'Flow/Stock data for behavioural equations' in Table 4.2, Chapter 4. GD has the same figure for Net uses and Gross uses, as there is no GD as a source of funds in the OFIs. The stock data on 31st March, 1952 is the first observation.

Table 7.2a Financial instruments to be modelled for the OFIs

Model	Financial Instruments with notations		Mean (%)
Net uses	GD	Government Debt	65.3
	CS	Company Securities – Share Capital	0.2
	LA	Loans and Advances – Bonds and Debentures	34.5
Gross uses	GD	Government Debt	52.1
	CS	Company Securities	8
	LA	Loans and Advances	39.9

- Mean (%): a proportion of total wealth

Table 7.2b Flow/Stock data for the financial instruments for the OFIs

1) Stock data on 31st March 1951 Rs. crore

	Net uses	Gross uses
CUR		
R		
DEP		
GD	292.3	292.3
CS	-40.0	40.0
LA	299.8	349.84
PF	(-508.5)	
Net Worth	43.6	/

2) Flow data during 1st April 1951 to 31st March 1952 Rs. crore

	Net uses	Gross uses
CUR		
R		
DEP		
GD	32.7	32.7
CS	2.2	3.5
LA	16.1	10.1
PF	(-39.6)	
Net Worth	11.4	/

3) Stock data on 31st March 1952 Rs. crore

	Net uses	Gross uses
CUR		
R		
DEP		
GD	325.0	325.01
CS	-37.8	43.5
LA	315.9	350.94
PF	(-548.1)	
Net Worth	55.0	/

- CUR=Currency, R=Bank reserves, DEP=Deposit, GD=Government debt, CS=Company securities LA=Loans and advances, PF=Provident funds
- Negligible components are ignored for simplicity.
- ( )= Demand determined
- Stock data sources: RBI Bulletin various issues
- The figure in Net uses is the reproduction of the OFIs in 'Flow/Stock data for behavioural equations' in Table 4.2, Chapter 4.
- Rs. crore=10 million rupees

The interest rates used to formulate the AIDS prices ($\ln p_i^r$, $i = 1$, 2 and 3) are the same as other sectors. Table 7.3 presents the explanatory variables used for estimation.

Table 7.3 Explanatory variables

Variables	Notes
$\ln p_1^r$ = PGD (Price of GD)	r_1 = Government securities yields
$\ln p_2^r$ = PCS (Price of CS)	r_2 = Return on shares (The rate of growth in share prices)
$\ln p_3^r$ = PLA (Price of LA)	r_3 = Lending rate
Ln(Y/W)	Log of GDP at factor cost deflated by W
Dummy 69	0: 1951-68 and 1: 1969-93
Dummy 90	0: 1951- 89 and 1: 1990-93

In this sector, the effect of SLR on the share of financial assets should be insignificant; if the role of the OFIs is to transfer funds from the banking sector to the PCB sector, then the net transaction should be unaffected. The test run for Net uses including SLR with homogeneity and symmetry imposed is found in Appendix 7.1, in which the long-run model generates numerically and statistically insignificant coefficients for SLR in all three equations. Hence SLR is excluded in the model specification in this sector.

7.3 Estimation

Starting with unit root tests, we present the overview of the general to specific model. Specific models are then thoroughly examined.

7.3.1 Unit Root Tests

Table 7.4a and 7.4b present the unit root tests for each share of assets, wealth and income variables for Net uses and Gross uses respectively. In respect of prices, please refer to the banking sector in Chapter 5 (it is reported that the prices are I(l) for PGD, PCS and PLA). The DF and ADF statistics in levels indicate that none of the series are I(0).

Table 7.4a Order of Integration of the variables: Net uses

	Level		Differenced	
	DF	ADF	DF	ADF
S_1 (GD)	-0.39	-0.99	-4.55 *	-1.87
S_2 (CS)	0.70	-2.52	-3.52 *	-2.24
S_3 (LA)	1.49	-0.41	-2.92 *	-2.24
$\ln(W^{\tau} / P^{*\tau})$	-2.06 (t)	-1.43 (t)	-6.00 *	-3.77 *
ln(Y/W)	-0.23	-0.24	-5.96 *	-2.79

Table 7.4b Order of Integration of the variables: Gross uses

	Level		Differenced	
	DF	ADF	DF	ADF
S_1 (GD)	-0.60	-0.52	-4.15 *	-2.52
S_2 (CS)	-0.49	-1.79	-2.87 *	-2.50
S_3 (LA)	-1.00	-0.99	-3.32 *	-2.74
$\ln(W^{\tau} / P^{*\tau})$	-1.86 (t)	-1.21(t)	-6.17 *	-3.64 *
ln(Y/W)	-1.06	-1.11	-5.99 *	-2.88 *

Notes:
- * Significant at the 5% level.
- ADF is modelled as $\Delta X_{it} = \alpha + \beta X_{t-1} + \sum_{i=1}^{2} \delta_i \Delta X_{t-i} + e_t$. (t): a deterministic trend is specified as the trend is statistically significant at the 5% level.
- Critical value τ_c (constant, no trend): -3.43 (1%), -2.86 (5%), -2.57 (10%)
  Critical value τ_{ct} (constant, trend) : -3.96 (1%), -3.41 (5%), -3.13 (10%)
  by Davidson and MacKinnon, p708, 1993

In testing differenced series, the DF tests suggest that all the series are stationary at a 5% significance level, though the share variables (GD, CS and LA in both tables) tend to exhibit non-stationary according to the ADF tests. We would resort to the DF test results in determining the I(1) of the share variables. The level of $\ln(W^{\tau} / P^{*\tau})$ in both Net uses and Gross uses suggests an existence of a deterministic trend.

The Perron's unit root test results are found in Appendix 7.2. In the main, the variables do not reject a null of unit root test. There does not appear to be much contribution of the structural break in the Perron's model in determining the unit root in the variables.

Based on the unit root tests, variables are categorised in the following (common to both Net uses and Gross uses:

I(1) endogenous variables: GD, CS, LA, PCS, PLA, $\ln(W^{\tau} / P^{*\tau})$

I(1) exogenous variables: PGD, ln(Y/W)

I(0) variable: Dummy

7.3.2 Overview of the General to Specific Model

Figures 7.1a and 7.1b show the overview of the general to specific model with the likelihood ratio tests for Net uses and Gross uses respectively, whereas Tables 7.5a and 7.5b show the estimates and residual diagnostics of the general model (with an adding-up restriction).

Both general models suffer from serial correlation. Net uses satisfies homoskedasticity in all share equations, whereas Gross uses exhibits heteroskedasticity in GD and LA at a 5% significance level. Common to both models is that the own price coefficients for GD and LA satisfy the *a priori* expectations with a negative sign, but that for CS is wrongly-signed being positive. However, as compared with GD and LA the CS share equation as a whole is statistically well-determined, accompanied with a relatively high R-squared 74.21% and 73.0% respectively.

Figure 7.1a General to Specific model with likelihood ratio tests: Net uses

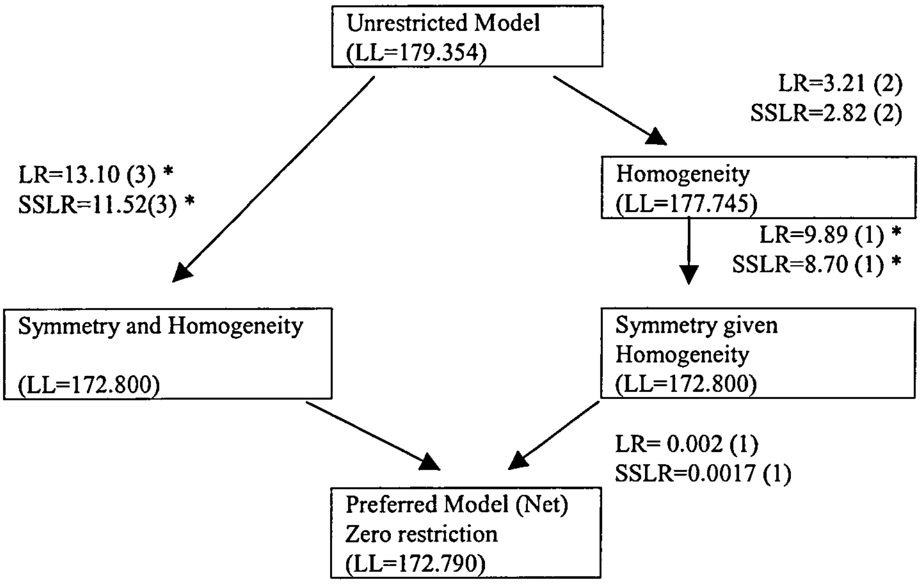
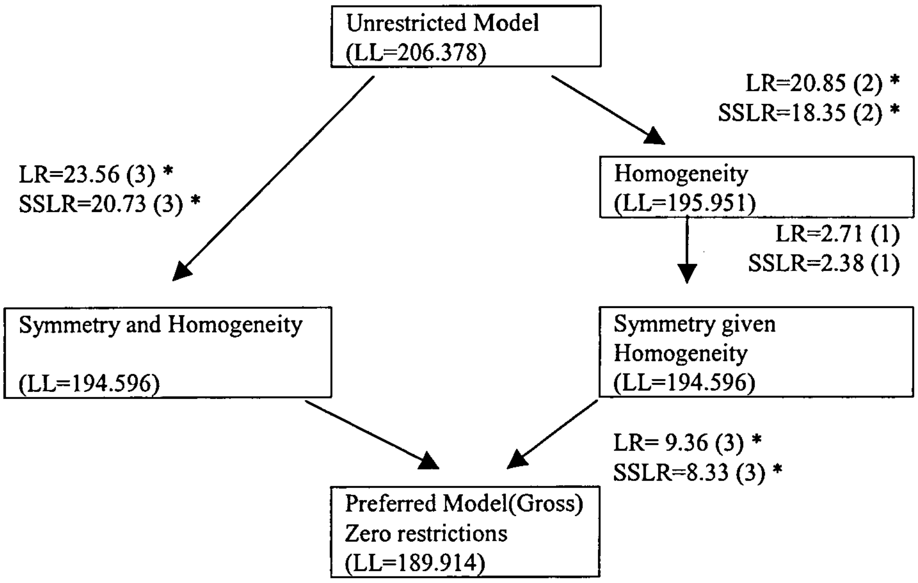


Figure 7.1b General to specific model with likelihood ratio tests: Gross uses



Notes:
-LL: Log likelihood
-LR: Likelihood Ratio (LR) test
-SSLR: The small sample-adjusted LR given by the product of LR and (T-K)/T, where T=No. of observations and K=No. of exogenous variables in each equation (Bohm, Rieder and Tintner, 1980).
-Critical values: d.f. 1=3.84 (5%), 6.64 (1%), d.f. 2 = 5.99 (5%), 9.21 (1%),
d.f. 3 = 7.82 (5%), 11.34 (1%)
- * Significant at the 5% level

Table 7.5a Unrestricted (General) Model: Net uses

Log Likelihood: 179.354

	$\ln p_1^\tau$ (PGD)	$\text{Ln}\, p_2^\tau$ (PCS)	$\ln\ p_3^\tau$ (PLA)	Constant	$\ln(W^\tau / P^{*\tau})$	ln(Y/W)
1. GD	-1.2349 (2.21)	0.0151 (0.28)	1.4911 (2.68)	0. 4870 (0.61)	0.0036 (0.04)	-0.0285 (0.18)
2. CS (–)	1.5551 (3.78)	0.0379 (0.96)	-1.3935 (3.41)	-1.0263 (1.74)	0.0660 (1.05)	0.2414 (2.07)
3. LA	-0.3202 (0.34)	-0.0529 (0.59)	-0.0977 (0.11)	1.5393 (1.16)	-0.0696 (0.49)	-0.2129 (0.81)

	Dummy 69	Dummy 90	R-squared	SSR	SE of regression
1. GD	-0.0212 (0.60)	-0.0547 (1.44)	46.20 %	0.0942	0.0468
2. CS (–)	0.0236 (0.91)	-0.1031 (3.70)	74.21 %	0.0507	0.0344
3. LA	-0.0024 (0.04)	0.1577 (2.50)	47.17 %	0.2593	0.0776

- t-ratio is in parenthesis.
- No. of observations: 43 (1951-52 to 1993-94)
-Columns may fail to sum to zero due to rounding.
-SSR: Sum of squared residuals

Residual diagnostics (chi-square values): Net uses

	LM Heteroskedasticity	LM Serial Correlation (Order =1)	LM Serial Correlation (Order =2)
1. GD	2.555 [0.11]	32.329 [0.00]	32.219 [0.00]
2. CS (–)	1.058 [0.30]	28.220 [0.00]	29.419 [0.00]
3. LA	2.384 [0.12]	36.685 [0.00]	36.735 [0.00]

[ ] is P-value. One tail tests

Table 7.5b Unrestricted (General) Model: Gross uses

Log Likelihood: 206.378

	$\ln p_1^{\tau}$ (PGD)	$\ln p_2^{\tau}$ (PCS)	$\ln p_3^{\tau}$ (PLA)	Constant	$\ln(W^{\tau} / P^{*\tau})$	ln(Y/W)
1. GD	-0.2914 (0.52)	0.0066 (0.12)	0.4781 (0.83)	0.1376 (0.14)	0.0167 (0.15)	0.0906 (0.48)
2. CS	0.3052 (2.54)	0.0365 (3.01)	-0.1450 (1.18)	-1.0595 (5.04)	0.1111 (4.74)	0.2272 (5.61)
3. LA	-0.0138 (0.02)	-0.0432 (0.68)	-0.3331 (0.52)	1.9218 (1.76)	-0.1277 (1.05)	-0.3178 (1.51)

	Dummy 69	Dummy 90	R-squared	SSR	SE of regression
1. GD	-0.0430 (1.14)	-0.0765 (1.90)	66.38 %	0.1082	0.0502
2. CS	0.0123 (1.52)	0.0298 (3.46)	73.00 %	0.0049	0.0107
3. LA	0.0307 (0.73)	0.0467 (1.04)	58.48 %	0.1336	0.0557

- t-ratio is in parenthesis.
- No. of observations: 43 (1951-52 to 1993-94)
-Columns may fail to sum to zero due to rounding.
-SSR: Sum of squared residuals

Residual diagnostics (chi-square values): Gross uses

	LM Heteroskedasticity	LM Serial Correlation (Order =1)	LM Serial Correlation (Order =2)
1. GD	8.097 [0.00]	37.994 [0.00]	37.295 [0.00]
2. CS	1.419 [0.23]	7.419 [0.01]	6.836 [0.03]
3. LA	5.213 [0.02]	38.557 [0.00]	38.767 [0.00]

[ ] is P-value. One tail tests

We impose symmetry and homogeneity in the general models, and further zeros on the statistically insignificant variables. The likelihood test results for symmetry and homogeneity are mixed. Figure 7.1a for Net indicates that the joint test of 'symmetry and homogeneity' is rejected given SSLR=11.52 at a 5% significance level, but it is only marginally rejected at a 1% level. The 'homogeneity' on its own is not rejected. Figure 7.1b for Gross shows that the joint test is rejected given SSLR=20.73, however, 'symmetry given homogeneity', is not rejected at a 5% level. Zero restrictions in Gross uses are rejected at a 5% level, but not rejected at a 1% level.

Specific models imposed of symmetry and homogeneity yielded statistically far more significant coefficients than did the general models. We therefore maintain the restrictions, and determine the specific models as our preferred models, to which we now turn.

7.3.3 Preferred Models

Tables 7.6a and 7.6b show the estimates of the preferred model for Net and Gross respectively. Table 7.7 presents the EG cointegration test, and Table 7.8, the Johansen cointegration test.

Cointegration Tests

The Engle-Granger cointegration test results are disappointing in that there is no indication of cointegration in all the share equations in both Net and Gross, since none of the tests reject null of unit root in residuals. However, this result is reversed by the Johansen cointegration test. The maximum eigenvalue and trace tests both strongly suggest the presence of at least one cointegrating vector for each equation. In LA of Gross uses (in Table 7.8b), there are $n = r$ (i.e. the number of I(1) variables are equal to that of cointegration vectors). If $n = r$, it is argued that variables are all stationarity; but surely we find that there are I(1) variables in LA by the unit root test, hence the finding of cointegration may still be legitimate.

Table 7.6a Long-run preferred model: Net uses (homogeneity and symmetry imposed)

Log Likelihood: 172.790

	$\ln p_1^r$ (PGD)	$\ln p_2^r$ (PCS)	$\ln p_3^r$ (PLA)	Constant	$\ln(W^r / P^{*r})$	ln(Y/W)
1. GD	-2.9578 (9.43)	0.0772 (1.35)	2.8806 (8.89)	2.0329 (6.94)	-0.1425 (3.73)	-0.3359 (4.92)
2. CS (–)		0.0862 (2.00)	-0.1634 (1.69)	0.1657 (3.11)	-0.0462 (3.32)	0
3. LA			-2.717 (7.44)	-1.1985 (3.88)	0.1886 (4.12)	0.3359 (4.92)

	Dummy 69	Dummy 90	R-squared	SSR	SE of regression
1. GD	0.0589 (1.95)	-0.0676 (1.84)	36.92 %	0.1197	0.0528
2. CS (–)	0.0898 (4.25)	-0.1179 (4.38)	65.24 %	0.0684	0.0399
3. LA	-0.1487 (3.05)	0.1855 (3.03)	32.80 %	0.3448	0.0895

Table 7.6b Long-run preferred model: Gross uses (homogeneity and symmetry imposed) (Adjusted White's Heteroskedasticity-Consistent S.E.'s)

Log Likelihood: 189.914

	$\ln p_1^r$ (PGD)	$\ln p_2^r$ (PCS)	$\ln p_3^r$ (PLA)	Constant	$\ln(W^r / P^{*r})$	ln(Y/W)
1. GD	-1.8829 (6.34)	0.0383 (0.70)	1.8446 (5.79)	0.8866 (7.64)	-0.0313 (2.08)	-0.0795 (3.20)
2. CS		0.0362 (2.39)	-0.0744 (1.24)	-0.2300 (2.05)	0.0313 (2.08)	0.0795 (3.20)
3. LA			-1.7702 (5.07)	0.3434 (18.85)	0	0

	Dummy 69	Dummy 90	R-squared	SSR	SE of regression
1. GD	0	-0.1664 (9.40)	54.93 %	0.1451	0.0581
2. CS	0.0308 (3.63)	0.0236 (2.17)	52.02 %	0.0088	0.0143
3. LA	-0.0308 (3.63)	0.1428 (7.39)	40.64 %	0.1914	0.0667

Notes:
- t-ratio is in parenthesis.
- No. of observations: 43 (1951-52 to 1993-94)
-Columns may fail to sum to zero due to rounding.
-SSR: Sum of squared residuals
-Zeros are imposed.

Table 7.7a EG Cointegration Tests: Net uses

	EG	AEG
1. GD (n = 4)	-3.240	-3.186
2. CS (–) (n = 4)	-2.860	-2.670
3. LA (n = 4)	-2.870	-2.979

Table 7.7b EG Cointegration Tests: Gross uses

	EG	AEG
1. GD (n = 4)	- 2.614	- 2.879
2. CS (n = 4)	- 2.675	- 1.849
3. LA (n = 3)	- 2.417	- 2.977

Notes:

-ADF is modelled as $\Delta X_{it} = \alpha + \beta\ X_{t-1} + \sum_{i=1}^{2} \delta_i \Delta X_{t-i} + e_t$.

- n : Number of I(1) endogenous variables
- Asymptotic Critical Values for Cointegration Tests: for n = 3, 3.74 (5%), 3.45 (10%), and for n=4 4.10 (5%), 3.81 (10%) (Davidson and Mackinnon, 1993, p722),

Table 7.8a Johansen Cointegration LR test for the preferred Model: Net uses (Order of VAR=1, Unrestricted intercept with no trend)

GD

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	97.69 *	33.87	r >= 1	160.40 *	68.06
r <= 1	r = 2	31.16 *	27.75	r >= 2	62.71 *	46.44
r <= 2	r = 3	26.83 *	21.07	r >= 3	31.55 *	28.42
r <= 3	r = 4	4.71	14.35	r = 4	4.71	14.35

CS (-)

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	83.01 *	33.87	r >= 1	145.72 *	68.06
r <= 1	r = 2	31.07 *	27.75	r >= 2	62.70 *	46.44
r <= 2	r = 3	19.54	21.07	r >= 3	31.64 *	28.42
r <= 3	r = 4	12.10	14.35	r = 4	12.10	14.35

LA

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	90.50 *	33.87	r >= 1	165.76 *	68.06
r <= 1	r = 2	39.79 *	27.75	r >= 2	75.27 *	46.44
r <= 2	r = 3	29.94 *	21.07	r >= 3	35.47 *	28.42
r <= 3	r = 4	5.53	14.35	r = 4	5.53	14.35

-In the partial VECM, variables are categorised as follows.

	I(1) endogenous	I(1) weakly exogenous	I(0)
GD	GD, PCS, PLA, $\ln(W^{r} / P^{*r})$	PGD, ln(Y/W)	Dum 69, Dum90
CS (−)	CS, PCS, PLA, $\ln(W^{r} / P^{*r})$	PGD, ln(Y/W)	Dum 69, Dum90
LA	LA, PCS, PLA, $\ln(W^{r} / P^{*r})$	PGD, ln(Y/W)	Dum 69, Dum90

Table 7.8b Johansen Cointegration LR test for the preferred Model: Gross uses (Order of VAR=1 for GD and CS and VAR=2 for LA, unrestricted intercept with no trend)

GD

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	90.62 *	33.87	r >= 1	179.57 *	68.06
r <= 1	r = 2	54.50 *	27.75	r >= 2	88.95 *	46.44
r <= 2	r = 3	27.60 *	21.07	r >= 3	34.45 *	28.42
r <= 3	r = 4	6.85	14.35	r = 4	6.85	14.35

CS

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	89.14 *	33.87	r >= 1	138.85 *	68.06
r <= 1	r = 2	32.55 *	27.75	r >= 2	49.71 *	46.44
r <= 2	r = 3	15.20	21.07	r >= 3	17.16	28.42
r <= 3	r = 4	1.95	14.35	r = 4	1.95	14.35

LA

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	26.13 *	24.59	r >= 1	64.10 *	38.93
r <= 1	r = 2	24.79 *	18.06	r >= 2	37.97 *	23.32
r <= 2	r = 3	13.18 *	11.47	r = 3	13.18 *	11.47

-In the partial VECM, variables are categorised as follows.

	I(1) endogenous	I(1) weakly exogenous	I(0)
GD	GD, PCS, PLA, $\ln(W^{\tau} / P^{*\tau})$	PGD, ln(Y/W)	Dum90
CS	CS, PCS, PLA, $\ln(W^{\tau} / P^{*\tau})$	PGD, ln(Y/W)	Dum 69, Dum90
LA	LA, PCS, PLA	PGD	Dum 69, Dum90

Estimates of the Preferred Models

Net uses and Gross uses generate broadly comparable price effects; the sign on the *price* parameters are the same indicating that the estimates in Net uses are unbiased. The following general features common to both Net uses and Gross uses are of interest in the long-run share equations (see Table 7.6a and 7.6b).

i) Overall R-squared fell as compared with the general models. Yet, with the imposition of symmetry and homogeneity, there is a substantial improvement in the statistical significance. Notably, almost all explanatory variables in GD and LA are highly significant, where the general model generated relatively poor results.

ii) The own-price coefficients in GD and LA satisfy a priori expectations and the own-price parameter for GD is larger than cross price parameters.

iii) Substitution effects between GD and LA are observed, given a positive cross-price effect of PLA and PGD respectively.

iv) The sign on the own price coefficients in CS is persistently positive in the specific model, but we do not pursue the imposition of negative own price effect, as this is not implausible. The positive sign means that as PCS increases (or the return on shares falls), in the case of Net the sector increases its net holdings of CS, and in the case of Gross the OFIs increase its gross holdings of CS. This is intuitively acceptable: a fall in the return on shares means an increase in share prices, hence the OFIs increase the holdings of CS as an asset. The detail is left in Section 7.4 for inference.

Parameter Stability and Other Tests

Tables 7.9a and 7.9b present the test results of parameter stability, axioms of rational choice, weak separability and homotheticity for Net uses and Gross uses respectively.

Chow tests for parameter stability are conducted for three different periods of 1) 1951-60 and 1961-93, 2) 1951-68 and 1969-93, and 3) 1951-79 and 1980-93. The stability is rejected in five out of nine cases in Net uses at a 5% significance level. However, the instability is not severe since at a 1% significance level there is only one case being rejected. In the case of Gross uses, three cases are rejected at a 5% level, and only one at a 1% level.

The axioms of negativity in consumer demand theory are rejected in Net uses given a positive sign for CS in eigenvalues, however they are not rejected in Gross uses. Taking the preferred model as a restricted model, the small-sample adjusted LR indicates that the joint test of homogeneity and symmetry (at the 1% significance level) and weak separability (at the 5% significance level) are not rejected in Net uses, whereas they are decisively rejected in Gross uses. Conversely, homotheticity is decisively rejected in Net uses, whereas it is not in Gross uses.

Table 7.9a Other tests for the preferred long-run model: Net uses

Chow Tests		F-test
1) 1951-60 and 1961-93	GD	1.386
	CS (–)	2.549 *
	LA	1.726
2) 1951-68 and 1969-93	GD	2.953 *
	CS (–)	3.454 *
	LA	3.137 *
3) 1951-79 and 1980-93	GD	2.004
	CS (–)	3.016 *
	LA	2.330

- * Significant at the 5% level.
- Degrees of freedom for GD and LA is (8, 27) and for CS (7, 29).
- Critical values are almost the same for both degree of freedoms: 2.34 at a 5% significance level and 3.33 at a 1% level.

Negativity	GD	CS (–)	LA
Eigenvalues	-3.092	0.043	-2.780

	LR (No. of restrictions)	SSLR (No. of restrictions)
Homogeneity	0.526 (2)	0.428 (2)
Symmetry (given Homogeneity)	8.520 (1) *	7.582 (1) *
Symmetry and Homogeneity	9.046 (3) *	8.050 (3) *
Weak Separability Bank rate	1.282 (2)	1.102 (2)
Weak Separability Money market rate	1.268 (2)	1.128 (2)
Homotheticity (β_i=0, i=1, 2)	15.956 (2) *	14.200 (2) *

- * Significant at the 5% level.
- We take the preferred model as a maintained model.
- Critical values: d.f. 1 = 3.84 (5 %), 6.64 (1%), d.f. 2 = 5.99 (5%), 9.21 (1%), d.f. 3 = 7.82 (5%), 11.34 (1%).
- SSLR: The small sample-adjusted LR

Table 7.9b Other tests for the preferred long-run model: Gross uses

Chow Tests		F-test
1) 1951-60 and 1961-93	GD	2.178
	CS	2.502 *
	LA	1.945
2) 1951-68 and 1969-93	GD	2.377 *
	CS	1.515
	LA	1.335
3) 1951-79 and 1980-93	GD	0.173
	CS	4.054 *
	LA	0.001

- * Significant at the 5% level
- Degree of freedom for GD (7, 36), CS (8, 27) and LA (6, 31).
- Critical values for GD and CS: 2.30 (5%) and 3.20 (1%), and for LA: 2.42 (5%) and 3.47(1%).

Negativity	GD	CS	LA
Eigenvalues	-2.128	-0.033	-0.043

	LR (No. of restrictions)	SSLR (No. of restrictions)
Homogeneity	23.504 (2) *	19.038 (2) *
Symmetry (given Homogeneity)	0.006 (1)	0.005 (1)
Symmetry and Homogeneity	23.510 (3) *	19.043 (3) *
Weak Separability Bank rate	21.078 (2) *	17.073 (2) *
Weak Separability Money market rate	29.086 (2) *	23.559 (2) *
Homotheticity (β_i=0, i=1)	4.288 (1) *	3.473 (1)

- * Significant at the 5% level.
- We take the preferred model as a maintained model.
- Critical values: d.f. 1 = 3.84 (5 %), 6.64 (1%), d.f. 2 = 5.99 (5%), 9.21 (1%), d.f. 3 = 7.82 (5%), 11.34 (1%)
- SSLR: The small sample-adjusted LR

7.4 Inference for Net uses and Gross uses

7.4.1 Interest Rate, Wealth and Income Impact

Interest rate, wealth and income elasticities are presented in Tables 7.10a and 7.10b for Net uses and Gross uses respectively. Tables 7.11a and 7.11b show the impact of changes in the interest rates on the actual holdings of assets. The salient features are as follows:

i) We have found the same sign on the own-price parameters of CS in Net uses and Gross uses (recall Tables 7.6a and 7.6b), however the sign on the own-interest rate elasticities is not the same between them. With the negative sign in Net uses, the same argument applies as in the case of the price estimate; an increase in R_2 or a fall in share prices reduces the net holdings of CS. This could be due to the fact that, given a fall in share prices, the contraction in subscribing to CS as an asset outweighs the contraction in issuing CS as a liability; consequently this may have resulted in the fall of the net holdings of CS. Alternatively, it could be argued that the OFIs may perceive that a fall in share prices is a good time to issue more shares, unit trusts and mutual funds, so that they can be sold cheaply and easily on the stock market. This leads to an increase in issuing CS as a liability, thereby to a fall of the net holding of CS. This behaviour may be reasonable for financial companies, being contrasted with the one found for the non-financial corporate sector in Chapter 6.

ii) As opposed to the negative sign in Net uses, a positive sign is found on the own-interest rate effect in CS in Gross uses. The positive sign is due to the numerically small coefficient of 0.036 in Gross (Table 7.6b) as compared with 0.086 in Net (in Table 7.6a), therefore the inconsistent sign is not unduly troublesome.

iii) With respect to government debt, the sensitivity to government securities' yields (R_1) of the own-interest rate is similar to that in the banking sector, and this is not trivial given a relatively large interest rate elasticity of 4.7 in Net uses and 4.0 in Gross uses.

iv) As government securities' yields (R_1) rise, there is a move out of CS and LA into GD. Conversely, when lending rates (R_3) increase, there is a switch from GD to

CS and LA. This is observed in all tables of 7.10a, 7.10b, 7.11a and 7.11b. The GD is therefore a substitute for the CS and LA. In particular a close substitute with the LA gives insight into policy effectiveness, in that a fall in government securities' yields may exert a substantial impact on loanable funds in this sector. On the other hand, LA is a complement to CS. In this sense, there appears to be a distinctive behaviour between risk-free assets and risky assets in the OFIs.

v) It is observed that there is a large impact of the lending rate on holding loans in this sector with the own-interest rate elasticity of 8.06 in Net uses and 5.04 in Gross uses. This is a much larger impact as compared with that of banks at 1.47 (in Table 5.9a, Chapter 5).

Table 7.10a Real interest rate, wealth and income elasticities: Net uses

	R_1	R_2	R_3	Wealth	Income
1. GD	4.733	-0.221	-4.567	0.782	-0.514
2. CS (–)	-2.550	-0.754	3.249	0.184	0
3. LA	-8.649	0.533	8.062	1.547	0.974

Table 7.10b Real interest rate, wealth and income elasticities: Gross uses

	R_1	R_2	R_3	Wealth	Income
1. GD	4.084	-0.145	-3.939	0.940	-0.153
2. CS	-0.944	0.412	0.531	1.391	0.993
3. LA	-5.144	0.106	5.038	1	0

Notes for Table 7.9a and 7.9b:
- The interest rate elasticities imply the effect of a one percentage point change in the interest rate (R) on the percentage change in asset holdings, i.e. $(\Delta a_i / a_i)$*100.
- Wealth and income elasticities, i.e. $[\ (\Delta a_i / a_i)(\Delta \ln(W^\tau / P^{*\tau}) / \ln(W^\tau / P^{*\tau}))^{-1}\ ]$and $[\ (\Delta a_i / a_i)(\Delta \ln(Y/W)/\ln(Y/W))^{-1}\ ]$ respectively. (Barr and Cuthbertson, 1991c)
- Zeros are imposed. For the wealth elasticity, the zero imposition on the coefficient implies a unitary elasticity by definition.

Table 7.11a Long-run Impact of Asset Holdings (Rs.Crore): Net uses

	R_1	R_2	R_3	Mean Value
1. GD	770.4	-35.9	-743.4	16277.6
2. CS (–)	-66.3	-19.6	84.5	2600.2
3. LA	-1097.1	67.6	1022.6	12684.3

Table 7.11b Long-run Impact of Asset Holdings (Rs.Crore): Gross uses

	R_1	R_2	R_3	Mean Value
1. GD	664.8	-23.6	-641.3	16277.6
2. CS	-32.3	14.1	18.1	3417.2
3. LA	-1034.9	21.4	1013.5	20118.1

Notes for Table 7.10a and 7.10b:

R = Interest rate, Rs. crore=10 million rupees.
This shows the effect of a one percentage point change in the rate of return on the holdings of the assets, using the mean value of stocks for the sample period 1951-93.

vi) The wealth elasticities in Net uses and Gross uses suggest that GD is inelastic with the elasticity less than unity (though close to unity in the case of Gross uses), whereas LA in Net uses and CS in Gross uses are elastic with the elasticities above unity. This is intuitively plausible; irrespective of the level of wealth, OFIs invest in a risk-free asset of GD and as wealth increases, investment in risky assets increases.

v) With respect to income elasticities, in both Net uses and Gross uses, GD is seen as an inferior good with a negative income elasticity. A 'near' unity elasticity is found in LA in Net uses and CS in Gross uses. This result is somewhat similar to the one with respect to wealth indicating a risk-averse behaviour, in that as the income falls, the OFIs increase the holdings of risk-free asset.

vi) In general the findings of the wealth and income elasticities for the OFIs are broadly the same as those found in the banking sector: the perception of risk in loans or equity will decline as the level of wealth or income increases, and that the lending or the subscription of equity will increase in the OFIs.

7.4.2 Dummy Variables

In Table 7.12 the coefficients of dummy variables for Net uses and Gross uses are reproduced from Tables 7.6a and 7.6b, in which the sign direction is the same, except dummy 90 on CS.

Table 7.12 Dummy variables for Net uses and Gross uses

	Dummy 69 (Net uses)	Dummy 69 (Gross uses)	Dummy 90 (Net uses)	Dummy 90 (Gross uses)
1. GD	0.0589 (1.95)	0	-0.0676 (1.84)	-0.1664 (9.40)
2. CS (-) for Net CS for Gross	0.0898 (4.25)	0.0308 (3.63)	-0.1179 (4.38)	0.0236 (2.17)
3. LA	-0.1487 (3.05)	-0.0308 (3.63)	0.1855 (3.03)	0.1428 (7.39)

- t-ratio is in parenthesis.
- Reproduced from Tables 7.6a and 7.6b.

i) A negative effect of dummy 69 on LA means a decline in lending since 1969. It is interesting to observe that as credit rationing towards priority sectors started in the banking sector, loans fell in this sector. It may reflect that the demand for loans from the priority sectors falls.

ii) By contrast, there is a positive effect of dummy 90 on LA. This can be due to the contraction of the loans in the banking sector in the post-reform period, hence the demand for loans from the corporate sector may have increased. This illustrates a somewhat compensating role in the credit market by the OFIs, where banks fail to fulfil the demand for loans.

iii) With respect to the negative dummy 90 on GD, financial liberalisation led the OFIs to switch from GD to other assets in their holdings of assets. This behaviour is contrasted with the commercial banks, which have increased their holdings of the risk-free assets since 1990. There appears to be a difference in risk-perception between the two financial institutions after the financial liberalisation.

iv) The effect of dummy 90 on CS between Net uses and Gross uses is in the opposite direction: negative in Net uses and positive in Gross uses. However, this is not a contradictory outcome. The implication is that the OFIs have increased issuing shares owing to the gradual de-regulation of equity markets, and also to the fact that in the post-reform period with a contraction of subsidised sources (under the SLR), term lending institutions have to raise resources directly from the market; these are relevant to the negative sign in Net uses (i.e. an increase of CS as a liability). Simultaneously, OFIs have increased their investment in CS relative to other financial assets in the post-reform period; this is relevant to the positive sign in Gross uses (i.e. an increase of CS as an asset).

7.5 Conclusion

For the OFIs, in which intra-transactions are commonly found, we have conducted estimations of Net uses and Gross uses. Overall, both preferred models with imposed symmetry and homogeneity yielded statistically and economically significant coefficients. Although cointegration is not found in the share equations by the Engle-Granger test, this is reversed by the more powerful Johansen test.

Comparing Net uses and Gross uses, the direction and magnitude of the sign on the parameters are almost the same; the estimation results of Net uses are supported by those of Gross uses indicating some robustness. In this sense, we are fairly confident in applying the long-run model of Net uses to simulation experiments.

The study highlights that while the OFIs show risk-averse behaviour similar to the banks, their portfolio behaviour appears to be less restrictive than the banks: Evidence of a high sensitivity to the lending rate, on holding loans suggests that OFIs sector may exert a more significant impact in the credit market than the banking sector. This may be due to a more rational view by banks of the market interest rate. This suggests that the impact of direct regulations on banks attenuates the lending activities in the banking sector: the credit market in the banking sector is seen as a captive market and the funds at their discretion are limited, consequently the sensitivity to the lending rate should be less than the one found in the OFIs sector.

We also find a relatively strong sensitivity to the government securities' yields in determining the share of government securities, and government securities are a close substitute for loans. There is therefore scope for the yields as a policy instrument in influencing the portfolio behaviour in this sector: a decrease in government securities' yields would potentially encourage the OFIs sector to invest in the private sector.

Appendix 7.1

Long-run model with SLR (Net uses) : homogeneity and symmetry imposed

	$\ln p_1^\tau$ (PGD)	$\ln p_2^\tau$ (PCS)	$\ln p_3^\tau$ (PLA)	Constant	$\ln(W^\tau / P^{*\tau})$	ln(Y/W)
1. GD	-2.9334 (-8.46)	0.0771 (1.34)	2.8564 (8.04)	2.0932 (3.81)	-0.1486 (2.15)	-0.3496 (2.72)
2. CS (–)		0.0866 (2.00)	-0.1637 (1.69)	0.2194 (0.53)	-0.0530 (1.03)	-0.0127 (0.13)
3. LA			-2.6926 (6.86)	-1.3126 (1.42)	0.2015 (1.74)	0.3623 (1.68)

	SLR	Dummy 69	Dummy 90	R-squared	SSR	SE of regression
1. GD	-0.0003 (0.06)	-0.0608 (1.45)	-0.0658 (1.73)	37.19 %	0.1191	0.0526
2. CS (–)	0.0001 (0.02)	0.0903 (2.87)	-0.1168 (4.14)	65.25 %	0.0684	0.0399
3. LA	0.0002 (0.03)	-0.1511 (2.14)	0.1826 (2.87)	32.98 %	0.3436	0.0894

- t-ratio is in parenthesis.
- No. of observation: 43 (1951-52 to 1993-94), Log Likelihood: 172.808
-Columns may fail to sum to zero due to rounding.
-SSR: Sum of Squared Residuals

Residual diagnostics (chi-square values)

	LM Heteroskedasticity	LM Serial Correlation (Order =1)	LM Serial Correlation (Order =2)
1. GD	1.378 [.240]	33.845 [0.00]	32.579 [0.00]
2. CS (–)	2.765 [.096]	30.935 [0.00]	32.788 [0.00]
3. LA	1.424 [.233]	35.621 [0.00]	35.475 [0.00]

[ ] is P-value. One tail tests

Appendix 7.2

Perron's Unit Root Test

	Perron's Model (C) $k=0$			DF Level	Perron's Model (C) $k=2$			ADF Level
OFI Sector (Net uses)	Dummy	$\hat{\rho}$	$t_{\hat{\rho}}$	From Table 7.4a	Dummy	$\hat{\rho}$	$t_{\hat{\rho}}$	From Table 7.4a
S_1 (GD)	1	-0.104	1.666	N	0	-0.184	2.405	N
S_2 (CS)	1	-0.177	2.630	N	2	-0.220	3.181	N
S_3 (LA)	0	-0.088	1.875	N	0	-0.141	2.381	N
$\ln(W^{\tau} / P^{*\tau})$	2	-0.540	3.919	N	2	-0.712	3.639	N
ln(Y/W)	1	-0.231	2.361	N	1	-0.268	1.955	N

	Perron's Model (C) $k=0$			DF Level	Perron's Model (C) $k=2$			ADF Level
OFI Sector (Gross uses)	Dummy	$\hat{\rho}$	$t_{\hat{\rho}}$	From Table 7.4b	Dummy	$\hat{\rho}$	$t_{\hat{\rho}}$	From Table 7.4b
S_1 (GD)	3	-0.070	1.965	N	0	-0.135	3.156	N
S_2 (CS)	1	-0.157	1.745	N	0	-0.143	1.161	N
S_3 (LA)	1	-0.051	1.094	N	0	-0.124	2.365	N
$\ln(W^{\tau} / P^{*\tau})$	2	-0.583	4.212 *	N	2	-0.744	4.001	N
ln(Y/W)	1	-0.409	3.327	N	1	-0.118	1.490	N

- * Significant at a 5% level, N= null of unit root is not rejected at a 5% significance level, R= null of unit root is rejected at a 5% significance level.

- Model (C) : $\Delta y_t = \mu + \beta t + \theta DU_t + \gamma DT_t^* + \varsigma DTB_t + \rho y_{t-1} + \sum_{i=1}^{k} \delta_i \Delta y_{t-i} + e_t$

- Null hypothesis: $\rho = 0$ and $\theta = \beta = \gamma = 0$

- Alternative hypothesis of a trend stationary process: $\rho < 0$ and θ, β, $\gamma \neq 0$

- Dummy: the number of significant dummy coefficients out of θ, β and γ.

- T_B = 1969, T = 18, λ = 18/43=0.44

- Critical Value for $t_{\hat{\rho}}$: 4.21 (5%), 4.85 (1%) (Perron 1989, p.1377)

Chapter 8 A Flow of Funds Model for the Household Sector and the Demand for Money for India [1]

8.1 Introduction

A stable demand for money function provides a reliable link between changes in monetary aggregates and changes in variables included in the demand for money function (Siddiki, 1984). This suggests that it facilitates the monetary control, and therefore it is of significant importance in applying macroeconomic policies. The study of demand for money, which is based on the hypotheses of the transactions motive and asset motive for holding money, has gone through different phases in its development. The traditional study of demand for money function is typically specified by income in order to capture the transaction motive and a representative interest rate and sometimes also an inflation rate[2] as opportunity costs. The traditional demand for money is confined to a closed economy framework. In the recent study, open economy factors have become very important in the determination of money demand, subsequently foreign interest rates and exchange rates have significant implications for the effectiveness of monetary policy. This is also the case for developing countries with the rapid financial market liberalisation in the last decade (Khalid 1999).[3] Empirical results tend to show the significant effects of the foreign variables in the money demand function (e.g. Arize 1994 and Weliwita and Ekanayake 1998).

The traditional specifications of money demand also fail to take into account the non-stationary behaviour of macroeconomic time series resulting in what has become known as 'spurious regression'. With a development of cointegration techniques, empirical evidence tends to show a stable long-run linear combination among a monetary aggregate and its arguments in the demand function for developing

[1] This chapter is a revised version of the paper by Moore *et al.* (2002a). The paper was presented at the Finance and Development conference, Manchester in April,2002. We acknowledge, with thanks, the valuable comments made by an anonymous referee of Journal of Development Studies on the paper.

[2] Inflation is viewed as a proxy for real assets.

[3] Foreign currency deposits held abroad by residents of developing countries rose from about US$80billion in 1981 to US$450 billion by the end of 1990, an annual average rate of increase of nearly 50%, according to IFS (Agenor and Khan, 1996).

economies (e.g. Bahmani-Oskooee and Rhee, 1994, Arrau, Gregorio, Reinhard and Wickham, 1995 and Weliwita and Ekanayake, 1998).

In this chapter, we model a flow of funds for the household sector in India. One of the central issues in modelling portfolio behaviour for this sector is that the demand for narrow and broad money is analysed. The methodology undertaken in this chapter follows the recent trend by incorporating a foreign variable with a cointegration technique; but it departs from the existing literature. First, the demand for money is examined as an integral part of the portfolio behaviour for the household sector in a system of equations, rather than in an aggregate single equation framework. Hence the substitution effect between money and other financial assets is examined in a rigorous manner. Second, a theoretical framework of almost ideal demand system (AIDS) is utilised in model specification. Hence, the demand for money is analysed from the standpoint of neoclassical demand theory, rather than considering explicit motives for holding money. Yet, the AIDS model allows one to examine the asset motive in a richer fashion: the opportunity cost includes all the interest rates that are relevant to the household sector's holding of financial assets, and the role of each interest rate is rigorous with each being the own-interest rate for the asset in question in a system of equations. Besides, the AIDS model is consistent with the transactions motive as the variable of transactions can be added to the model specification. This is theoretically regarded as part of a subsistence level in demand theory. Third, it is needless to say, the data used for estimation are derived from the household sector in the complete flow of funds matrix, rather than aggregated data.

The application of the neo-classical demand theory into modelling portfolio behaviour in the household sector has direct relevance to the assertion by Friedman (1956): he argues that the demand for assets, in particular, focusing on the demand for money, should be based on axioms of consumer choice. There are some specific motivations in applying the AIDS model to the household sector. Thomas (1985) notes that the weakness of the system of demand equations is to take into account the heterogeneous characteristics of different households. The problem may be circumvented by utilising the AIDS model, since the AIDS cost function belong to the PIGLOG class which has a desirable aggregation property: it allows the presentation of market demand as if they were the outcome of decisions by a rational representative consumer (Chapter 2).

Besides, the AIDS model theoretically allows the inter-relationship between the assets and the expenditure to take place by incorporating the expenditure in a theoretically acceptable form. It is argued that different assets are perceived by individuals to offer different liquidity services when planning transactions in goods and services (for example, if you plan to purchase some holiday package near future, you need to hold some portion of your wealth in more liquidity form, e.g. current account saving, rather than a time deposit). Thus it is expected that the marginal rate of substitution between any two assets at time t to depend on the level of transaction expected to prevail in period $t + 1$ (Barr and Cuthbertson, 1991).

The objective of this chapter is to examine scope for policy implications by obtaining an economically sensible equilibrium relationship of variables, and at the same time to investigate the extent to which the demand for money in a system of a flow of funds model is robust.

The system of the dynamic AIDS model is applied to the demand for money by Weale (1986) and Barr and Cuthburtson (1991a) both for the UK and Adam (1999), for Kenya. The model presented here shares a common core with theirs except in the following respects: Given only a low frequency flow data, our model is limited to being static. In this respect our approach may be less rigorous, but in other aspects our model scores highly. In the work of Barr and Cuthbertson, the data are taken from a complete flow of funds matrix, however the financial instruments are restricted to be capital certain assets. This restricts the substitution effect among financial assets, in particular, the inflation hedge activities are limited; here we include both capital certain and uncertain financial assets. Moreover, for the UK as a small open economy, the effect of foreign variables on the demand for money has not been examined. A similar drawback applies to the study of Weale. In the empirical work of Adam, the asset portfolio consists not only of financial assets, but also real assets. However, as we discussed in Chapter 2 there are two limitations in terms of data. First, the consolidated data of the household and corporate sectors are used for estimation. Second, the data for real assets are aggregated data.

The remaining chapter is organised in the following manner. Section 8.2 is a clarification of financial instruments that are modelled for the household sector. Non-price sensitive explanatory variables are dealt in Section 8.3. Unit root tests, general models and specific models are reported in Section 8.4. The estimation results are analysed in Section 8.5. In Section 8.6, our result is compared with the existing empirical evidence of the demand for money in a single equation framework for developing countries. A conclusion drawn from the empirical work is found in Section 8.7.

8.2 Financial Instruments

Table 8.1 shows the simplified aggregate financial liabilities and assets for the household sector in India.

Table 8.1 Liabilities and Assets in the Household sector

Liabilities (Sources) and Net Worth	Assets (Uses)
Borrowing (deducted Corporate Bonds and Debentures)	Currency
Net Worth	Deposits (Demand and Time)[4]
	Government Debt (including Provident Funds)
	Company Securities

The liability consists of borrowing. The holdings of corporate bonds and debentures are netted from the borrowings on the liability side. The household sector includes not only income-earning and saving entities, but also non-corporate enterprises, which are net users of funds, hence bank loans are primarily for production purposes. Some component of the loans is involuntary under the 'priority sector lending requirement' to the household sector from the banking sector.

'Provident Funds', which include the provident, life and pension funds, are consolidated into 'Government Debt', since the contributions of the provident funds are predominantly invested in the government sector. The RBI (various issues) reports

[4] The separate flow data for time and demand deposits are available only until 1977, so both are consolidated together as deposits.

that the quantitative ratio of the life and pension funds to provident funds is approximately 1 : 2, and these funds are roughly invested as given by:

Life and pension funds (100%) = Gov't Securities (50%) + Loans & Advances (50%)
Provident fund (100%) = Gov't Securities (80%) + Small Savings[5] and Bank Deposits (20%)

Hence, instruments floated by insurance companies or provident funds are similar to those classified under 'Government Debt' with respect to the rate of return, the degree of risk and date of maturity.

In the present approach, decisions in the real sector are made first, and therefore the size of the saving is exogenous. We seek to explain the composition of net worth. The financial instruments to be modelled are listed in Table 8.2 together with the mean value of the share. CUR, DEP and GD are the major holdings of the financial assets in the household sector over the sample period. In the early period, the share of currency is the largest (around 60%). This is probably due to the higher transaction costs in a financially repressed economy as a consequence of the higher degree of inefficiency among financial intermediaries, and also the relatively underdeveloped nature of payment technology (Sen and Vaidya, 1997).

Table 8.2 Financial instruments and the mean share values

Financial Instruments with notations		Mean (%)
CUR	Currency	34.2
DEP	Deposits	46.0
GD	Government Debt	48.5
CS	Company Securities	9.5
LA (-)	Borrowing *	-38.2

- Mean (%): a proportion of total wealth
* Bank loans in sources deducted the corporate bonds and debentures in uses.

[5] Small savings are claims on government.

The nominal interest rates used for the AIDS prices are in Table 8.3.

Table 8.3 Interest rates used for the AIDS prices

AIDS prices	Interest rates
$\ln p_1^r$ = PCUR (Price of CUR)	$r_1 = 0$
$\ln p_2^r$ = PDEP (Price of DEP)	r_2 = Deposit rate
$\ln p_3^r$ = PGD (Price of GD)	r_3 = Government securities yields
$\ln p_4^r$ = PCS (Price of CS)	r_4 = Return on shares (=The rate of growth in share prices)
$\ln p_5^r$ = PLA (Price of LA)	r_5 = Lending rate

- The CPI is used for deriving the rate of inflation. The nominal rate of return for cash is zero, hence the PCUR is derived as given by $p_i^r = [(1-g)]^{-1}$.

8.3 Non-Price Sensitive Explanatory Variables and the Hypotheses

Non-price sensitive explanatory variables are listed in Table 8.4 with the expected sign where appropriate. Appendix 8.1 briefly inform readers of some estimation trials by using different explanatory variables, so that it justifies the choice of explanatory variables listed in this table.

The expenditure (lnEXP) variable is a causal link with the real sector, at the same time this variable is to capture the transaction requirements associated with the transaction demand hypothesis. If the hypothesis is supported, the sign on CUR is expected to be positive. The effect of dummy 69 on LA(-) is expected to be negative; with the credit ration to priority sectors, it is expected that borrowing will increase[6]. The effect of dummy 90 in the portfolio behaviour of the household sector remains to be seen.

It may be argued that modelling India as a small open economy by specifying the exchange rate in the AIDS model is not appropriate, since there were strict foreign exchange controls prevailing in India over the sample period (1951-52 to 1993-94) by the Foreign Exchange Regulation Act. In particular, foreign exchange was rationed

[6] Recall that negative implies an increase in liability of LA(-).

out strictly according to availability, and purchase and sale of foreign securities by Indians were strictly controlled. It was only in the early 1990's that the government started relaxing the foreign exchange regulations.

Table 8.4 Non-price sensitive explanatory variables

Variables		Expected sign
lnEXP	Log of constant consumer spending	+ CUR
lnREXC	Log of real exchange rates*	+ CUR
Dummy 69	0: 1951-68 and 1: 1969-93	– LA (–)
Dummy 90	0: 1951- 89 and 1: 1990-93	

* Real exchange rates are expressed as ep^*/p, where e = the number of national units of currency per US dollar, p^* = US CPI, and p = India CPI.

Yet, Simmons (1992) argues that it is possible that currency substitution occurs with variations in the *timing* of conversion of foreign exchange earned abroad (e.g. worker's remittances) or export earnings into local currency even under the regime of exchange control. In the context of India, it is assumed that, whilst the conversion from the domestic currency to foreign currency is constrained, conversion from foreign money to Indian rupees can be freely determined by the agents. From this perspective, we present an open economy model with the exchange rate together with a closed economy model without the exchange rate. This is important, not only in identifying any possible missing variables, but also to test the hypothesis that authorities are able to influence the household portfolio behaviour by exchange rate policy.

There are two hypotheses about the effect of the exchange rate on the demand for money in terms of the portfolio behaviour[7]: First, the depreciation of the domestic currency increases the value of foreign currencies held by domestic residents, and if the conversion from foreign money to domestic money takes place and if this is perceived as an increase in residents' wealth, their demand for domestic currency will increase (Weliwita and Ekanayake, 1998). Second, the depreciation of the domestic currency raises the expected return from holding foreign money, hence it lowers the

[7] The discussion is confined to the choice of portfolio. The effect of depreciation on money through fundamentals is beyond scope of this chapter.

demand for domestic money. Without exchange control, this would lead individuals to substitute foreign currency for domestic money. (Chowdhury, 1997, Simmons, 1992 and Bahmani-Oskooee and Pourheydarian, 1990). With exchange control, if this hypothesis holds, the effect of the exchange rate should be insignificant on domestic money, since individuals are unable to convert freely from domestic money to foreign currency.

In the case of India under the exchange control regime, the first hypothesis is more appropriate. Hence the sign on the exchange rate in the share of currency equation is expected to be positive for India, and in order to capture the timing effect the level of ln*REXC* is used[8].

8.4 Estimation

Like other sectors, starting with unit root tests, we present the overview of the general to specific model. We report two long run models; one is a closed-economy model, Model 1 and the other one is an open-economy model, Model 2. Specific models of a closed economy and an open economy are then thoroughly examined.

8.4.1 Unit Root Tests

Table 8.5 presents the unit root tests. The DF test indicates that the null of unit root for the share of financial assets is not rejected in level at a 5% significance level, whereas it is rejected in differenced. We take this result as an implication of I(1) for these variables. With respect to price, the null is rejected in the levels of PCUR and PDEP in both AD and ADF tests at the 5 % significance level, suggesting that they are stationarity[9]. Other prices appear to be I(1) (see the banking sector in Chapter 5 for the comments). The unit root tests also indicate that $\ln(W^{\tau} / P^{*\tau})$, lnREXC and lnEXP are I(1).

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[8] The second hypothesis is examined by using the rate of change in real exchange rates, i.e. $\Delta REXC / REXC$, which is more consistent with the expectation hypothesis than the level of ln*REXC*. We find a decisively statistically insignificant effect of $\Delta REXC / REXC$ in all share equations.

[9] The stationarity of the rate of inflation is also found in the study of demand for money for India (Pradhan and Subramanian, 1999).

Perron's unit root test is found in Appendix 8.2. Note that lnEXP variable rejects a null of unit root in terms of $\hat{\rho}$; this may be the example of what Perron (1989) argues that trend stationary *with one-structural change* reject the null, where trend stationary *without structural change* may not. For others, the results are the same as those of either DF or ADF test results.

Table 8.5 Order of Integration of the variables

	Level		Differenced	
	DF	ADF	DF	ADF
S_1 (CUR)	-1.86	-2.08	-6.65 *	-3.35 *
S_2 (DEP)	-1.77	-1.91	-3.09 *	-2.62
S_3 (GD)	-2.87 *	-1.90	-4.18 *	-2.68
S_4 (CS)	1.44	-0.28	-4.06 *	-3.31 *
S_5 (LA)	1.12	-0.60	-4.27 *	-2.92 *
$\ln p_1^\tau$ (PCUR)	-4.02 *	-3.33 *	-5.75 *	-3.78 *
$\ln p_2^\tau$ (PDEP)	-4.03 *	-3.24 *	-5.86 *	-3.92 *
$\ln p_3^\tau$ (PGD)	-3.84 *	-2.84	-5.77 *	-3.79 *
$\ln p_4^\tau$ (PCS)	-3.41 *	-2.40	-5.49 *	-4.39 *
$\ln p_5^\tau$ (PLA)	-3.43 *	-2.30	-5.71 *	-3.80 *
$\ln(W^\tau / P^{*\tau})$	-1.97 (t)	-0.98 (t)	-6.52 *	-4.48 *
lnEXP	-2.16	-1.12	-6.15 *	-6.19 *
lnREXC	-1.44 (t)	-0.02 (t)	-8.42 (t) *	-4.33 (t) *

* Significant at the 5% level.

Notes: 1. ADF is modelled as $\Delta X_{it} = \alpha + \beta\, X_{t-1} + \sum_{i=1}^{2} \delta_i \Delta X_{t-i} + e_t$. (t): a deterministic trend is specified as the trend is statistically significant at the 5% level.

2. Critical value τ_c (constant, no trend): -3.43 (1%), -2.86 (5%), -2.57 (10%)

Critical value τ_{ct} (constant, trend) : -3.96 (1%), -3.41 (5%), -3.13 (10%)

by Davidson and MacKinnon, p708, 1993

Based on the test results, we categorise the dependent and independent variables in the following manner:

I(l) Endogenous variables : CUR, DEP, GD, CS, LA, PCS, PLA, $\ln(W^{\tau} / P^{*\tau})$

I(l) Exogenous variables : PGD, lnEXP, lnREXC

I(0)Exogenous variables : PCUR, PDEP, Dummy

8.4.2 Overview of General to Specific Model

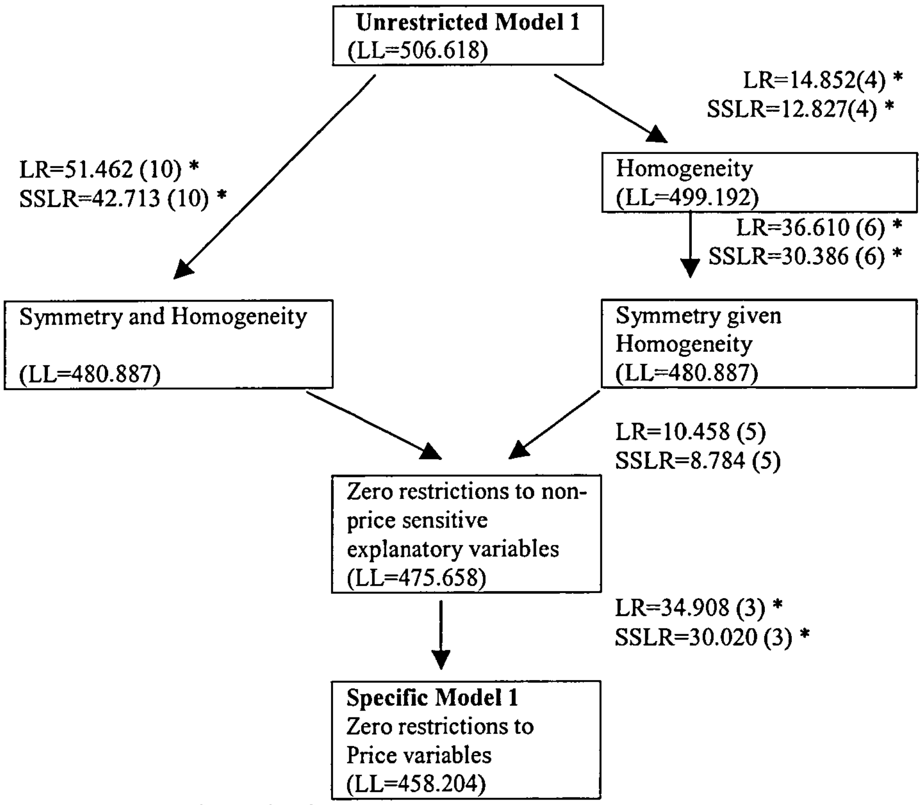
Figures 8.1a and 8.1b show the overview of the general to specific model with the likelihood ratio tests for Model 1 and Model 2 respectively. Tables 8.6a and 8.6b present the estimates of the general model (with an adding-up restriction) and residual diagnostics. Model 1 and 2 both have arrived by and large at similar estimates.

For both general models, the LM test indicates heteroskedasticity for GD, CS and LA. Serial correlation is also observed in the share of equations. Both models exhibit relatively high R-squared, especially for CUR and DEP given around 97 to 98 %. The estimates of the own price are, however, very poor. Except LA in Model 1 and CUR and LA in Model 2, the own-price coefficients are wrongly signed, and many of them are statistically insignificant. The anomalies in the own-price coefficients are perhaps an indication of multicollinearity.

The parsimonious specific model is pursued in order to obtain economically sensible price coefficients. We impose symmetry and homogeneity in the general models, and further zeros on the explanatory variables (see Figures 8.1a and 8.1b), though the joint test of symmetry and homogeneity is rejected. The restriction is, however, one way to alleviate the problem of multicolinearity by reducing the number of explanatory variables in the system of equations, hence we maintain homogeneity and symmetry. The zero restrictions on the non-price sensitive explanatory variables are not rejected with the likelihood ratio (LR) tests.

Some cross-price coefficients are imposed at zero, namely PCS in CUR, PGD and PLA in DEP (further PLA in GD in Model 2). This is however rejected by the LR test, in particular, the deletion of PLA in DEP may be most responsible as it was statistically highly significant (*t*-ratio: 9.24 in Model 1 and 9.88 in Model 2). Nevertheless the zero impositions are maintained in the specific model on the following grounds: First, this greatly contributed to a correct sign on almost all the own-price coefficients with a statistical significance. Second, it doesn't make any economic sense that, with a negative significant effect of PLA on DEP in the general models; it implies that an increased lending rate will exert a significant influence by increasing the holdings of deposits in the household sector. It can be assumed that PLA spuriously picked up the effect on DEP where the own price of PDEP should have come into play. In addition, as it will be revealed later in Section 8.5, the pattern of zero restrictions implies some differentiation between liquid assets (i.e. CUR and DEP) and assets in the capital market (i.e. GD and CS); CUR/DEP constitutes substitutes, GD/CS constitutes compliments, and CUR/DEP and GD/CS form substitutes as blocks. This is quite a plausible pattern.

Figure 8.1a Unrestricted general to specific model: Model 1 (closed economy)



- * Significant at the 5% level.

-LL: Log likelihood

-LR: Likelihood Ratio (LR) test: $L = 2(l_u - l_r) \sim \chi^2_{(J)}$

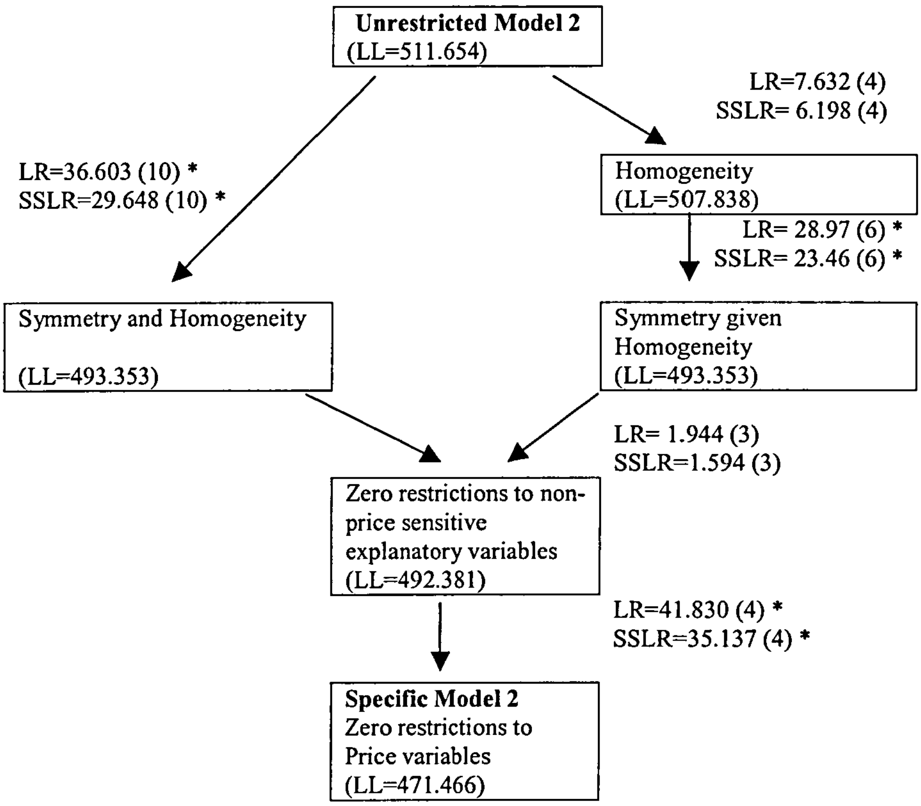
where $l_u (l_r)$ is the log likelihood of the unrestricted (restricted) equation

and (J) is the number of restrictions.

-SSLR: The small sample-adjusted LR given by the product of LR and (T-K)/T, where T=No. of observations and K=No. of exogenous variables in each equation (Bohm, Rieder and Tintner, 1980).

- Critical values: d.f. 3 = 7.82 (5%), 11.34 (1%), d.f. 4 = 9.49 (5%), 13.28(1%),
d.f. 5 = 11.07 (5%), 15.09 (1%), d.f. 6 = 12.59(5%), 16.81 (1%), d.f. 10 = 18.31 (5%), 23.21 (1%)

Figure 8.1b Unrestricted general to specific model: Model 2 (Open economy)



- * Significant at the 5% level.
-LL: Log likelihood
-LR: Likelihood Ratio (LR) test: $L = 2(l_u - l_r) \sim \chi^2_{(J)}$
where $l_u (l_r)$ is the log likelihood of the unrestricted (restricted) equation
and (J) is the number of restrictions.
-SSLR: The small sample-adjusted LR given by the product of LR and (T-K)/T, where T=No. of observations and K=No. of exogenous variables in each equation (Bohm, Rieder and Tintner, 1980).
- Critical values: d.f. 3 = 7.82 (5%), 11.34 (1%), d.f. 4 = 9.49 (5%), 13.28(1%),
d.f. 6 = 12.59(5%), 16.81 (1%), d.f. 10 = 18.31 (5%), 23.21 (1%).

Table 8.6a Unrestricted General Model 1 (Closed-economy)

Log Likelihood: 506.618

	$\ln p_1^r$ (PCUR)	$\ln p_2^r$ (PDEP)	$\ln p_3^r$ (PGD)	$\ln p_4^r$ (PCS)	$\ln p_5^r$ (PLA)	Constant	$\ln(W^r / P^{*r})$
1. CUR	0.4035 (0.54)	0.6632 (1.03)	-1.9319 (2.64)	-0.0448 (1.57)	0.5924 (1.79)	1.3362 (4.30)	-0.1717 (5.87)
2. DEP	0.0400 (0.08)	0.9510 (2.10)	1.1968 (2.32)	0.0001 (0.00)	-2.1601 (9.24)	-0.0475 (0.22)	0.0519 (2.52)
3. GD	-2.3989 (2.81)	-2.1160 (2.88)	3.4000 (4.08)	0.0105 (0.32)	1.5683 (4.15)	-0.0245 (0.07)	0.1662 (4.98)
4. CS	1.0583 (3.12)	0.4610 (1.58)	-1.7010 (5.13)	0.0034 (0.26)	0.0438 (0.29)	0.2554 (1.81)	-0.0380 (2.86)
5. LA(-)	0.8970 (2.06)	0.0409 (0.11)	-0.9639 (2.26)	0.0308 (1.86)	-0.0444 (0.23)	-0.5195 (2.86)	-0.0084 (0.49)

	lnEXP	Dummy 69	Dummy 90	R-squared	SSR	SE of Regression
1. CUR	0.0290 (1.20)	-0.0330 (2.10)	0.0278 (1.36)	97.31 %	0.0227	0.0230
2. DEP	0.0077 (0.46)	0.0709 (6.39)	-0.1011 (7.02)	98.14 %	0.0113	0.0162
3. GD	-0.0668 (2.44)	0.0216 (1.20)	-0.0310 (1.33)	64.51 %	0.0295	0.0262
4. CS	0.0122 (1.11)	-0.0152 (2.12)	0.0287 (3.09)	80.81 %	0.0047	0.0104
5. LA(-)	0.0180 (1.28)	-0.0443 (4.82)	0.0756 (6.34)	87.21 %	0.0077	0.0134

-LA(-): liability.
- t-ratio is in parenthesis.
- No. of observation: 43 (1951-52 to 1993-94)
- Columns may fail to sum to zero due to rounding.
- SSR: sum of squared regression

Residual diagnostics (chi-square values)

	LM Heteroskedasticity	LM Serial Correlation (Order =1)	LM Serial Correlation (Order =2)
1. CUR	2.047 [0.15]	26.317 [0.00]	27.306 [0.00]
2. DEP	0.066 [0.80]	3.389 [0.07]	8.042 [0.02]
3. GD	4.294 [0.04]	25.621 [0.00]	26.621 [0.00]
4. CS	5.372 [0.02]	22.964 [0.00]	23.190 [0.00]
5. LA(-)	7.292 [0.01]	6.259 [0.01]	6.294 [0.04]

[ ] is P-value. One tail tests

Table 8.6b Unrestricted General Model 2 (Open-economy)

Log Likelihood: 511.654

	$\ln p_1^\tau$ (PCUR)	$\ln p_2^\tau$ (PDEP)	$\ln p_3^\tau$ (PGD)	$\ln p_4^\tau$ (PCS)	$\ln p_5^\tau$ (PLA)	Constant	$\ln(W^\tau / P^{*\tau}$
1. CUR	-0.5410 (0.72)	0.1329 (0.22)	-0.5301 (0.65)	-0.0303 (1.15)	0.7983 (2.57)	0.8751 (2.70)	-0.1573 (5.79)
2. DEP	0.5233 (0.94)	1.2223 (2.70)	0.4795 (0.79)	-0.0073 (0.38)	-2.2654 (9.88)	0.1884 (0.79)	0.0445 (2.22)
3. GD	-1.4735 (1.67)	-1.5965 (2.22)	2.0267 (2.11)	-0.0036 (0.12)	1.3666 (3.76)	0.4272 (1.13)	0.1521 (4.79)
4. CS	0.6144 (1.81)	0.2118 (0.76)	-1.0423 (2.82)	0.0102 (0.86)	0.1405 (1.00)	0.0387 (0.27)	-0.0312 (2.55)
5. LA(-)	0.8768 (1.82)	0.0295 (0.08)	-0.9338 (1.78)	0.0311 (1.84)	-0.040 (0.20)	-0.5294 (2.55)	-0.0081 (0.46)

	lnEXP	lnREXC	Dummy 69	Dummy 90	R-squared	SSR	SE of Regression
1. CUR	0.0319 (1.45)	0.1211 (2.94)	-0.0422 (2.87)	0.0080 (0.40)	97.75 %	0.0189	0.2098
2. DEP	0.0063 (0.39)	-0.0620 (2.04)	0.0756 (6.97)	-0.0910 (6.22)	98.30 %	0.0103	0.0155
3. GD	-0.0697 (2.71)	-0.1186 (2.46)	0.0306 (1.78)	-0.0116 (0.50)	68.89 %	0.0258	0.0245
4. CS	0.0135 (1.37)	0.0569 (3.06)	-0.0195 (2.94)	0.0193 (2.16)	84.25 %	0.0038	0.0094
5. LA(-)	0.0180 (1.28)	0.0026 (0.10)	-0.0445 (4.73)	0.0752 (5.93)	87.21 %	0.0077	0.0134

-LA(-): liability.
- t-ratio is in parenthesis.
- No. of observation: 43 (1951-52 to 1993-94)
- Columns may fail to sum to zero due to rounding.
- SSR: sum of squared regression

Residual diagnostics (chi-square values)

	LM Heteroskedasticity	LM Serial Correlation (Order =1)	LM Serial Correlation (Order =2)
1. CUR	1.543 [0.22]	21.049 [0.00]	20.488 [0.00]
2. DEP	0.002 [0.96]	0.922 [0.34]	6.502 [0.04]
3. GD	3.572 [0.06]	24.218 [0.00]	25.864 [0.00]
4. CS	4.458 [0.04]	18.811 [0.00]	19.599 [0.00]
5. LA(-)	7.057 [0.01]	7.682 [0.01]	7.512 [0.02]

[ ] is P-value. One tail tests

8.4.3 Specific Model: Model 1 and Model 2

Table 8.7a and 8.7b show the estimates of the specific model for Model 1 and Model 2 respectively. Table 8.8 presents the EG cointegration test, and Table 8.9a and 8.9b, the Johansen cointegration test for both models.

Table 8.7a Specific model 1(closed economy): homogeneity, symmetry and zeros imposed (Adjusted White's Heteroskedasticity-Consistent S.E.'s)

Log Likelihood: 458.204

	$\ln p_1^\tau$ (PCUR)	$\ln p_2^\tau$ (PDEP)	$\ln p_3^\tau$ (PGD)	$\ln p_4^\tau$ (PCS)	$\ln p_5^\tau$ (PLA)	Constant	$\ln(W^\tau / P^{*\tau}$
1. CUR	-1.9850 (8.15)	0.4092 (1.92)	0.9990 (3.55)	0	0.5768 (5.30)	0.4958 (1.94)	-0.0908 (10.98)
2. DEP		-0.4255 (1.93)	0	0.0163 (0.56)	0	-0.1214 (2.84)	0.0908 (10.98)
3. GD			-0.8050 (2.74)	-0.0570 (2.63)	-0.1371 (0.70)	1.1272 (3.83)	0
4. CS				0.0193 (1.62)	0.0214 (1.17)	-0.0895 (1.13)	0
5. LA(-)					-0.4612 (3.27)	-0.4121 (79.76)	0

	lnEXP	Dummy 69	Dummy 90	R-squared	SSR	SE of Regression
1. CUR	0.0526 (2.04)	-0.0589 (4.22)	0.0837 (5.30)	95.91 %	0.0345	0.0283
2. DEP	0	0.1118 (6.47)	-0.1665 (7.55)	92.78 %	0.0437	0.0319
3. GD	-0.0723 (2.38)	0.0365 (1.65)	-0.0720 (3.92)	33.92 %	0.0552	0.0358
4. CS	0.0197 (2.41)	-0.0317 (5.39)	0.0593 (6.72)	66.79 %	0.0081	0.0137
5. LA(-)	0	-0.0577 (8.98)	0.0955 (6.06)	83.07 %	0.0103	0.0154

LA(-): liability. Zeros are imposed.
t-ratio is in parenthesis.
-SSR: sum of squared regression.
-No. of observation: 43 (1951-52 to 1993-94)
-Columns may fail to sum to zero due to rounding.

Table 8.7b Specific model 2 (open economy): homogeneity, symmetry and zeros imposed (Adjusted White's Heteroskedasticity-Consistent S.E.'s)

Log Likelihood: 471.466

	$\ln p_1^\tau$ (PCUR)	$\ln p_2^\tau$ (PDEP)	$\ln p_3^\tau$ (PGD)	$\ln p_4^\tau$ (PCS)	$\ln p_5^\tau$ (PLA)	Constant	$\ln(W^\tau / P^{*\tau}$
1. CUR	-1.8786 (7.70)	0.5764 (2.24)	0.9063 (2.88)	0	0.3959 (4.08)	0.3932 (2.00)	-0.1316 (10.81)
2. DEP		-0.5831 (2.24)	0	0.006632 (0.24)	0	-0.0042 (0.05)	0.0975 (6.12)
3. GD			-0.8489 (2.69)	-0.0573 (2.48)	0	1.4103 (6.21)	0.0502 (2.48)
4. CS				0.0203 (1.99)	0.0304 (1.63)	-0.1729 (2.19)	-0.0160 (2.29)
5. LA(-)					-0.4263 (4.73)	-0.6264 (6.68)	0

	lnEXP	lnREXC	Dummy 69	Dummy 90	R-squared	SSR	SE of Regression
1. CUR	0.0449 (2.22)	0.1715 (5.12)	-0.0591 (4.96)	0.0235 (1.54)	97.24 %	0.0233	0.0233
2. DEP	0	-0.0723 (1.67)	0.1130 (5.95)	-0.1392 (4.99)	93.36 %	0.0402	0.0306
3. GD	-0.0795 (3.17)	-0.2093 (5.57)	0.0391 (2.57)	0	55.86 %	0.0367	0.0292
4. CS	0.0172 (1.97)	0.0865 (5.56)	-0.0316 (6.11)	0.0273 (4.17)	80.18 %	0.0048	0.0106
5. LA(-)	0.0174 (1.83)	0.0236 (1.19)	-0.0615 (10.55)	0.0885 (4.82)	83.99 %	0.0097	0.0150

LA(-): liability. Zeros are imposed. t-ratio is in parenthesis. No. of observation: 43 (1951-52 to 1993-94). Columns may fail to sum to zero due to rounding. SSR: sum of squared regression

Table 8.8 Engle-Granger tests

Model 1 (Closed economy)	EG	AEG	Model 2 (Open economy)	EG	AEG
1. CUR (n = 3)	-2.838	-2.327	1. CUR (n = 3)	-3.450 *	-3.902 **
2. DEP (n = 3)	-3.230	-2.886	2. DEP (n = 3)	-3.140	-3.147
3. GD (n = 3)	-3.006	-2.770	3. GD (n = 3)	-3.782 **	-3.128
4. CS (n = 3)	-3.540 *	-2.950	4. CS (n = 4)	-4.103 **	-4.760 **
5. LA(-) (n = 3)	-4.580 **	-3.288	5. LA(-) (n = 3)	-4.668 * *	-3.007

Notes:

- * , ** Significant at the 10% and 5% level respectively.
- ADF is modelled as $\Delta X_{it} = \alpha + \beta X_{t-1} + \sum_{i=1}^{2} \delta_i \Delta X_{t-i} + e_t$.
- n: number of I(1) endogenous variables.
- Asymptotic Critical Values for Cointegration Tests: 3.74 (5%), 3.45 (10%) for n = 3 and 4.10 (5%), 3.81 (10%) for n = 4 (Davidson and MacKinnon, 1993, p722).

Table 8.9a Johansen Cointegration LR test for Model 1
(Order of VAR=1 except DEP of VAR=2, Unrestricted intercept with no trend)

CUR

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	175.47 *	27.75	r >= 1	185.25 *	46.44
r <= 1	r = 2	6.52	21.07	r >= 2	9.77	28.42
r <= 2	r = 3	3.25	14.35	r = 3	3.25	14.35

DEP

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	49.47 *	24.59	r >= 1	58.16 *	38.93
r <= 1	r = 2	6.60	18.06	r >= 2	8.68	23.32
r <= 2	r = 3	2.07	11.47	r = 3	2.07	11.47

GD

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	144.76 *	27.75	r >= 1	187.78 *	46.44
r <= 1	r = 2	34.73 *	21.07	r >= 2	43.02 *	28.42
r <= 2	r = 3	8.29	14.35	r = 3	8.29	14.35

CS

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	162.52 *	27.75	r >= 1	205.53 *	46.44
r <= 1	r = 2	35.80 *	21.07	r >= 2	43.00 *	28.42
r <= 2	r = 3	7.20	14.35	r = 3	7.20	14.35

LA (-)

Null	Maximum Alternative	λ_{max}	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	153.05 *	24.59	r >= 1	195.89 *	38.93
r <= 1	r = 2	30.22 *	18.06	r >= 2	42.84 *	23.32
r <= 2	r = 3	12.62 *	11.47	r = 3	12.62 *	11.47

- Notes: In the partial VECM, variables are categorised as follows.

	I(1) endogenous	I(1) exogenous	I(0)
CUR	CUR, PLA, $\ln(W^{\tau} / P^{*\tau})$	PGD, lnEXP	PCUR, PDEP, Dummy 69, Dummy 90
DEP	DEP, PCS, $\ln(W^{\tau} / P^{*\tau})$	lnEXP	PCUR, PDEP, Dummy 69, Dummy 90
GD	GD, PCS, PLA	PGD, lnEXP	PCUR, Dummy 69, Dummy 90
CS	CS, PCS, PLA	PGD, lnEXP	PDEP, Dummy 69, Dummy 90
LA	LA, PCS, PLA	PGD	PCUR, Dummy 69, Dummy 90

Table 8.9b Johansen Cointegration LR test for Model 2
(Order of VAR=1 for CUR, CS and LA, VAR=2 for DEP and GD, Unrestricted intercept with no trend)

CUR

Null	Maximum Alternative	$\lambda_{\max}$	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	177.69 *	30.74	r >= 1	187.93 *	53.41
r <= 1	r = 2	6.95	24.22	r >= 2	10.23	33.35
r <= 2	r = 3	3.28	16.90	r = 3	3.28	16.90

DEP

Null	Maximum Alternative	$\lambda_{\max}$	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	49.83 *	24.59	r >= 1	56.78 *	38.93
r <= 1	r = 2	2.45	18.06	r >= 2	6.94	23.32
r <= 2	r = 3	2.36	11.47	r = 3	2.36	11.47

GD

Null	Maximum Alternative	$\lambda_{\max}$	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	53.64 *	30.74	r >= 1	87.26 *	53.41
r <= 1	r = 2	25.82 *	24.22	r >= 2	33.61 *	33.35
r <= 2	r = 3	7.78	16.90	r = 3	7.79	16.90

CS

Null	Maximum Alternative	$\lambda_{\max}$	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	179.92 *	37.08	r >= 1	243.30 *	77.21
r <= 1	r = 2	45.85 *	30.74	r >= 2	63.38 *	53.41
r <= 2	r = 3	16.41	24.22	r >= 3	17.52	33.35
r <= 3	r = 4	1.10	16.90	r = 4	1.10	16.90

LA (-)

Null	Maximum Alternative	$\lambda_{\max}$	95% C.V.	Trace Alternative	λ_{trace}	95% C.V.
r = 0	r = 1	119.57 *	27.75	r >= 1	173.22 *	46.44
r <= 1	r = 2	37.98 *	21.07	r >= 2	53.64 *	28.42
r <= 2	r = 3	15.65 *	14.35	r = 3	15.65 *	14.35

- Note: In the partial VECM, variables are categorised as follows.

	I(1) endogenous	I(1) exogenous	I(0)
CUR	CUR, PLA, $\ln(W^{\tau} / P^{*\tau})$	PGD, lnEXP, lnREXC	PCUR, PDEP, Dummy 69, Dummy 90
DEP	DEP, PCS, $\ln(W^{\tau} / P^{*\tau})$	lnREXC	PCUR, PDEP, Dummy 69, Dummy 90
GD	GD, PCS, $\ln(W^{\tau} / P^{*\tau})$	PGD, lnEXP, lnREXC	PCUR, Dummy 69, Dummy 90
CS	CS, PCS, PLA, $\ln(W^{\tau} / P^{*\tau})$	PGD, lnEXP, lnREXC	PDEP, Dummy 69, Dummy 90
LA	LA, PCS, PLA	lnEXP, lnREXC	PCUR, Dummy 69, Dummy 90

CointegrationTests

In respect of the Engle-Granger test in Table 8.8, the inclusion of the exchange rate seems to improve the test statistics. The EG statistics indicate that in Model 1, the linear combination of the I(1) variables are stationary in the share of LA equation at a 5 % significance level. In Model 2, a stable long-run relationship appears to exist in all share equations, except DEP, in either EG or AEG tests.

Both maximum eigenvalue and trace tests of the Johansen cointegration test (in Tables 8.9a and 8.9b) reveal that in both models there is at least one cointegrating relationship existing for all share equations, as the null of non-cointegrating vectors is rejected by the LR test. A unique cointegration vector is found in CUR and DEP in both models.

Estimates of the Specific Models

We have obtained very similar results in terms of the magnitude and direction of the variables for both models. The following properties which are common to both are noteworthy. (The impact of the explanatory variables will be discussed in detail in the next section.)

i) There is a substantial improvement in the own-price coefficients as compared with the general model. The own price effect for CUR, DEP, GD and LA are acceptable on the *a priori* grounds with the correct sign, where the own price coefficients on DEP, GD (and also CUR in the case of Model 1) were wrongly-signed in both general models. Noticeably, the own price effect of CUR becomes statistically highly significant with the *t*-ratio of 8.15 and 7.70 in Model 1 and 2 respectively. The statistical improvement is also observed in LA: *t*-ratio from 0.23 to 3.27 for Model 1 and from 0.20 to 4.73 for Model 2.

ii) With respect to deposits, it is argued that in developing countries any positive link between real rates of interest and personal saving is empirically much less apparent to warrant a definitive statement (McKinnon, 1988). Fry (1995) however indicates that there tends to be an aggregation error in dependent variables (e.g. the inclusion of government savings), and it may well be the cause for the perverse results. In the case of our study, a positive relationship between the real deposit rates and the holdings of deposits is found with a statistical significance, given a negative sign on the own price in DEP. This is consistent with the finding by Sen *et al.* (1996) in their flow of funds study for India. Further, the aggregation error is unlikely, since the deposits include time and demand deposits, disaggregated from other type of savings.

iii) There is one positive on-diagonal price coefficient, that is, the own price effect on CS, implying that as the return on shares falls the household sector holds more company securities. This is not, however, implausible on the following reason. An increase in the rate of return means a fall in share prices, and if the household sector has extrapolative expectations and speculations in stock market, it increases the perception of risk in holding shares, hence the household disinvests itself of shares.

iv) The non-price sensitive explanatory variables comply with our prediction for the sign on the coefficients (see Table 8.4).

Parameter Stability

Parameter stability of the model (see Table 8.10) is examined by the Chow test for the three period settings: 1) 1951-60 and 1961-93, 2) 1951-68 and 1969-93, and 3) 1951-79 and 1980-93. For Model 1, 6 out of 15 test statistics exceed the critical values at a 5 % significance level, but it is reduced to 3 out of 15 at a 1 % significance level. In the case of Model 2, 7 out of 15 share equations exhibit parameter instability at a 5% significance level, and 5 out of 15, at a 1% significance level. Notably, LA tends to show the instability.

Further Tests for the Long-Run Specific Model

Table 8.11 presents tests for negativity, homogeneity, symmetry, weak separability and homotheiticy. The eigenvalues of the price parameters satisfy negative semi-definite, implying that the cost function is concave[10]. With the specific model being taken as a null, 'Homogeneity', 'Symmetry given Homogeneity' and the 'Joint test for Homogeneity and Symmetry' are all comfortably accepted in the LR and the small sample-adjusted LR tests. This is contrasted with the results in the general model in

[10] One may argue that this conflicts with the finding of the positive own price effect on CS. But as we mentioned in the PCB sector in Chapter 6, if a price coefficient is numerically very small, it is possible that the sign between the coefficient and the eigenvalue (and also the price elasticity) is not the same.

Figure 8.1. These test results appear to support the hypotheses of axioms of rational choice in consumer demand theory embedded in the AIDS model.

Weak separability with respect to bank rate and money market rate is not rejected, though homotheticity is rejected in both models.

Table 8.10 Parameter stability tests for Model 1 and Model 2

Chow Tests		Model 1	Model 2
1) 1951-60 and 1961-93	CUR	2.295 *	1.543
	DEP	2.821 *	2.220
	GD	1.507	0.306
	CS	0.183	1.746
	LA	1.743	4.010 *
2) 1951-68 and 1969-93	CUR	0.505	0.640
	DEP	5.707 *	6.390 *
	GD	1.143	7.133 *
	CS	0.209	1.837
	LA	5.550 *	8.930 *
3) 1951-79 and 1980-93	CUR	0.487	2.987 *
	DEP	3.045 *	2.732 *
	GD	0.711	0.555
	CS	0.797	1.720
	LA	4.020 *	3.500 *

* Significant at the 5% level

-Chow test Critical Values for F-test (d.f. : degree of freedom)

Model 1	CUR	DEP	GD	CS	LA
d.f.	9, 25	7, 29	8, 27	8, 27	7, 29
5% c.v.	2.28	2.33	2.31	2.31	2.33
1% c.v.	3.22	3.30	3.24	3.24	3.30

Model 2	CUR	DEP	GD	CS	LA
d.f.	10, 23	8, 27	8, 27	10, 23	8, 27
5% c.v.	2.27	2.31	2.31	2.27	2.31
1% c.v.	3.21	3.25	3.25	3.21	3.25

Table 8.11 Other tests for Model 1 and Model 2

Eigenvalues	CUR	DEP	GD	CS	LA
Model 1	-2.164	-0.628	-1.055	-0.067	-0.697
Model 2	-2.006	-0.779	-1.085	-0.065	-0.662

	Model 1		Model 2	
	LR (no. of restrictions)	SSLR (no. of restrictions)	LR (no. of restrictions)	SSLR (no. of restrictions)
Homogeneity	1.82 (4)	1.56 (4)	0.31 (4)	0.26 (4)
Symmetry (given Homogeneity)	7.99 (4)	6.87 (4)	7.75 (4)	6.51 (4)
Joint test for Homogeneity and Symmetry	9.81 (8)	8.43 (8)	7.44 (8)	6.25 (8)
Weak Separability				
Bank rate	2.79 (4)	2.34 (4)	1.43 (4)	1.17 (4)
Money market rate	3.39 (4)	2.91 (4)	3.06 (4)	2.57 (4)
Homotheticity				
$\beta_i = 0, i = 1$	55.76 (1) *	42.74 (1) *		
$\beta_i = 0, i = 1, 2, 3$			50.42 (3) *	37.37 (3) *

- * Significant at a 5% level.
- The specified Model 1 and 2 being taken as null.
- Critical values: d.f. 3 = 7.82 (5%), 11.34 (1%), d.f. 4 = 9.49 (5 %), 13.28 (1%), d.f. 8 = 15.5 (5%), 20.09 (1%)
- LR: Likelihood Ratio test
- SSLR: Small sample-adjusted LR test

8.5 Inference

8.5.1 Elasticities for Model 1 and Model 2

The impact of interest rates, wealth and expenditure on the holding of assets derived from the mean value of shares is found in Tables 8.12a and 8.12b for elasticities and Tables 8.13a and 8.13b for actual holdings for Model 1 and Model 2 respectively. As in the case of parameters, the magnitude and the sign of the elasticites are broadly similar between the two models. The following comments common to both models are drawn from the tables (Note that R_1 (=the real interest rate for currency) is the inverse of the rate of inflation):

i) The own-interest rate elasticities are larger than the respective cross interest rates for almost all asset holdings. In terms of actual holdings (in Tables 8.13a and 8.13b) a similar argument applies. This is intuitively expected.

ii) Currency appears to be the most sensitive asset to a relative change in the own and some cross interest rates. In particular, the own long-run interest elasticity suggests that a 1% increase in R_1 (or a fall in the rate of inflation) induces domestic residents to increase the holding of CUR by 6.33 % for Model 1 and 5.87 % for Model 2. This is anticipated in a developing economy, where the holding of currency is relatively high, due to the under-developed financial instruments and financial intermediaion.

iii) It is observed in any of the four tables that a relative rise in R_1 leads investors to switch from DEP and GD to CUR, by contrast a relative increase in R_2 (deposit rate) and R_3 (government securities yields), from CUR to DEP and GD respectively. This constitutes a substitution effect between risk-free assets. In particular, the cross impact of R_1 on GD is the largest, (2.40 and 2.13 in Model 1 and 2 respectively), implying that as the rate of inflation increases (i.e. a lower R_1), the GD seems to offer the safest hedge against inflation[11].

iv) Furthermore, a fall in the rate of inflation (i.e. an increase in R_1) increases borrowing (given by negative effect on LA(-)). This is counter-intuitive, as it falls, the

[11] Adam (1999) and Jenkins (1999) find a similar result in the portfolio study for Kenya and Zimbabwe respectively.

real cost of borrowing increases. However, to the extent that the household sector, which encompasses informal sector, borrows money for production purposes (as we discussed in Section 8.2), the lower level of inflation helps lower the risk attached in any additional investment, then the expansion of capital formation by loans is more likely to occur, when the rate of inflation is at a lower level[12].

v) The CUR is more sensitive to R_3 (indicating at -3.409 and -3.029 for Model 1 and 2 respectively) than to R_2 (-1.523 and -1.937) and R_5 (-2.071 and -1.541), suggesting that government securities' yields may be an effective policy instrument in controlling the level of narrow money.

vi) The positive own interest rate elasticity on the holdings of DEP and GD also indicates some policy implications, in particular, a relatively large magnitude of own-interest rate elasticity in GD (2.174 and 2.235 for Model 1 and 2 respectively). In order to increase financial saving for private economic activities, real deposit rates should be positive, rather than being repressed, and the real government securities' yields may well be maintained at a lower level. (As we discussed in the banking sector, this is ironical as the financial reform envisaged market-related yields and this resulted in a rise in nominal government securities' yields.)

vii) GD and CS are complimentary with respect to R_3 and R_4 as both elasticities are positive in both equations. It can be argued by Sen *et al.* (1996) that in India, government bonds are an attractive 'store of wealth' because of their assured returns, hence an increase in R_3 could be leading to a substantial wealth effect, and this may be inducing households to invest in the relatively risky assets of company securities. On the other hand a rise in R_4 (the rate of growth in share prices), hence a fall in share prices, increases the perception of the risk in holding shares, hence they diversify their risk by investing in 'safe' assets of government securities.

viii) The holding of LA appears to be sensitive to changes in the own interest rate with elasticities being above unity. This is expected since the informal sector faces a high lending rate from the moneylender. Therefore, if the lending rate falls in the organised financial institutions, the demand for loans increases. The implication is that lending rates matter, even though credit rationing is prevalent in the household sector.

[12] In the presence of higher inflation, returns on capital are quite unpredictable (Perraudin, 1987, p.755).

ix) The wealth elasticity of DEP (1.197 for Model 1 and 1.211 for Model 2) exceeds that of CUR and is a 'luxury good', implying in the long run, any additional wealth is held primarily in DEP (and also GD in Model 2).

x) With respect to the expenditure elasticity, currency has a positive sign. This supports the hypothesis of 'transaction demand for money'.

Table 8.12a Model 1: Real interest rate, wealth and income elasticities

	R_1	R_2	R_3	R_4	R_5	Wealth	Expenditure
1. CUR	6.333	-1.523	-3.409	0	-2.071	0.734	0.154
2. DEP	-1.131	1.365	0	-0.131	0	1.197	0
3. GD	-2.400	0	2.174	0.022	-0.100	1	-0.149
4. CS	0	-0.631	0.112	0.703	-0.607	1	0.207
5. LA	-1.850	0	-0.127	-0.151	1.824	1	0

Table 8.12b Model 2: Real interest rate, wealth and expenditure elasticities

	R_1	R_2	R_3	R_4	R_5	Wealth	Expenditure
1. CUR	5.873	-1.937	-3.029	0	-1.541	0.615	0.132
2. DEP	-1.439	1.691	0	-0.091	0	1.211	0
3. GD	-2.133	0	2.235	0.032	0	1.103	-0.164
4. CS	0	-0.438	0.164	0.677	-0.701	0.831	0.180
5. LA (–)	-1.377	0	0	-0.175	1.733	1	0.045

Notes for Tables 8.12a and 8.12b:
- The interest rate elasticities imply the effect of a one percentage point change in the interest rate (R) on the percentage change in asset holdings, i.e. $(\Delta a_i / a_i)$*100.
- Wealth and income elasticities, i.e. $[\ (\Delta a_i / a_i)(\Delta \ln(W^r / P^{*r}) / \ln(W^r / P^{*r}))^{-1}\ ]$ and $[\ (\Delta a_i / a_i)(\Delta \ln EXP / \ln EXP)^{-1}\ ]$ respectively. (Barr and Cuthbertson, 1991c)
- Zeros are imposed. For the wealth elasticity, the zero imposition on the coefficient implies a unitary elasticity by definition.
- R_1 : the inverse of the rate of inflation

Table 8.13a Model 1: Long-run Impact of Asset Holdings (Rs.Crore)

	R_1	R_2	R_3	R_4	R_5	Mean Value
1. CUR	887.5	-213.4	-477.7	0	-290.1	14013.5
2. DEP	-454.3	548.1	0	-52.5	0	40162.5
3. GD	-873.6	0	791.1	8.0	-36.4	36392.7
4. CS	0	-54.5	9.7	60.7	-52.4	8636.3
5. LA (–)	-458.8	0	-31.4	-37.5	452.2	-24797.4

Table 8.13b Model 2: Long-run Impact of Asset Holdings (Rs.Crore)

	R_1	R_2	R_3	R_4	R_5	Mean Value
1. CUR	823.0	-271.5	-424.5	0	-108.8	14013.5
2. DEP	-577.9	679.5	0	-36.5	0	40162.5
3. GD	-776.4	0	813.5	11.7	0	36392.7
4. CS	0	-37.8	14.1	58.4	5.5	8636.3
5. LA (–)	-341.5	0	0	-43.4	429.6	24797.4

Notes for Tables 8.13a and 8.13b:
- R = Interest rate, Rs.crore=10 million rupees.
- Zeros are imposed.
- This shows the effect of a one percentage point change in the rate of return on the holdings of the assets, using the mean value of stocks for the sample period 1951-93.
- R_1 : the inverse of the rate of inflation

xi) In India it is argued that consumption is exclusively financed by own income; purchases of consumer durables by means of bank credit are still relatively insignificant. This is reflected in that the impact of expenditure on LA is very small (with the elasticity of 0 for Model 1 and 0.045 for Model 2).

8.5.2 Dummy and Exchange Rate Variables

Refer to Tables 8.7a and 8.7b for the coefficients on the dummy variables and Table 8.7b for the exchange rate coefficient. The salient common features for Models 1 and 2 are as follows:

i) The effect of dummy 69 appears to reflect the portfolio behaviour in two ways for the heterogenous household sector. With respect to non-corporate enterprises in this sector, the significant negative impact on LA(-) implies that they increase borrowing, as the credit rationing in favour of the priority sectors (or informal sector) increases, and this is consistent with the experience that India has had since 1969. Meanwhile, the wealthy population sector with a financial surplus increases DEP and GD, because in general credit rationing would push up interest rates.

ii) The dummy 90 on CS is statistically significant, indicating an increase in investing in CS as the equity market, in particular mutual and unit trust funds, has developed in the post-reform period. This appears to be consistent throughout all sectors in India.

iii) The effect of dummy 90 on LA(-) is positive, and this means a fall in borrowing. This could be due to the contraction of bank lending towards the private sector in the post-reform period. There is another argument to support this result. Recall that LA(-) is 'Borrowing deducted corporate bonds and debentures' (in Table 8.1). Therefore the positive dummy effect also implies an increase in the holdings of bonds and debentures. It is conceivable that the development of these capital market products since the early 1990's stimulated the holding of LA on the asset side in the household sector.

iv) The household sector-specific influence of financial liberalisation is also observed through dummy 90. The positive sign on CUR and the negative sign on DEP are in line with the finding by Sen and Vaidya (1997) who studied the demand for money in India for the sample period 1955-93, using the dummy variable for 1991-93. From the result, they argue that, i) there has been little change in payments technology (even credit cards or ATMs[13] are not commonly used), therefore it is hardly surprising that the dummy variable is positive on the demand for narrow money, on the other

[13] Automated Teller Machines.

hand ii) there has been a proliferation of new assets that are close to time deposits, particularly since 1991; this seems to have led to a negative impact of the dummy on deposits. The former is associated with the stability in narrow money, whereas the latter, the instability in broad money. It appears that the financial liberalisation process has developed the property of the demand for money as a store of wealth, rather than as a medium of exchange for India (Sen and Vaidya, 1997).

v) The real exchange rate in Model 2 appears to be a valid explanatory variable in the share equations. The statistically significant positive sign in CUR complies with the view; that the depreciation of the domestic currency increases the value of foreign currencies held by domestic residents; and that this in turn increases the demand for domestic currency, through the conversion from foreign money to domestic money or the perception of the increase in wealth (Weliwita and Ekanayake, 1998).

vi) With respect to other assets, the depreciation induces the domestic agents to hold more of CS and LA as an asset as indicated by the positive sign, whereas less of DEP and GD by the negative signs. This is probably due to the fact that the improvement of price competitiveness in domestic products attracts investors to invest in the industrial sector[14].

8.6 Comparison with Other Empirical Evidence for Developing Economies

The long-run elasticities derived from Models 1 and 2 can be compared with the studies of money demand in other developing economies. Table 8.14 shows the summary of selected empirical works in an aggregated single equation framework [15], except the study of Adam (1999) and the models developed here. The latter is based on a system of equations, and narrow money (M0) is approximated by CUR and broad money (M3), the total of CUR and DEP[16].

[14] It is assumed that the Marshall-Lerner condition holds, that is, the total price elasticities of demand for exports and imports are larger than unity.

[15] Evidence of cointegration in the money function is found in almost all these empirical works by either the Engle-Granger or the Johansen test.

[16] In India, M1 = currency + demand deposit, M2 = M1 + post office saving and M3 = M1 + time deposit (Datt and Sundharam, 2000).

Unitary value of long-run income elasticity[17] is supported for Congo, Mauritius, Tunisia (Simmons, 1992), Pakistan (Ariza, 1994) and India (Arrau *et al.*,1995). Some countries exhibit much higher than unitary income elasticities, in particular a value of 3.26 in Bangladesh for broad money (Siddiki, 1984). For these countries money is a luxury good, and such values are not unexpected in a developing country (Simmons, 1992): the long-run income elasticity greater than unity suggests that the demand for money is expected to rise at a faster rate than does income, due to limited opportunities to economize the cash balances, and little availability of other financial assets in developing countries. Simmons hypothesizes that as financial development proceeds, with greater availability of alternative financial assets as a substitute for money, the long-run income elasticity should fall towards unity or below as is the case in developed countries. The economies of scale in money holdings are then to emerge. In the case of our Models 1 and 2, the income elasticity for M0 is less than but close to unity, whereas the income elasticity for M3 is above unity. In this respect, the financial development may be moderate in India over the sample period.

For some African developing counties (Simmons, 1992) and Singapore (Arize, 1994), an inflation impact is insignificant (the sign / implies that the coefficients are statistically insignificant). This provides limited support for the role of expected inflation as an opportunity-cost variable. On the other hand, a strong inflation impact is found for Korea for M2 (-9.15) and Pakistan for M1 (-5.48) and M2 (-7.88) in the study of Arize, implying that real assets are the principle substitute for money. In the context of our models, large inflation elasticities are found, -6.33 and -5.87 for M0, but they are accompanied by a significant interest rate impact. Hence, unlike in the case of Pakistan, not only real assets but also other financial assets are substitutes for money in India. The role of the substitution effect in real assets has been possibly diminishing over time as financial development proceeds in India. This is shown in the small magnitude of the inflation effect on money in the study of Sen and Vaidya (1997) for India (-0.29 for M1), in which the sample period (1980-94) starts much later than that of our model.

[17] Unity income elasticity is typically found in traditional demand functions (e.g. Chow, 1966 and Laidler, 1966).

Table 8.14 Summary of the Selected Study of the demand for money for the developing economies

	Country	Period	Money	Income	Inflation	Interest rate
Model 1	India	1951-93	M0	0.88 *	- 6.33	-1.52 (real)
		,,	M3	1.12 *	- 0.74	0.64 (real)
Model 2	India	1951-93	M0	0.75 *	- 5.87	-1.94 (real)
		,,	M3	1.10 *	- 0.39	0.78 (real)
Siddiki (1984)	Bangladesh	1975- 95	M3	3.26 Per capita income		-0.088
Arestis and Demetriades (1991)	Cyprus	1963-88	M1	0.90 Consumption	-0.72	0.24
		,,	M3	0.89 Consumption	-0.66	0.23
Simmons (1992)	Congo	1972- 88	M1	1.00	/	
	Cote d'Ivoire	,,	M1	1.49	/	-0.36 (discount rate)
	Mauritius	,,	M1	1.00	/	-0.89
	Morocco	,,	M1	1.43	-0.13	-0.3
	Tunisia	,,	M1	1.00	/	
Arize (1994)	Korea	1973:1 to 1990:1	M1	0.57	/	-0.034 **
		,,	M2	1.16	-9.15	/
	Pakistan	,,	M1	1.03	-5.48	/
		,,	M2	0.77	-7.88	/
	Singapore	,,	M1	0.71	/	-0.11 ***
		,,	M2	1.12	/	-0.03 ***
Huang (1994)	China	1979:1 to 1990:4	M2	2.12 (GNP)	1.56	-0.29
Arrau et al. (1995)	India	1971:1 to 1988:3	M1	0.59 Industrial Production		-2.53
	India (with time trend)	,,	M1	1.00 Industrial Production		-2.83

	Country	Period	Money	Income	Inflation	Interest rate
Lee and Chung (1995)	Korea	1973:1 to 1990:4	M1	0.37 (GNP)		-0.64 (curb market rate)
		„	M2	0.60		-0.85 („)
Chowdhury (1997)	Thailand	1974:2 to 1993:3	M1	0.91	-1.57	
		„	M2	1.29	-0.89	
Sen and Vaidya (1997)	India	1980-94	M1	0.16	-0.29	-3.16
		„	M3	0.22	-0.34	/
Weliwita and Ekanayake (1998)	Sri Lanka	1978:1 to 1994:1	M1	0.427		-0.194
		„	M2	0.768		-0.71
Pradhan and Subramanian (1999)	India	1960-93	M1	1.14		-0.16
		„	M3	2.00		-0.40
Adam (1999)	Kenya	1973:1 to 1996:4	M0	0.70	- 2.43	- 5.27
		"	M3	1.77	-1.60	12.72
Jenkins (1999)	Zimbabwe	1976:1 to 1997:4	M0	0.88 (GDY)		-3.50 (real)
			M2	0.78 (GDY)	-2.45	-0.65 ****

1. Annual data are indicated by year only, whereas quarterly data are indicated by year and quarter for the sample period.
2. No entry means that the variables are not specified in the model, whereas the sign / implies that the variables are specified in the model, but deleted from the model due to statistically insignificant coefficients.
3. As a proxy for income, real GDP is used, unless otherwise noted. GDY=gross domestic income.
4. For interest rates, nominal deposit rates are used, unless otherwise noted.
5. For M3 of Model 1, Model 2 and Adam, elasticities are means (weighted by the share of mean values) of CUR and DEP.

* The total of wealth and expenditure elasticities (Barr and Cuthbertson, 1991a, p.864).

** Average of corporate bond yields, lending rate and deposit rate

*** Average of call money rate and three months fixed deposit rate

**** Spread between deposit rates and Treasury Bills rate

The interest rate elasticities of –1.52 and –1.94 for Model 1 and 2 respectively for M0 are relatively high. However, such high interest rate elasticities are also found in the study of Arrau *et al.* (1995) and Sen and Vaidya (1997) for India for narrow money (from around 2.5 to 3.0). Further, in the study for Kenya (Adam, 1999) and Zimbabwe (Jenkins, 1999), the interest rate elasticities are also very high. For these countries, the change in interest rate structure may exert a substantial effect in demand for money. For other developing countries, the interest rate elasticity is well below unity.

8.7 Conclusion

The portfolio behaviour for the household sector is estimated for the closed and open economy models. The finding of analogous results in both long-run models gives some confidence in the robustness of the estimates.

From the study, two main policy implications are drawn: First, given a strong influence of interest rates on the portfolio behaviour, the financial sector reform on interest rate structure proves to exert significant impact on the financial saving, loans and demand for money in India. The finding of a relatively strong sensitivity to the lending rate on borrowing in this sector implies that the there is scope for government policy to increase the funds toward the informal sector from the organised financial institutions. Second, the evidence of the significant exchange rate effect on the share equations in Model 2 may raise concerns about the closed-economy focus on money demand even in India, which was dominated by strict exchange controls; the monetary authorities should consider the response of domestic money demand to the foreign factor in formulating monetary policy.

The current study sheds light on modelling demand for money as an integral part of a flow of funds model for a developing economy. It presents portfolio opportunities in a rigorous fashion as compared with the single equation study, particularly, the inflation effect on demand for money is interpreted not only as a move from money into goods, but as a switch into an array of financial assets. This approach provides wider scope in assessing the substitution effect among financial assets. Yet, the brief survey conducted here reveals that the size of the overall elasticities for money in Models 1 and 2 is not significantly different from that in other studies for developing economies in a single equation framework.

Finally, with the exchange rate being a valid explanatory variable we choose to utilise the specific Model 2 for the simulation experiments.

Appendix 8.1

Empirical Trials

The following test runs are conducted for the long-run model with the restriction of symmetry and homogeneity, including dummy 69 and dummy 90.

1. In the work of Arrau, Gregorio, Reinhard and Wickkham (1995), **a time trend** is used as a proxy for financial innovation, assuming that the innovation has a permanent effect on the demand for money (see also Jenkins, 1999). The financial innovation captures the improvements in the financial sector's ability to provide liquidity services that are alternatives to currency and demand deposits. Arize (1989) also employed a time trend, postulating that technological improvements will reduce over time the real cost of transactions in the management of money balances. Barr and Cuthberston (1991a) used a time trend to model the 'learning period' associated with a rapid growth in the interest bearing element of demand deposits. In order to test for the possibility that the trend may have been omitted from the equations, a simple time trend is included in the system. In the test run, the negative significant time trend that is consistent with the arguments, but the incorrect positive sign on the own price coefficient is found in the currency equation[18]. It seems that the former is obtained at the expense of the perverse outcome of the latter, hence a time trend is not considered in the model specification.

2. In order to capture **the transactions demand for money**, Y (GDP) and EXP (consumption) are tested, and the EXP was chosen since this supported the transaction demand hypothesis. Since ln*EXP* (= log of constant price consumption) yields the better estimates than ln*(EXP/W)* (= log of constant price consumption deflated by each sector's wealth) in general terms, it is maintained as an explanatory variable in the model.

3. There is a motive to incorporate a wage variable in the model. As an extention of Baumol's (1952) optimal cost minimising transaction demand for money, Dowd

[18] Sen *et al.* (1996) also found the negative trend on the share of currency equation for the household sector in India.

(1990) advocates **wages** as a component of brokerage costs[19]. In addition, a significant part of the wages and salaries in India are paid in cash (Bhattachavya and Joshi, 2001), indicating the relevance of wages in the demand for narrow money. Wages are, however, very likely to cause multicollinearity in relation to the AIDS wealth and expenditure, as they depend on wages. In addition, if the cost-push (wage-push) cause of inflation is strong in India, then the wage and inflation variables would also exhibit some form of multicollinearity. It is therefore plausible to postulate that the wage effect is subsumed in the AIDS wealth, expenditure or inflation variables.

When the wage is replaced for the expenditure ln*EXP*, statistically significant wage coefficients are obtained, but in this case the transactions motive for holding money is rejected, and the other variables are poorly-determined.

[19] Dowd argued in his paper 'Shopping Time Model' that true brokerage costs may vary with the real wage, i.e. the brokerage cost includes not only fee but also time and inconvenience, hence wages and money holdings are hypothesized to have a positive relationship.

Appendix 8.2

Perron's Unit Root test

	Perron's Model (C) $k=0$			DF Level	Perron's Model (C) $k=2$			ADF Level
Household Sector	Dummy	$\hat{\rho}$	$t_{\hat{\rho}}$	From Table 8.5	Dummy	$\hat{\rho}$	$t_{\hat{\rho}}$	From Table 8.5
S_1 (CUR)	0	-0.283	2.375	N	0	-0.220	1.584	N
S_2 (DEP)	1	-0.006	0.159	N	1	-0.037	0.683	N
S_3 (GD)	1	-0.271	2.515	R	2	-0.512	4.345 *	N
S_4 (CS)	0	-0.027	0.444	N	0	-0.084	1.176	N
S_5 (LA)	0	0.003	0.029	N	1	-0.134	0.747	N
$\ln p_1^{\tau}$ (PCUR)	0	-0.799	4.837 *	R	0	-1.432	4.067	R
$\ln p_2^{\tau}$ (PDEP)	0	-0.796	4.149	R	0	-1.168	3.540	R
$\ln p_3^{\tau}$ (PGD)	0	-0.810	4.927 *	R	1	-1.142	4.091	N
$\ln p_4^{\tau}$ (PCS)	0	-0.984	4.301 *	R	0	-1.339	3.427	N
$\ln p_5^{\tau}$ (PLA)	0	-0.741	3.909	R	0	-0.997	3.129	N
$\ln(W^{\tau} / P^{*\tau})$	2	-0.629	4.235 *	N	2	-0.790	3.849	N
lnEXP	0	-0.757	4.678 *	N	1	-1.331	4.853 *	N
lnREXC	1	-0.477	3.186	N	0	-0.319	1.423	N

- * Significant at a 5% level, N= null of unit root is not rejected at a 5% significance level, R= null of unit root is rejected at a 5% significance level.

- Model (C) : $\Delta y_t = \mu + \beta t + \theta DU_t + \gamma DT_t^* + \varsigma DTB_t + \rho y_{t-1} + \sum_{i=1}^{k} \delta_i \Delta y_{t-i} + e_t$

- Null hypothesis: $\rho = 0$ and $\theta = \beta = \gamma = 0$

- Alternative hypothesis of a trend stationary process: $\rho < 0$ and θ, β, $\gamma \neq 0$

- Dummy: The number of significant dummy coefficients out of θ, β and γ.

- $T_B = 1969$, $T = 18$, $\lambda = 18/43 = 0.44$

- Critical Value for $t_{\hat{\rho}}$: 4.21 (5%), 4.85 (1%) (Perron 1989, p.1377)

Chapter 9 A Flow of Funds Simulation Experiments in the Financial Sector for India: Policy Analysis[1]

9.1 Introduction

This chapter uses simulation techniques to examine the effect of policy and real variables in the financial sector by utilising the long-run models estimated for all four sectors. As discussed in Chapter 3, the financial system in India, in common with other developing economies, tends to be characterised by a range of restrictions such as regulated interest rates, cash and liquid reserve requirements and controlled credits. Faced with such constraints, one of the principal concerns in policy analysis for economic development for a developing country is whether adequate funds are directed to economic activities, rather than remaining locked inside banking or government sectors by a captive market in credit allocation. The policy experiments are therefore expansionary with a view to delivering funds to sectors, which indulge in economic activities, thereby contributing to a nation's gross product. This, at the same time, refers to the importance of the cost of capital. The main strength of the current study is that both the cost of capital and loanable funds can be investigated simultaneously.

There are three contributions in this chapter. First, it is associated with the scale of simulation for a developing economy. The policy simulation experiments are conducted with fifteen long-run models and five market clearing identities, constituting a system-wide model for a whole financial sector. A policy study has never been empirically conducted on this scale in the financial sector for a developing economy. Second, the simulated policy analysis conducted here is closely associated with the programme of the financial reforms, which were designed to mitigate constraints in the financial sector by lowering the reserve requirements, removing interest rate restrictions, introducing market-determined government securities' yields; clear understanding of the policy effects is of significant importance to re-design the

[1] This chapter is a revised version of the paper by Moore *et al.* (2002c) presented at the Finance and Development conference, Manchester in April, 2002.

financial reform programme. Third, the simultaneous solutions for endogenous variables by combining all the long-run models give estimates of the impact of interactions among the portfolio behaviour of the different sectors, which are not captured in a single sector study.

The chapter is organised as follows. In Section 9.2, the theoretical flow of funds model in the financial sector is reviewed, followed by behavioural equations and market clearing identities. In Section 9.3, the evaluation of the tracking performance of the historical simulation is fully conducted in this section. In Section 9.4, expansionary simulation experiments are implemented to see the impact of changes in monetary policy instruments, interest rates and real variables on the financial sector. In Section 9.5, the contractionary effect by reversing the simulated policy shocks is examined. This is a digression from our main objective, yet it provides an interesting perspective in terms of the magnitude of policy effects. Summary and concluding remarks are found in Section 9.6.

This chapter involves a relatively large number of symbols. Table 9.1 lists the notations, starting with the financial instruments, then the sector variables, prices, interest rates and market clearing variables. This notation also apply to subsequent simulation chapters, Chapters 10 and 11.

Table 9.1 Notation for Chapter 9

CUR	Currency	
ER	Excess reserves	
GD	Government debt	
CS	Company securities	
LA	Loans and advances	
B	Banking Sector	
BW	Wealth in the Banking sector	
BER	Share or holding of excess reserves in B	
BGD	Share or holding of government debt in B	
BCS	Share or holding of company securities in B	
BLA	Share or holding of loans and advances in B	
PCB	Private corporate business sector	
PCBW	Wealth in the PCB sector	
PCBCS	Share or holding of company securities in PCB	
PCBLA	Share or holding of loans and advances in PCB	
PCBDEP	Share or holding of deposits in PCB	
OFI	Other financial institutions sector	
OFIW	Wealth in the OFI sector	
OFIGD	Share or holding of government debt in OFI	
OFICS	Share or holding of company securities in OFI	
OFILA	Share or holding of loans and advances in OFI	
H	Household sector	
HW	Wealth in the household sector	
HCUR	Share or holding of currency in H	
HDEP	Share or holding of deposits in H	
HGD	Share or holding of government debt in H	
HCS	Share or holding of company securities in H	
HLA	Share or holding of loans and advances in H	
PCUR	Price of Currency	(Rate of Inflation)
PER	Price of Excess reserves	(Bank rate)
PDEP	Price of Deposits	(Deposits rate)
PGD	Price of Government Debt	(Government Securities Yields)
PCS	Price of Company Securities	(Return on shares)
PLA	Price of Loans and Advances	(Lending rate)
RS	Return on Shares (the rate of growth in share prices)	
GSY	Government securities yields	
LR	Lending rate	
DR	Deposit rate (relevant to Chapter 10)	
GER	Bank excess reserves at the RBI	
DEP	Total deposit liabilities at commercial banks, cooperative banks and credit societies and OFIs	
GGD	Total government debt	
S1	Government debt endogenous in the government debt market	
S2	Government securities yields endogenous in the government debt market	

9.2 Theoretical Flow of Funds Model, Behavioural Equations and Market Clearing Conditions

9.2.1 Theoretical Flow of Funds Model

Table 9.2 presents the simplified theoretical flow of funds model in the financial sector for India based on Table 4.1 in Chapter 4.

Table 9.2 Theoretical flow of funds model in the financial sector for India

	Gov't (G)	Bank (B)	OFI	PCB	House-hold (H)		Endogenous Variables
CUR	-GCUR				+HCUR(·)	= 0	
ER	-GER	+BER (·)				= 0	GER
DEP		-BDEP		+PCBDEP(·)	+HDEP(·)	= 0	DEP
GD	-GGD	+BGD (·)	+OFIGD(·)		+HGD (·)	= 0	GGD or PGD
CS		+BCS (·)	-OFICS (·)	-PCBCS (·)	+HCS (·)	= 0	PCS
LA		+BLA (·)	+OFILA(·)	-PCBLA (·)	-HLA (·)	= 0	PLA
Net Worth	–	0	0	–	+	= 0	

CUR=Currency, ER=Excess reserves, DEP=Deposit, GD=Government debt, CS=Company securities, LA=Loans and advances

- (·) marked : behavioural equations
- Negative sign implies liability.
- RBI is consolidated into the government sector.
- Cooperative banks and credit societies and the foreign sector are treated as exogenous.
- Negligible components of the assets are treated as exogenous and ignored in the table.
- Provident funds market is consolidated into government debt market.
- Required reserves are excluded since it does not involve a behavioural equation.

In the system-wide model, there are assumed to be six financial markets in India, which are endogenously determined, namely; Currency (CUR), Excess reserves (ER), Deposits (DEP), Government debt (GD), Company securities (CS) and Loans and advances (LA). The six markets provide five independent market-clearing conditions, hence the five endogenous variables are obtained by simultaneous solution (Backus, Brainard, Smith and Tobin, 1980 and Green 1984). Since the nominal interest rate of CUR is zero, the currency market is postulated to be the sixth market, i.e. the market clearing condition in the CUR market is excluded from the simulation.

9.2.2 The Behavioural Equations

The preferred long-run models for the four sectors of Banking, PCB, OFIs and Household sectors are reproduced in Table 9.3. The sign in the PCB is reversed from the original presentation in Table 6.6a of Chapter 6, as this sector is a deficit sector. Since, we faced the difficulty in solving for the price of company securities (PCS) in the market solution (it will be discussed in detail in the next section), in order to avoid bias in simulation results, we derived another set of behavioural equations that are standard-error adjusted: the original behavioural equations (Original, hereafter) are supplemented by the standard error-adjusted behavioural equations (SE-adjusted, hereafter). The SE-adjusted equations are constructed by augmenting the coefficient of PCS in a CS equation in each sector by twice the standard errors, i.e. to the size of the confidence interval suggested by the long-run estimates. In order to maintain the homogeneity and symmetry constraints for the CS equation, the equivalent of 2SE is deducted equally from the surrounding cross price coefficients. See Appendix 9.1 for the detailed derivation.

Table 9.3 The long-run models of the four sectors for the simulation experiments (reproduced)

Bank Model 2	$\ln p_1^r$ (PER)	$\ln p_2^r$ (PGD)	$\ln p_3^r$ (PCS)	$\ln p_4^r$ (PLA)	Constant	$\ln(W^r / P^{*r})$	ln(Y/W)	CRR	SLR	Dummy 90	R^2	Standard Error
1. BER	-0.38 *	0.3670 (2.05)	0.0031 (0.17)	0.0099 (0.06)	0.134 (1.18)	-0.0178 (1.37)	-0.0382 (1.31)	0.0083 (7.24)	0	-0.0600 (4.02)	80.3%	0.0126
2. BGD		-1.0866 (4.11)	0.0083 (0.32)	0.7113 (2.34)	0.8109 (2.47)	-0.0526 (1.44)	-0.1188 (1.51)	0	-0.0029 (1.26)	0.0634 (3.54)	59.3%	0.0255
3. BCS			-0.0245 (3.08)	0.0131 (0.46)	-0.0298 (0.47)	0.0006 (0.08)	-0.0059 (0.38)	0	0.0037 (6.78)	0	93.3%	0.0083
4. BLA				-0.7343 (1.77)	0.0849 (0.22)	0.0698 (1.57)	0.1629 (1.67)	-0.0083 (7.24)	-0.0008 (0.34)	-0.0035 (0.20)	86.6%	0.0339

PCB Model 1	$\ln p_1^r$ (PCS)	$\ln p_2^r$ (PLA)	$\ln p_3^r$ (PDEP)	Constant	$\ln(W^r / P^{*r})$	ln(Y/W)	SLR	Dummy 69	Dummy 90	R^2	Standard Error
1. PCBCS (-)	-0.1239 (2.27)	1.3074 (2.19)	-1.5956 (2.66)	1.9298 (2.45)	-0.2215 (2.29)	-0.7186 (5.47)	0.024 (4.52)	0.037 (1.24)	-0.105 (3.22)	97.56 %	0.0392
2. PCBLA (-)	0.1239 (2.27)	-1.3074 (2.19)	1.5406 (2.57)	-2.3519 (2.98)	0.1597 (1.65)	0.5539 (4.12)	-0.0237 (4.52)	-0.0366 (1.24)	0.0720 (2.18)	97.16 %	0.0400
3.PCBDEP	0	0	0.0550 (1.11)	-0.5780 (4.0)	0.0618 (4.76)	0.1647 (6.57)	0	0	0.0331 (2.94)	67.58 %	0.0177

OFI Net	$\ln p_1^r$ (PGD)	$\ln p_2^r$ (PCS)	$\ln p_3^r$ (PLA)	Constant	$\ln(W^r / P^{*r}$	ln(Y/W)	Dummy 69	Dummy 90	R^2	Standard Error
1. OFIGD	-2.9578 (9.43)	0.0772 (1.35)	2.8806 (8.89)	2.0329 (6.94)	-0.1425 (3.73)	-0.3359 (4.92)	0.0589 (1.95)	-0.0676 (1.84)	36.92 %	0.0528
2. OFICS (-)		0.0862 (2.00)	-0.1634 (1.69)	0.1657 (3.11)	-0.0462 (3.32)	0	0.0898 (4.25)	-0.1179 (4.38)	65.24 %	0.0399
3. OFILA			-2.717 (7.44)	-1.1985 (3.88)	0.1886 (4.12)	0.3359 (4.92)	-0.1487 (3.05)	0.1855 (3.03)	32.80 %	0.0895

Household Model 2	$\ln p_1^\tau$ (PCUR)	$\ln p_2^\tau$ (PDEP)	$\ln p_3^\tau$ (PGD)	$\ln p_4^\tau$ (PCS)	$\ln p_5^\tau$ (PLA)	Constant	$\ln(W^\tau / P^{*\tau})$	ln*EXP*	ln*REXC*	Dummy 69	Dummy 90
1. HCUR	-1.8786 (7.70)	0.5764 (2.24)	0.9063 (2.88)	0	0.3959 (4.08)	0.3932 (2.00)	-0.1316 (10.81)	0.0449 (2.22)	0.1715 (5.12)	-0.0591 (4.96)	0.0235 (1.54)
2. HDEP		-0.5831 (2.24)	0	0.006632 (0.24)	0	-0.0042 (0.05)	0.0975 (6.12)	0	-0.0723 (1.67)	0.1130 (5.95)	-0.1392 (4.99)
3. HGD			-0.8489 (2.69)	-0.0573 (2.48)	0	1.4103 (6.21)	0.0502 (2.48)	-0.0795 (3.17)	-0.2093 (5.57)	0.0391 (2.57)	0
4. HCS				0.0203 (1.99)	0.0304 (1.63)	-0.1729 (2.19)	-0.0160 (2.29)	0.0172 (1.97)	0.0865 (5.56)	-0.0316 (6.11)	0.0273 (4.17)
5. HLA (-)					-0.4263 (4.73)	-0.6264 (6.68)	0	0.0174 (1.83)	0.0236 (1.19)	-0.0615 (10.55)	0.0885 (4.82)

Household Model 2	R^2	Standard Error
1. HCUR	97.24 %	0.0233
2. HDEP	93.36 %	0.0306
3. HGD	55.86 %	0.0292
4. HCS	80.18 %	0.0106
5. HLA (-)	83.99 %	0.0150

- t-ratio in parenthesis.
- (-) : The assets are explained as liabilities.
- Except PCB sector, homogeneity and symmetry are imposed.
- O and -0.38 * is imposed.
- For PCB sector, the sign is reversed from Table 6.6a in Chapter 6.

9.2.3 The Market Clearing Identities

The five market clearing identities are as follows: the LHS indicates supply of an asset and the RHS implies demand for an asset. The negligible and unidentified components of the financial asset holdings are taken as exogenous supply (EXOGS) and exogenous demand (EXOGD).

ER market	GER = BER(·)
DEP market	DEP = PCBDEP(·) + HDEP(·) + EXOGD
GD market	GGD = BGD(·) + OFIGD(·) + HGD(·) + EXOGD
CS market	OFICS(·) + PCBCS(·) + EXOGS = BCS(·) + HCS(·) + EXOGD
LA market	PCBLA(·) + HLA(·) + EXOGS = BLA(·) + OFILA(·) + EXOGD

Note: In GD market, PF (provident funds) are consolidated. Hence it can be expressed more precisely as given by : GGD = BGD(·) + OFIGD(·) + HGD(·) + HPF(·) – OFIPF + EXOGD
where OFIPF=the holding of the provident funds in the OFIs sector as a liability, HPF=the holding of the provident funds in the Household sector as an asset. OFIPF is determined as part of the consolidated behavioural equation of HGD + HPF in the household sector, and the majority of OFIPF is invested as OFIGD to the government sector, hence OFIPF needs to be deducted from RHS. (See Table 4.1, Chapter 4)

The first two market clearing identities determine the holdings of the excess reserves (GER) in the RBI, and the holdings of the deposits (DEP) in the commercial banks, co-operative banks and credit societies and OFIs. GER and DEP are assumed to be in infinitely elastic supply (Green, 1982). In the CS and LA markets, the prices of CS and LA are determined by market clearing identities, given supply-demand interaction of a full structural model[2]. With respect to the GD market, as mentioned in Chapter 3, before the financial reforms, the Indian government manipulated government securities' yields, hence the total government debt (GGD) is endogenous. However, when financial liberalisation started in the early nineties, the yields were more nearly market-determined, then the price of GD (PGD) is the one to clear the market.

For this reason, simulation is conducted in two ways; in Simulation 1 (S1, hereafter), GGD is an endogenous variable and PGD is an exogenous variable, conversely in Simulation 2 (S2, hereafter), the PGD is an endogenous variable and GGD is an

[2] A similar approach was taken by Friedman (1977), Backus, Brainard, Smith and Tobin (1980) and Green (1982).

exogenous variable. The underlying hypothesis of the difference between S1 and S2 is that controlled government securities' yields in S1 may dampen the credit and stock markets by preventing, to some degree, the free movement of market-determined interest rates. In this respect, the changes in PCS (or the return on shares) and PLA (or the lending rate) by policy shock in S1 are hypothesised to be smaller than those in S2.

9.3 Historical Simulation of the Behavioural Equations and the Solution of the Five Markets

The historical simulation[3] will enable us to examine how closely each endogenous variable tracks the historical data, and provide a way to evaluate the estimated model.

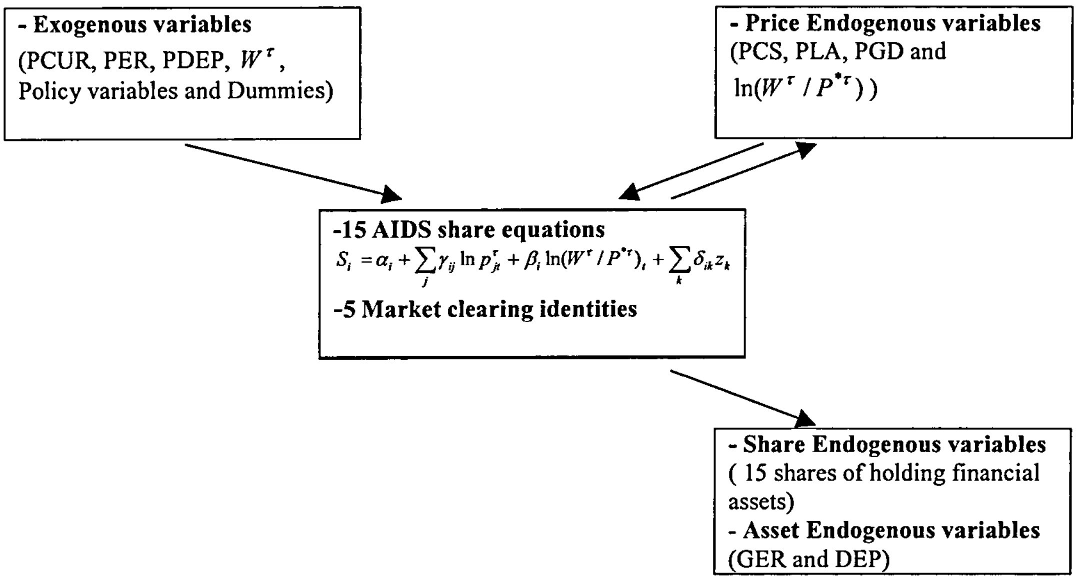
9.3.1 Methodology

An individual system of equations of four sectors (15 equations in Table 9.3) is combined to form a simultaneously determined system-wide model accompanied by the market clearing identity (5 identities). The Gauss-Seidel method was used to solve for the endogenous variables. Given a model of $Ax=b$, where A is a matrix of coefficients, x is the set of endogenous variables and b is a vector of exogenous elements. x is solved by inverting A, i.e. $x = A^{-1}b$ (Bahra, Green and Murinde, 1999).

The historical simulation was conducted for all the endogenous variables for the historical period of 1951-52 to 1993-94. The simultaneously determined AIDS share equations in a system-wide model can be described in chain-like paths. Figure 9.1 shows the solution in the case of regime S2 (PGD being endogenous in the GD market).

[3] By historical simulation, this means that the simulation is conducted over the sample period of the model.

Figure 9.1 The System-Wide Simultaneous Solution (Case: S2)



First, the actual time series for 1951-52 to 1993-94 are given for all the exogenous variables, but only initial values (i.e. base-year value of 1951-52) are specified for the endogenous variables. Then, given parameters in the AIDS share equations and the market clearing identities, the simultaneous solution will provide the simulated time series for the endogenous variables. The 15 AIDS share equations of holdings of financial assets, GER, DEP, PCS, PLA and PGD are all simultaneously determined. PCS, PLA and PGD are to be fed back into the AIDS share equations. In this context, we can investigate the property of the endogenous interest rates in two opposing directions in policy analysis: the effect of the endogenous interest rates on the flow of funds, and the effect of the supply of and demand for the funds on the endogenous interest rates.

Note that the sector wealth ($=W^{\tau}$) is exogenous, yet the AIDS wealth ($=\ln(W^{\tau}/P^{*\tau})$) is endogenous, since $P^{*\tau}$ is endogenous. $\ln(W^{\tau}/P^{*\tau})$ is therefore solved in simulation.

9.3.2 Evaluation of the Historical Simulation

Root Mean Square Error and Theil's U

Tracking performance of a historical simulation can be evaluated by the root mean square (RMS) error, mean simulation error and Theil's inequality coefficient (*U*) given by: (Pindyck and Rubinfeld, 1991, p.338 and p.340):

$$\text{RMS error} = \sqrt{\frac{1}{T}\sum_{t=1}^{T}(S_t - A_t)^2} \qquad (9.1)$$

$$\text{Mean simulation error} = \frac{1}{T}\sum_{t=1}^{T}(S_t - A_t) \qquad (9.2)$$

$$U = \frac{\sqrt{\frac{1}{T}\sum_{t=1}^{T}(S_t - A_t)^2}}{\sqrt{\frac{1}{T}\sum_{t=1}^{T}(S_t)^2} + \sqrt{\frac{1}{T}\sum_{t=1}^{T}(A_t)^2}} \qquad (9.3)$$

where

S_t = simulated time series

A_t = actual time series

T = number of periods in the simulation

The RMS error is a measure of the deviation of a simulated variable from its actual values. It can therefore be compared with the standard errors of the estimated equation. It is argued that mean simulation errors are a meaningless measurement because they may be close to zero if positive and negative errors cancel each other out. It is, however, useful as an indication of systematic bias. The numerator of Theil's *U* is exactly the same as the RMS error and the scaling of the denominator will normalise *U*[4]. *U* can be decomposed into the proportion of bias (*Um*), variance (*Uv*) and covariance (*Uc*), hence *Um* + *Uv* + *Uc* = 1 (Theil, 1961, p.35). *Um* measures a system

[4] *U* always falls between zero and one (Pindyck and Rubinfeld, 1991, p.340).

error and *Uv* indicates the ability of the simulated model to replicate the variation of the actual value. The implication is that the large values of *Um* and *Uv* are troubling. The component of *Uc* measures unsystematic error. Pindyck and Rubinfeld indicate the ideal distribution of inequality over the three sources as $Um=Uv=0$ and $Uc=1$.

Evaluation of the Historical Simulation by RMS and Theil's U

Tables 9.4a (for S1) and 9.4b (for S2) present the tracking performance of the share of holding of financial assets based on Original, whereas Tables 9.4c (for S1) and 9.4d (for S2), based on SE-adjusted. Table 9.4e shows the tracking performance of the five market solutions for Original and SE-adjusted. RMS errors are scaled by the mean and standard deviation of the actual time series.

Common to all the four tables (Table 9.4a-d) is that the result of Theil's *U* is quite satisfactory, except that of OFICS, being around or below 0.1.

With respect to the performance of Original, all *Um* are very small being below 0.03. This implies that in a system-wide model there is hardly bias in the simulated values, and this is also clear from the very small mean error (all less than 0.02). In terms of the fluctuation, *Uv,* in Original, Table 9.4a for S1 indicates a modest fluctuation with all less than 0.17, whereas Table 9.4b for S2 shows a relatively large value of *Uv* for BCS, OFIGD and OFILA (0.36, 0.51 and 0.42 respectively), and this is mirrored in a relatively low value of *Uc*.

With respect to the SE-adjusted, as compared with Original the magnitude of *Uv* is much more suppressed for both S1 and S2; the largest is 0.16 in OFIGD of S2 in Table 9.4d. However, in terms of *Um*, PCBLA and OFILA for both S1 and S2 tend to exhibit a large bias.

Table 9.4a Tracking Performance for the share of the financial assets in static simulations (S1: Original)

Variables	RMS error	RMS error % of mean	RMS error % of S.D.	Mean Error	Theil's *U*	*Um*	*Uv*	*Uc*
BER	0.0122	38.99	42.66	0.0005	0.1511	0.0016	0.1153	0.8830
BGD	0.0332	12.91	82.45	0.0021	0.0639	0.0043	0.0561	0.9394
BCS	0.0148	21.03	45.90	-0.0015	0.0935	0.0114	0.1333	0.8551
BLA	0.0351	5.48	59.69	-0.0011	0.0273	0.0010	0.1716	0.8274
PCBCS	0.0673	18.68	26.48	0.0075	0.0762	0.0125	0.0755	0.9119
PCBLA	0.0679	9.11	28.26	-0.0072	0.0430	0.0115	0.0838	0.9046
PCBDEP	0.0156	14.80	49.54	-0.0002	0.0713	0.0002	0.0289	0.9708
OFIGD	0.0595	9.11	92.17	0.0043	0.0454	0.0054	0.1231	0.8714
OFICS	0.0558	97.89	81.52	0.0042	0.3715	0.0056	0.0710	0.9227
OFILA	0.1046	30.33	96.77	-0.0085	0.1407	0.0067	0.1478	0.8455
HCUR	0.0283	8.28	19.97	0.0013	0.0384	0.0023	0.0002	0.9974
HDEP	0.0309	6.72	25.74	-0.0002	0.0326	0.0000	0.0168	0.9831
HGD	0.0469	9.67	105.44	-0.0041	0.0479	0.0076	0.0002	0.9921
HCS	0.0151	15.80	62.53	0.0014	0.0776	0.0095	0.0781	0.9123
HLA	0.0673	17.60	177.48	0.0075	0.0762	0.0125	0.0755	0.9119

Table 9.4b Tracking Performance for the share of the financial assets in static simulations (S2: Original)

Variables	RMS error	RMS error % of mean	RMS error % of S.D.	Mean Error	Theil's *U*	*Um*	*Uv*	*Uc*
BER	0.0096	30.68	33.57	0.0001	0.1148	0.0017	0.0040	0.9944
BGD	0.0424	16.43	104.92	0.0034	0.0817	0.0073	0.0007	0.9919
BCS	0.0153	21.74	47.45	-0.0024	0.0954	0.0234	0.3622	0.6144
BLA	0.0376	5.87	63.95	-0.0011	0.0292	0.0019	0.1669	0.8311
PCBCS	0.0849	23.56	33.40	0.0152	0.0961	0.0298	0.1134	0.8568
PCBLA	0.0890	11.95	37.05	-0.0146	0.0560	0.0271	0.1313	0.8415
PCBDEP	0.0151	14.33	47.95	-0.0006	0.0692	0.0015	0.0000	0.9983
OFIGD	0.0718	10.99	111.22	0.0064	0.0542	0.0080	0.5121	0.4798
OFICS	0.0628	110.18	91.75	0.0071	0.3960	0.0131	0.1354	0.8514
OFILA	0.1247	36.16	115.37	-0.0136	0.1628	0.0119	0.4265	0.5615
HCUR	0.0302	8.84	21.31	-0.0005	0.0408	0.0003	0.0006	0.9989
HDEP	0.0308	6.69	25.66	-0.0000	0.0325	0.0000	0.0168	0.9831
HGD	0.0418	8.61	93.98	-0.0050	0.0427	0.0145	0.0037	0.9817
HCS	0.0180	18.89	74.74	0.0022	0.0931	0.0153	0.0121	0.9726
HLA	0.0247	6.46	65.14	0.0032	0.0321	0.0172	0.0178	0.9648

Table 9.4c Tracking Performance for the share of the financial assets in static simulations (S1: SE adjusted)

Variables	RMS error	RMS error % of mean	RMS error % of S.D.	Mean Error	Theil's *U*	*Um*	*Uv*	*Uc*
BER	0.0128	40.92	44.78	-0.0007	0.1551	0.0036	0.0845	0.9118
BGD	0.0365	14.13	90.27	-0.0148	0.0680	0.1647	0.0480	0.7873
BCS	0.0139	19.81	43.24	0.0044	0.0923	0.1037	0.0071	0.8891
BLA	0.0372	5.82	63.35	-0.0053	0.0288	0.0205	0.1425	0.8369
PCBCS	0.0554	15.38	21.81	-0.0236	0.0615	0.1819	0.0044	0.8136
PCBLA	0.1117	14.99	46.48	0.0996	0.0759	0.7969	0.0014	0.2016
PCBDEP	0.0162	15.36	51.42	0.0021	0.0733	0.0176	0.0645	0.9178
OFIGD	0.0483	7.40	74.86	0.0321	0.0377	0.4439	0.0020	0.5539
OFICS	0.0511	89.72	74.72	-0.0148	0.3584	0.0839	0.0114	0.9045
OFILA	0.0901	26.13	83.37	0.0619	0.1360	0.4730	0.0015	0.5254
HCUR	0.0274	8.01	19.30	-0.0004	0.0371	0.0002	0.0097	0.9900
HDEP	0.0304	6.61	25.32	-0.0017	0.0319	0.0033	0.0205	0.9761
HGD	0.0387	7.97	86.94	0.0172	0.0404	0.1980	0.1009	0.7010
HCS	0.0140	14.69	58.16	-0.0046	0.0699	0.1109	0.0434	0.8456
HLA	0.0170	4.46	44.93	0.0107	0.0218	0.3980	0.0115	0.5904

Table 9.4d Tracking Performance for the share of the financial assets in static simulations (S2: SE adjusted)

Variables	RMS error	RMS error % of mean	RMS error % of S.D.	Mean Error	Theil's *U*	*Um*	*Uv*	*Uc*
BER	0.0108	34.54	37.79	0.0047	0.1334	0.1900	0.0000	0.8099
BGD	0.0490	18.97	121.16	-0.0260	0.0893	0.2832	0.0002	0.7164
BCS	0.0157	22.35	48.79	0.0082	0.1060	0.2736	0.0261	0.7002
BLA	0.0391	6.11	66.49	-0.0031	0.0303	0.0063	0.1318	0.8618
PCBCS	0.0805	22.34	31.68	-0.0447	0.0878	0.3093	0.0003	0.6902
PCBLA	0.1391	18.67	57.90	0.1224	0.0959	0.7751	0.0006	0.2241
PCBDEP	0.0154	14.65	49.04	0.0001	0.0704	0.0001	0.0292	0.9706
OFIGD	0.0353	5.40	54.68	0.0098	0.0270	0.0785	0.1603	0.7611
OFICS	0.0621	108.87	90.66	-0.0295	0.4052	0.2266	0.0362	0.7371
OFILA	0.1205	34.94	111.48	0.0980	0.1885	0.6623	0.0308	0.3068
HCUR	0.0334	9.78	23.58	0.0158	0.0462	0.2245	0.0031	0.7723
HDEP	0.0306	6.65	25.48	0.0017	0.0321	0.0032	0.0203	0.9763
HGD	0.0283	5.83	63.55	0.0103	0.0293	0.1328	0.1427	0.7244
HCS	0.0182	19.11	75.66	-0.0090	0.0888	0.2441	0.0014	0.7544
HLA	0.0141	3.68	37.13	0.0054	0.0181	0.1489	0.0103	0.8407

Table 9.4e Tracking Performance for the market solutions in static simulations

Variables	RMS error	RMS error % of mean	RMS error % of S.D.	Mean Error	Theil's *U*	*Um*	*Uv*	*Uc*
S1: Original								
GER	1439.01	58.89	35.72	-117.46	0.1604	0.0066	0.0654	0.9279
GGD	2860.77	6.12	3.66	706.63	0.0157	0.0610	0.1020	0.8369
DEP	3799.15	7.14	4.33	475.17	0.0185	0.0169	0.2579	0.7251
PCS	0.5614	55.36	354.56	0.0652	0.2614	0.0135	0.6159	0.3706
PLA	0.0178	1.77	25.91	0.0010	0.0091	0.0037	0.0054	0.9909
S2: Original								
GER	1356.77	55.52	33.68	-9.98	0.1487	0.0000	0.0358	0.9641
PGD	0.0249	2.46	36.04	-0.0015	0.0123	0.0036	0.0275	0.9687
DEP	3725.51	6.99	4.25	500.70	0.0181	0.0180	0.2698	0.7121
PCS	0.6889	67.92	435.04	0.1003	0.3148	0.0211	0.6653	0.3135
PLA	0.0241	2.38	34.88	-0.0004	0.0123	0.0004	0.0047	0.9948
S1: SE adjusted								
GER	1787.97	73.17	44.38	35.67	0.1931	0.0003	0.0047	0.9948
GGD	4823.99	10.33	6.18	-1395.29	0.0272	0.0836	0.4241	0.4921
DEP	3416.24	6.42	3.90	480.54	0.0166	0.0197	0.2377	0.7425
PCS	0.3139	30.95	198.23	-0.1034	0.1439	0.1085	0.1781	0.7133
PLA	0.0186	1.91	26.79	-0.0048	0.0094	0.0671	0.0136	0.9192
S2: SE adjusted								
GER	1447.05	59.22	35.92	-176.77	0.1638	0.0149	0.1167	0.8683
PGD	0.0275	2.72	39.81	0.0150	0.0136	0.2985	0.0202	0.6812
DEP	3361.61	6.31	3.83	449.06	0.0163	0.0178	0.224	0.7581
PCS	0.3881	38.26	245.06	-0.1853	0.1708	0.2280	0.2125	0.5594
PLA	0.0222	2.28	31.96	0.0038	0.0113	0.0298	0.0100	0.9600

- GER, GGD and DEP in terms of Rs. crore for the RMS error.

Table 9.4e refers to the five market solutions. In Original, there appears to be difficulty in solving PCS in both S1 and S2, as indicated by relatively large values of RMS error % of S.D. and Theil's *U*. Further, although there is hardly a systematic error with the small *Um* of PCS, the variation of the simulated value against the actual value is quite large, with 0.61 (S1) and 0.66 (S2) of *Uv*. This is perhaps largely due to the excessive volatility in share prices in the Indian stock market. This, in solving PCS in Original, has drastically improved in SE-adjusted, in which the RMS error, *U* and *Uv* all have substantially fallen for PCS, in particular with 0.17 (S1) and 0.21 (S2) of *Uv*.

Regarding the other market solutions, they are reasonably good in both Original and SE-adjusted. In particular, solving the PGD (derived from the government securities yields) and PLA (derived from the lending rate) are quite satisfactory. The results of the RMS error as reproduced below in Table 9.5 can be compared with the ones found by Green (1984), who has solved interest rates of Treasury Bill rate (TB) and loan rate (LR) in a dynamic system-wide flow of funds model for the UK during the period 1972:2 to 1977:12. Although, the study of Green (1984) is qualitatively different from the current study, it is a useful scale to assess our results in some respects, since to the best of our knowledge there has been no study of this kind conducted for developing economies. The table suggests that the performance in our study, in general, outperforms that of Green, except RMS error % of S.D. for PGD (counter-part of TB).

Table 9.5 RMS error % of mean and S.D. of PLA and PGD

RMS error	Original			SE-adjusted			Green (1984)	
	PLA S 1	PLA S2	PGD S2	PLA S 1	PLA S2	PGD S2	LR	TB
% of mean	1.77	2.38	2.46	1.91	2.28	2.72	11.30	6.10
% of S.D.	25.91	34.88	36.04	26.79	31.96	39.81	44.31	24.34

PLA: Real AIDS price for loans and advances, PGD: Real AIDS price for government debt
TB: Nominal Treasury Bill rate, LR: Nominal loan rate

Evaluation of the Historical Simulation in Graphs

The historical simulations for the market clearing endogenous variables are shown in graphs as follows:

Figure 9.2 a-e	Historical tracking simulations: S1 Original
Figure 9.3 a-e	Historical tracking simulations: S2 Original
Figure 9.4 a-e	Historical tracking simulations: S1 SE-adjusted
Figure 9.5 a-e	Historical tracking simulations: S2 SE-adjusted

where

a	GER (excess reserves)
b	DEP (deposits)
c	GGD or PGD (total government debt or price of government debt)
d	PCS (price of company securities)
e	PLA (price of loans and advances)

The actual and simulated series are plotted on the same set of axes. For the simulated values, 'S' is added after notation of the actual values. This is one criterion to see how well the model simulates *turning points* in the data.

The following is common to Original and SE-adjusted and also to S1 and S2. For GER until the end of the eighties, there is relatively good tracking performance, but in the early nineties the simulated values somewhat diverge and fail to capture the sharp decline, which occurred in 1992. In the asset of DEP and GGD, the simulated values trace the mild curve of the actual values quite well. With respect to PLA and PGD, the simulated values are almost identical to actual values in terms of turning points and fluctuations.

In the case of PCS, there is a significant fluctuation in the simulated values in Original with the relatively large scale range of around 2.5 to –0.5 for both S1 (Figure 9.2d) and S2 (Figure 9.3d)[5]. This is substantially suppressed in SE adjusted. See Figure 9.4d for S1 and 9.5d for S2 with the smaller scale range of around 1.8 to 0.6.

[5] Due to this large fluctuation in the simulated values in Original, there is a rationale to present SE-adjusted to supplement Original.

Figure 9.2a GER in the Excess Reserve Market (Rs.crores): S1 Original

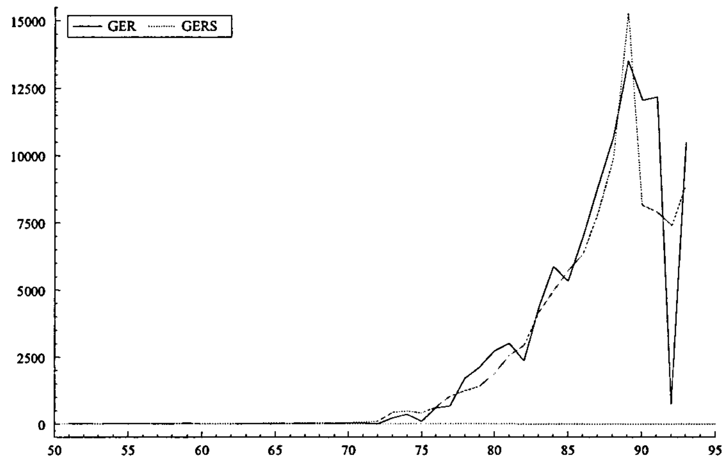


Figure 9.2b DEP in the Deposit Market (Rs.crores): S1 Original

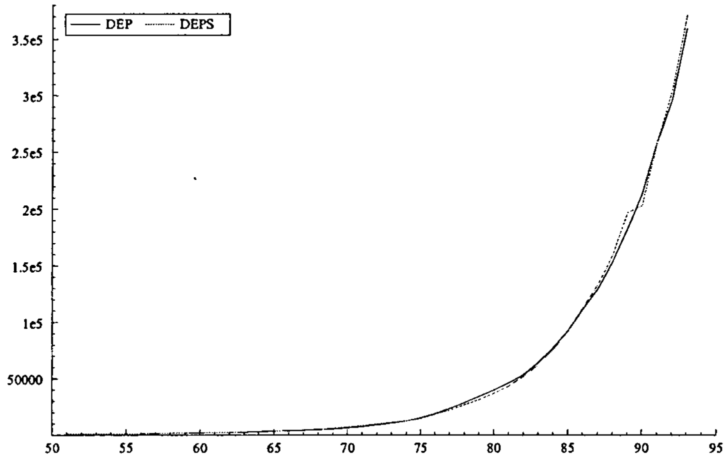


Figure 9.2c GGD in the Government Debt Market (Rs.crores): S1 Original

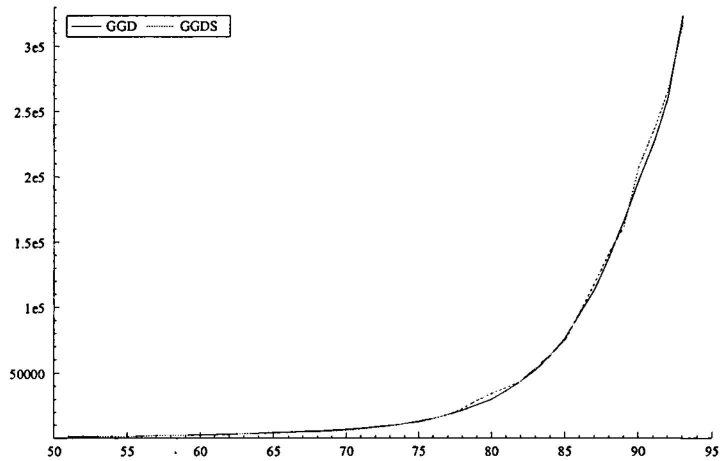


Figure 9.2d PCS in the Company Securities Market: S1 Original

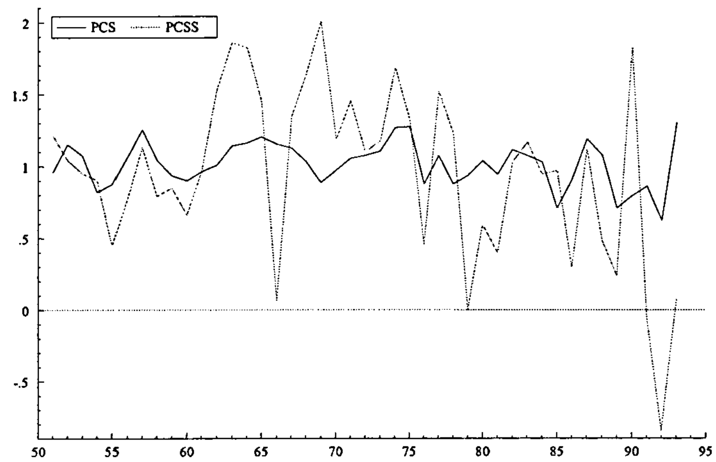


Figure 9.2e PLA in the Loans and Advances Market: S1 Original

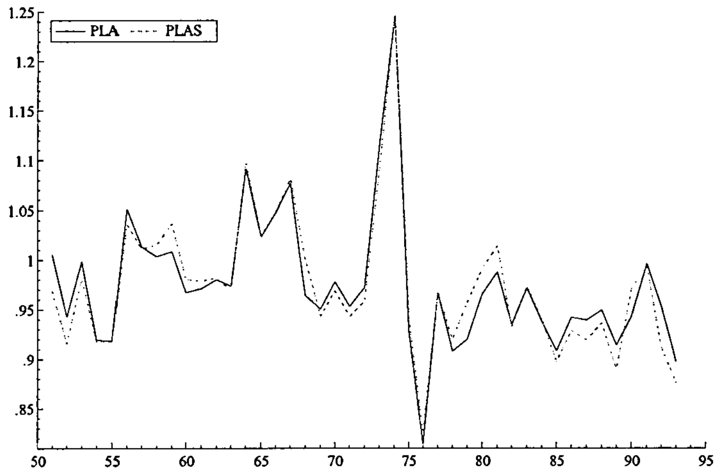


Figure 9.3a GER in the Excess Reserves Market (Rs.crore): S2 Original

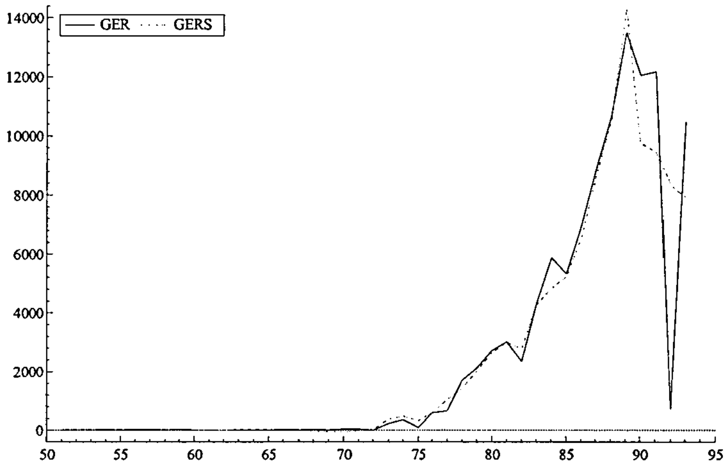


Figure 9.3b DEP in the Deposits Market (Rs.crore): S2 Original

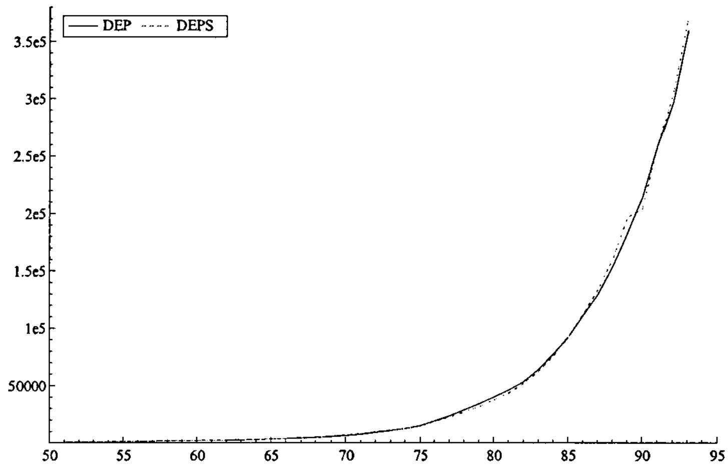


Figure 9.3c PGD in the Government Debt Market: S2 Original

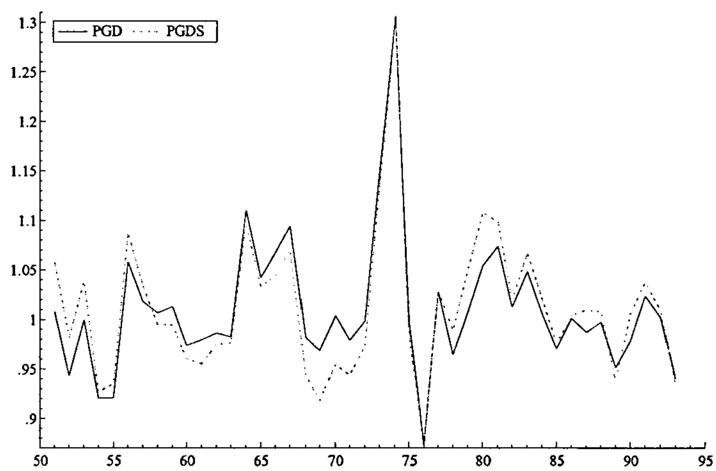


Figure 9.3d PCS in the Company Securities Market: S2 Original

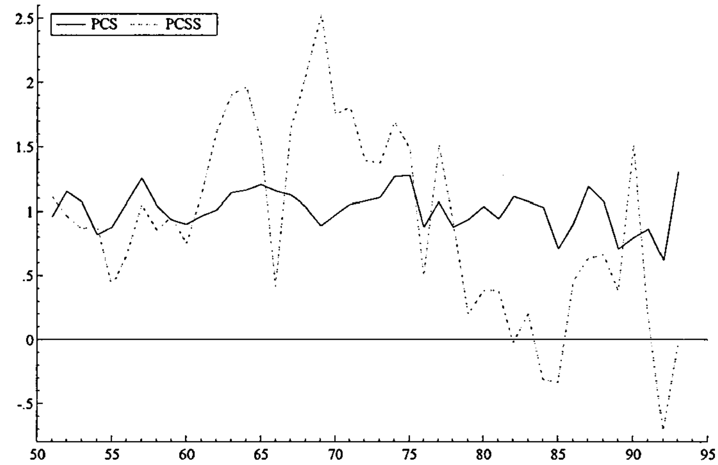


Figure 9.3e PLA in the Loans and Advances Market: S2 Original

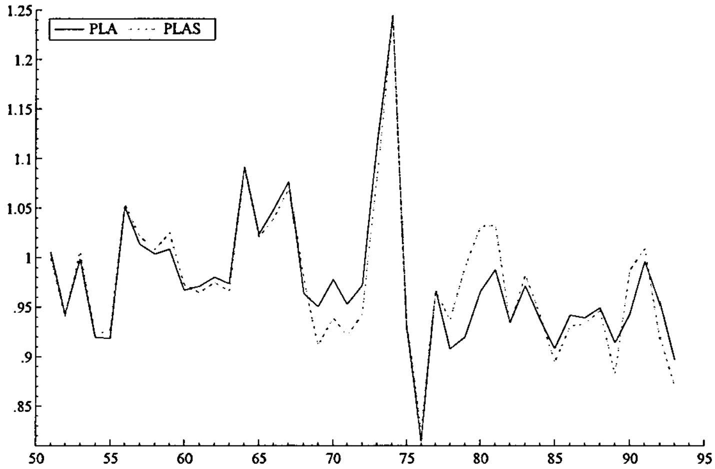


Figure 9.4a GER in the Excess Reserve Market (Rs. crores): S1 SE-adjusted

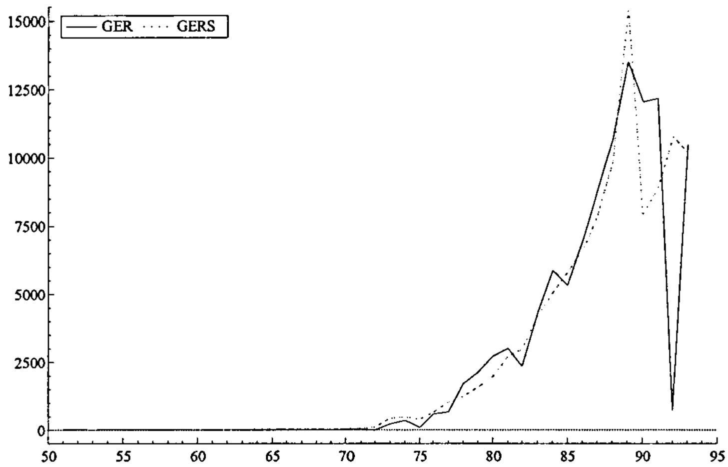


Figure 9.4b DEP in the Deposit Market (Rs. crores): S1 SE-adjusted

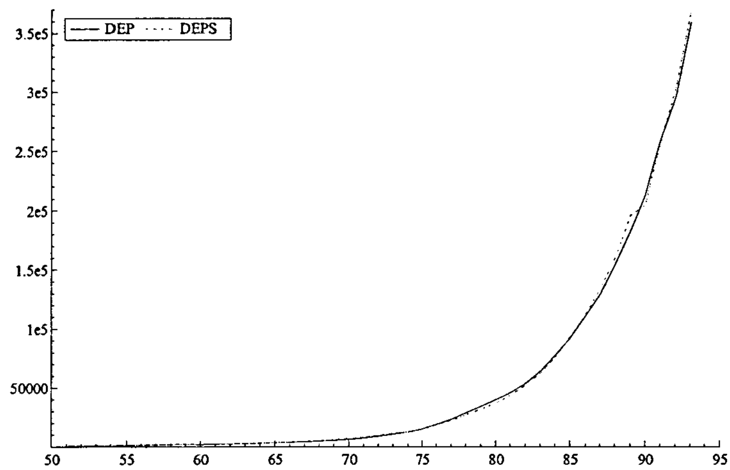


Figure 9.4c GGD in the Government Debt Market (Rs. crores): S1 SE-adjusted

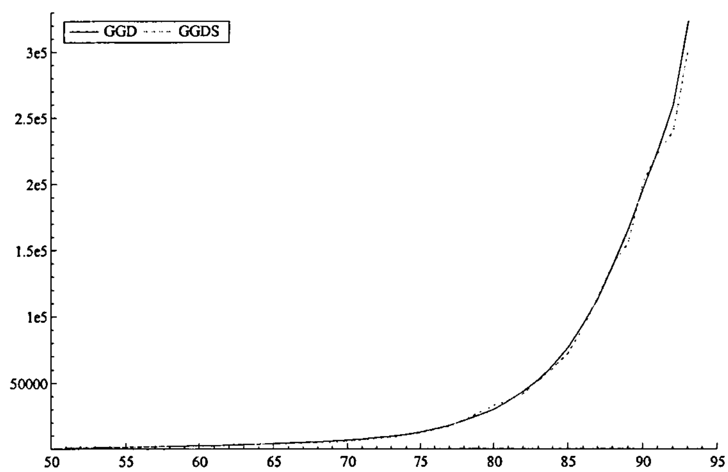


Figure 9.4d PCS in the Company Securities Market: S1 SE-adjusted

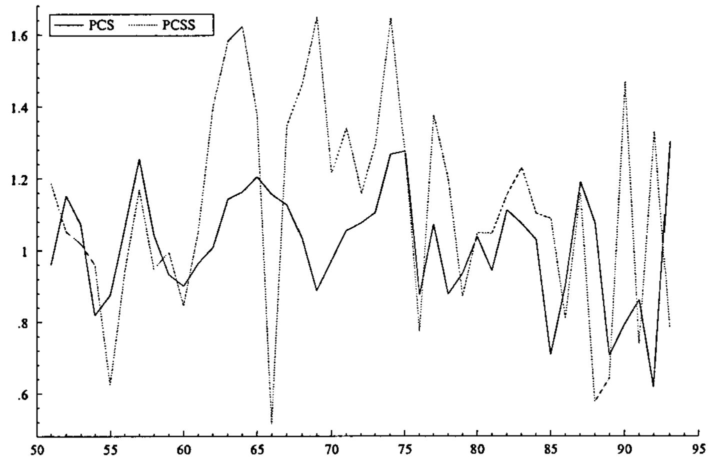


Figure 9.4e PLA in the Loans and Advances Market: S1 SE adjusted

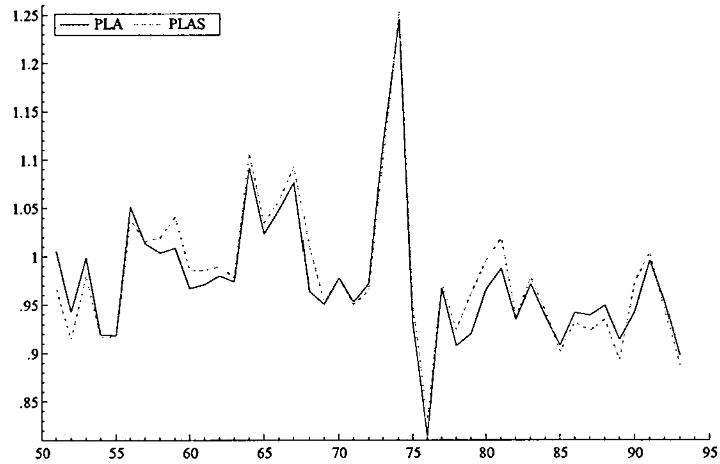


Figure 9.5a GER in the Excess Reserves Market (Rs. crores): S2 SE-adjusted

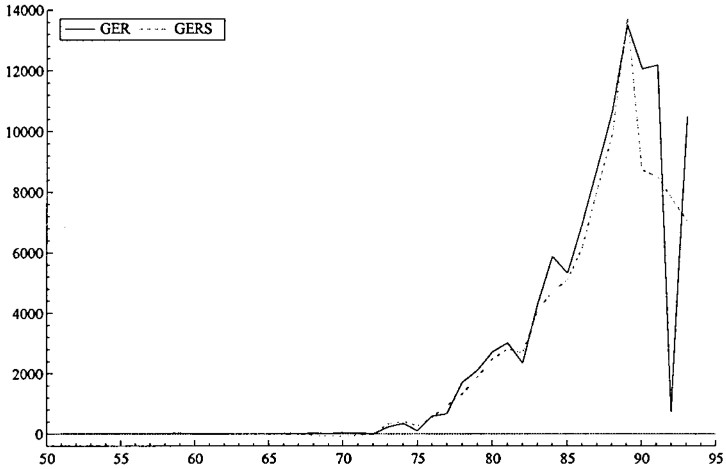


Figure 9.5b DEP in the Deposit Market (Rs. crores): S2 SE-adjusted

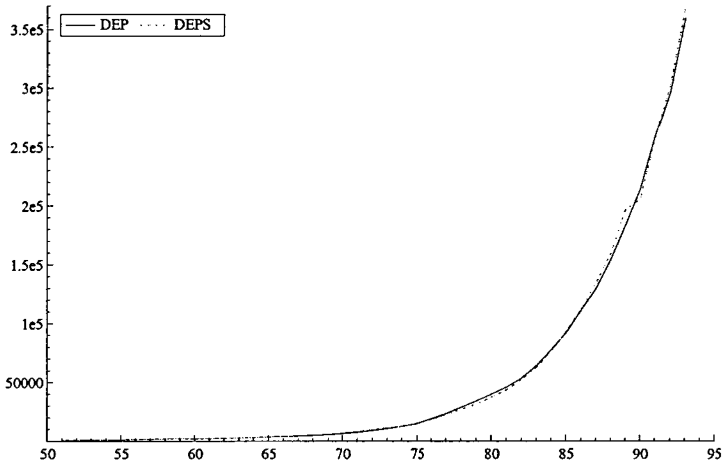


Figure 9.5c PGD in the Government Debt Market: S2 SE-adjusted

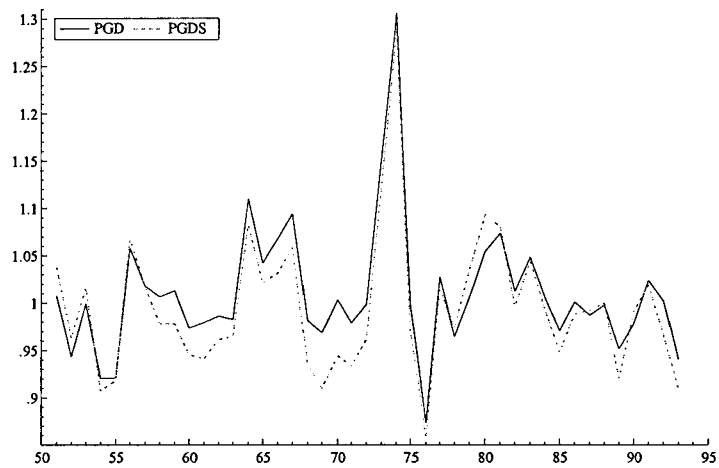


Figure 9.5d PCS in the Company Securities Market: S2 SE-adjusted

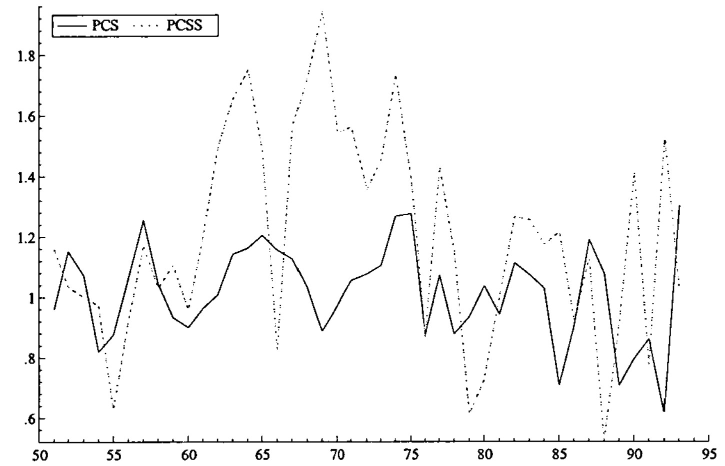
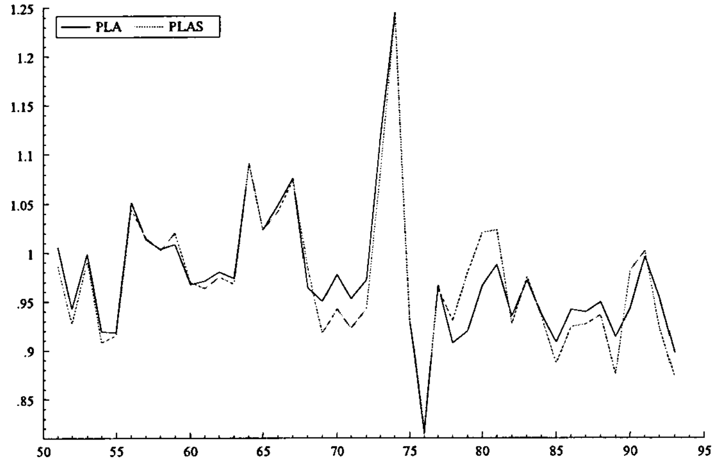


Figure 9.5e PLA in the Loans and Advances Market: S2 SE-adjusted



Overall Assessment

There is some trade-off in terms of tracking performance between Original and SE-adjusted in the share of holding financial assets, in that Original outperforms SE-adjusted in terms of bias in the simulated values, whereas SE-adjusted outperforms Original in terms of fluctuation in the simulated values. In the market solution, SE-adjusted improves the result of Original with respect to PCS; this is also demonstrated in the historical simulations in graphs.

When S1 is compared with S2, the overall results are similar. Yet, the former slightly outperforms the latter in its ability to track the historical movements, not surprisingly since PGD is endogenous in S2. This is in particular seen in PCS: the variation of the simulated value of PCS is subdued in S1 as compared with that of S2 (see Figure 9.2d for S1 and 9.3d for S2 of Original, and Figure 9.4d for S1 and 9.5d for S2 of SE-adjusted).

On balance, these simulation results are very good considering the fact that the estimated models are derived from data over a relatively long time span of 43 years for a developing economy. Furthermore, although no dynamic model is involved in simulation, there is little apparent loss of information[6], and that this satisfactory result allows us to concentrate on long-run. We are therefore reasonably confident in performing policy experiments given Original and SE-adjusted. The latter is to play a supplementary role for the former.

9.4 Policy Analyses by Simulation Experiments

9.4.1 Imperfect Tracking Solution versus Perfect Tracking Solution

So far, we have been dealing with an *imperfect* tracking solution, as the tracking solution for historical simulation is imperfect. As opposed to this, a *perfect* tracking solution is to solve the endogenous variables by incorporating all the residuals of the share equations into the simulation. By doing so, the simulated values in the historical simulation perfectly track the actual time series. In simulation experiments, the perfect tracking solution technique, rather than imperfect tracking solution technique, is employed with the same Gauss-Seidel methodology for the following reason: In the preliminary results, comparing the residual-out (i.e. imperfect tracking) and residual-in (i.e. perfect tracking) solutions, the main results in the policy changes are similar and intuitively plausible, for example, a fall in CRR and Bank rate reduces excess reserves, a fall in government securities yields reduces the holding of government securities and a rise in the deposit rate increases deposits. However in the case of the residual-out solutions, there tend to be volatile responses to policy changes, especially, in the equity financing in the PCB sector. This makes the inference drawn from the results in the imperfect tracking solution very difficult. The residuals-in simulation appears to circumvent this drawback, since the overall policy effects are within a plausible range. Furthermore, arguing that the actual time series as being equilibrium, make it possible to isolate the policy effects more meaningfully in terms of implementing policy actions (Murinde and Rarawa, 1996), it is therefore plausible to concentrate on the perfect tracking solution technique in analysing the policy effect[7].

9.4.2 Simulation Experiments for the Period of 1969-93

The period for the experiments is chosen to be during 1969-93 for 25 years on the grounds that when 20 major commercial banks were nationalized in 1969, there was a large impact on sectors in their portfolio choices as indicated by the significant effect of dummy 69.

The policy effects on endogenous variables in the simulation experiments can be given by

$$\delta_i^D = D_i^{simu} - D_i^{base} \qquad (9.4)$$

where

---

[6] It is argued that, in general, static models have rather poor tracking performance as compared with that of dynamic models.
[7] Murinde (1992) and Murinde and Rarawa (1996) included residuals in simulated policy experiments.

δ_i^D = a mean for the period 1969-93 of the policy effect that a simulated change in exogenous variables has on the i'th endogenous variable

D_i^{base} = a mean of the i'th endogenous variable for the period 1969-93 with a base set of exogenous variables

D_i^{simu} = a mean of the i'th endogenous variable for the period 1969-93 with a simulated change in exogenous variables

The base run (i.e. D_i^{base}) is the same as the actual time series. The mean base run for the period 1969-93 is found in Appendix 9.2 (the AIDS prices are converted into the real interest rates). The simulated run (i.e. D_i^{simu}) is conducted by changing a single policy or an exogenous variable at a time with all other exogenous variables unaltered (i.e. single-shot simulation), so that the new equilibrium of the endogenous variables is derived. The simulated run is equivalent of a one period-ahead forecast. The difference (δ_i^D) between the base run and the simulated run quantifies the effect of a policy shock.

The simulation policy experiments are conducted with the view to examining the impact of policy on the release of loanable funds for private economic activities from the government and banking sectors, and on the cost of debt and equity capital. The shock from the real variables is also examined. The numerical magnitude in the experiments is all within a plausible range for the Indian authorities. We specifically conduct the following simulations:

1. CRR 2 % reductions (CRR)
2. Bank Rate 2 % reduction (Bank rate)
3. SLR 2 % reduction (SLR)

4(S1). Government Securities Yields 2 % reduction (GSY)

4(S2). Open market purchase of government securities by 2 % (OMO)

5. Deposit rate 2 % increase (Deposit)[8]
6. Real devaluation by 10 % (Devaluation)
7. Nominal GDP 10 % increase with a 8 % inflation rate

[8] A rise in deposit rates is assumed to increase loanable funds in the banking sector.

8. Nominal GDP 10 % increase with a zero inflation rate
9. Inflation rate 8% without any growth in GDP

Since the rate of inflation is exogenous, the nominal interest rate changes in the Bank rate, GSY and deposit rates are all in real terms.

9.4.3 Inference Based on the Perfect Tracking (Residual-in) Solution

The results of the policy simulations are presented in Appendix 9.3a, 9.3b and 9.3c:

Original	S1 and S2	in the upper table
SE-adjusted	S1 and S2	in the lower table

In these appendices, the mean percentage deviation of endogenous variables from the base run, and also the mean actual change in asset holdings in terms of Rs. crore are presented. In the market solutions, we have converted the AIDS prices into the interest rates. GGD applies to S1 and GSY applies to S2. The first fifteen endogenous variables are associated with the holding of financial assets in each sector, and the last five endogenous variables, with the market solutions.

When Original and SE-adjusted in the perfect solution are compared, as it was expected, the effects of policy changes on the RS are more suppressed in SE-adjusted. The magnitude of policy effects (in particular in the OFICS and PCBCS) are somewhat different between Original and SE-adjusted. However, in general both arrive at the same sign in the policy effects for almost all policy changes. Besides, the policy effect on PGD and PLA are satisfactory close. The salient features are, therefore, by and large similar between them. It may indicate the robustness of the results in Original and so unbiased inference may be drawn from Original. We now concentrate on Original.

Refer to Tables 9.6a, 9.6b and 9.6c (reproduced from Appendix 9.3a, 9.3b and 9.3c in the upper table)[9]. Prior to inference, the simulation solution needs explaining. Since each sector's wealth is fixed, the policy effect in terms of Rs. crores sums zero in each sector; the analysis is to examine the relative movement in the portfolio. The holding

[9] These tables and any further tables are found after the last section of this chapter.

of a liability is indicated by the negative sign (i.e. OFICS(-), PCBCS(-), PCBLA(-) and HLA(-)), and a positive change implies an increase in the holding of a liability. For example, in the OFIs sector for S1 of a change in CRR in Table 9.6a, the policy change sums zero given –1,873 Rs. crores of OFIGD, 2,640 of OFICS(-) and 4,514 of OFILA. In the simulation of CRR and OMO, the exogenous BW and HW will change respectively, hence the policy effect does not sum to zero (it will be explained in detail in each simulation). The market solutions for GER, DEP and GGD are consistent with the total policy change in all sectors, for example, DEP of 544 Rs.crores in S1 of CRR is the total of 77.25 in PCBDEP and 467.51 in HDEP.

The policy effect of CRR is discussed in detail to give an idea of how to interpret the results. For the subsequent policy change we avoid repetitive analyses, but concentrate on the specific effect of the policy. The comments made apply to both S1 and S2, unless otherwise indicated. The overall results are left to the concluding remarks in the last section of this chapter.

In analysing the policy effects, the underlying assumption is that the funds used in the government sector are mainly spent on government consumption[10], whereas the funds that flow into the PCB and household sectors are used for private economic activities. For the PCB sector, the emphasis is on the flow of loans, rather than the flow of equity, since not only are new share issues costly, but they also involve uncertainty in the volatile equity market in India.

No.1 Reduction of CRR by 2 %

Since the wealth in the banking sector is the total assets minus required reserves (i.e. BW = BER+BGD+BCS+BLA = Deposits – Required reserves), a fall in CRR means an exogenous increase in the mean of bank wealth (BW) by 1,649 Rs.crores (this is equivalent to commercial bank deposits x 0.02) for the period 1969-93. The policy change therefore sums 1,649 Rs.crores in the banking sector. This policy change increases the proportion of earning assets to total assets, and this raises profitability in

[10] Non-development expenditure such as defence, debt service and administrative expenses are so large and significant in India (Datt and Sundharam, 2000).

the banking sector. The change in CRR should therefore affect the lending capacity of the banking sector.

i) The effect on the interest rates:

The policy has an expansionary effect by bringing down LR (lending rate), reflecting the loose monetary control by lowering CRR. The GSY (government securities yields) also falls by 1.73 % in S2. By contrast, there is a dramatic increase in RS, implying a fall in the stock market. Such a volatile effect on RS is frequently found in other policy simulations, making it somewhat difficult to arrive at a coherent inference (even in SE-adjusted in Appendix 9.3, the policy effect on RS is, though suppressed, quite striking). This is not unusual in the real world. A large fluctuation is observed during the period of 1992-1995 with the annual change of RS being around 50 to 70 %.

ii) S1 regime vs. S2 regime:

In comparing S1 with S2, the dampening effect on the stock and credit markets by the controlled GSY (i.e. S1) emerges: the policy effects are 53.68% for RS and –1.69% for LR in S2, whereas 44.66% and –0.46% respectively in S1. In this respect, S1 regime may be detrimental as it suppresses to a certain degree the free movement of interest rates, as it is hypothesized. However, the magnitude of the policy effects on the flow of financial funds tends to be larger in S1 than in S2. Moreover, in general, the dampening effect is not particularly evident in other policy simulation experiments (on the contrary, in the simulation of Deposit rates and Devaluation, there is an inverse dampening effect: the policy effect in the S2 regime is somewhat suppressed).

iii) Banking sector:

BER is reduced, and there is a relatively significant increase in BCS and BLA, though LR falls. In the long-run model for this sector, the coefficient of CRR in the BER and BLA share equations was relatively small at 0.0083, and the lending rate and BLA had a positive relationship (in Table 9.3)[11]. The increase in BLA (and also BCS) may therefore be, in the main, attributes to an increase in disposable income (i.e. BW); banks choose to invest in riskier assets. In this respect lowering CRR exerts a preferable effect in releasing funds for the private sector.

iv) OFIs sector:

[11] Note that in the table the price of LA (PLA) is the inverse of lending rate.

Given an increase in RS, the OFIs sector actively issues new securities, mutual funds and unit trusts, being indicated by a rise in the liability of OFICS. A relatively strong influence of RS in this sector is quite plausible, since for OFIs the capital market products are one of the major financial instruments. OFIGD falls in S1, and also a fall in GSY leads the OFIs to disinvest GD(government debt) in S2. In the counter-part there is a significant increase in OFILA, despite the fall in the lending rate. OFILA was, however, highly sensitive to the lending rate (positively) given the coefficient at 2.71 in the single sector long-run model. The conflicting outcome from the single sector model may suggest a relatively strong influence of GSY outweighing the effect of the fall in LR in the system-wide model.

v) Banking vs. OFIs sectors:

It can be shown that there is a larger reshuffle in the flow of funds in the OFIs than in the Banking sectors in terms of both proportionate and actual changes (this is also true in SE-adjusted in the proportionate change, see the lower part of Appendix 9.3a). This is consistent with the finding in the less regulated OFIs in Chapter 7. This trend is frequently seen in other policy effects.

vi) PCB (and Household) sector:

The increasing lending activity by the financial institutions and the fall in lending rate appear to affect preferably the PCB and household sectors, as indicated by a rise in both PCBLA and HLA. In the PCB sector, with an ease of borrowing from the institutions and a fall in share prices (because a rise in RS), there is a shift in capital structure towards debt finance rather than equity finance.

vii) Household sector:

The falling share prices appear to trigger risk perception in the household sector, hence the sector retrieves the funds from the stock market (i.e. a fall in HCS) and transfers the majority of them into a risk-free asset of GD (i.e. a rise in HGD).

viii) Government debt (GD) market:

In the GD market, there is quite a large increase in GGD at 4,042 Rs.crores in S1 owing to the increase in HGD. HGD rises even in S2, where GSY falls (this also emerges in the simulation of Bank rate, OMO and Deposit rates); in the system-wide model HGD may not be so sensitive to the yields as it is in the single sector model. The increase in HGD may also be the result of a relatively strong substitution effect between the risk-free and risky assets.

No. 2 Reduction of the Bank Rate by 2 per cent

The Bank rate is one of the instruments used to control credit in India. It is also believed to serve as a tool for influencing the interest rates of the economy. The effect of this policy on the flow of funds and on interest rates is, however, very small.

The lending rate falls by only 24 basis points in S2 and none in S1, and the effect on RS is also very small, hence, unlike in developed economies, the role of the Bank rate as a signalling device for market rates is weak. This appears to reflect that the administrative interest rate structure prevalent in India makes the response of interest rates to the change in the Bank rate less sensitive. It could be also due to the risk-free substitution effect in the banking sector: The proportionate fall in BER is not small[12], yet this is absorbed by an increase in BGD, in particular, in S1 in terms of actual change, making this policy ineffective. The insensitivity of the interest rates to the bank rate may be the consequence of this.

No. 3 Reduction of SLR by 2 per cent

The main purpose of this ratio may be to make the government security market more captive to support a programme of government borrowing. The reduction of SLR is, therefore, equivalent to a fall in involuntary investment by commercial banks in the government sector, and therefore it can be assumed that the banking sector increases investment in private sectors.

i) There is a very large fall in RS of S1 by 85 % and more in S2 by 91.45 %. The lending rate also falls, though it falls more in S1 by –0.48 than in S2 by –0.06, hence the dampening effect is not particularly apparent in this policy change.

ii) There is a relatively large decrease in BCS. This may be due to the fall in RS; also lowering SLR may be contributing to a fall in the banks' involuntary investment in the government approved company securities. Instead, an increase in investment in risk-free government debt (i.e. BGD) is observed, indicating that, as opposed to

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[12] A fall by 14.02% in S1 and 11.88% in S2 in BER is close to the finding by Sen *et al.* (1996) who found the fall by 12.84% in the simulated 2% reduction of the Bank rate.

government approved company securities, the investment in government securities is not directly associated with the level of SLR. The result is consistent with that found in the banking sector study.

iii) The fall in RS also affects OFICS to contract significantly. It is surprising to find that the OFIs have shown such a strong sensitivity to the SLR, though SLR is not included in the OFIs' long-run model specification.

iv) Contractionary portfolio behaviour in the financial institutions adversely affects the private sector in terms of borrowing. There is a substantial decline in PCBLA and HLA, (despite the fall in lending rate). Instead, PCBCS increases, but this is mainly taken up by the household sector as shown by the rise in HCS, not by the financial institutions. This finding suggests that the SLR may be, contrary to our prediction, contributing to delivering funds from the financial institutions to the non-financial private sectors.

No. 4 (S1) Reduction in Government Securities Yields by 2%

The simulation results are qualitatively in accord with the *a priori* expectation, in that a fall in the return of risk-free assets leads to a 'crowding-in' effect, in general terms. It exerts a substantial withdrawal of GD in the financial institutions, and this has contributed to increasing loanable funds: BLA and, especially, OFILA rise. There is also an expansionary effect through a fall in the cost of borrowing. Consequently, both PCBLA and HLA increase significantly.

However, substitution effects between risk-free assets are observed (though not by much) in the banking sector; part of a fall in BGD is absorbed by a rise in BER. In the household sector, there is a significant increase in HGD, even though GSY falls. Further, the yields were market-determined in the post-reform period, hence this policy is perhaps fading as a policy instrument in India.

No. 4 (S2) Open Market Purchase by 2 per cent

In the complete general model, the consequences of government deficits for supplies of government securities and crowding-out will be taken into account automatically. The effect of such changes in supply can be inferred from a simulation of the financial sector by an 'open market operation'.

Here, we take an expansionary open market operation. This is accompanied by an increase in the circulation of currency by 2 % of government debt. This is reflected in the mean increase of HW (wealth in the household sector) by 1,444Rs.crores for the period 1969-93.

i) The sign on the change in the asset holdings and interest rates is the same as for the simulation of a 2 % reduction of GSY, hence the effects are expansionary.

ii) The open market purchase leads to a relatively large decline in government securities' yields by 1.33 %. Given a relatively high demand for risk-free securities, the reduction in their supply will push up the prices, hence the yields on government securities fall significantly.

iii) With the open market purchase, it is expected that not only will the banks be able to obtain loanable funds by selling government securities in the market, but also that funds will be directly obtainable by those, who sell their securities to the authorities. However, such an expected result does not appear to be significant: In the banking sector, BGD falls and BCS and BLA increases, as anticipated. Yet, part of the fall in BGD is substituted by a rise in BER. In the case of the household sector, the behaviour is counter-intuitive in that they purchase government securities rather than sell them (reflected in the increase in HGD). An increase in PCBLA and HLA in the main is attributed to the OFIs' expansion of lending.

iv) There is a relatively large increase in broad money (the total of HCUR and HDEP) in the household sector. If the high ratio of broad money to GNP is associated with economic growth as McKinnon (1973 and1988) argues, this policy would exert a desirable effect on the Indian economy. At the same time, however, an inflationary effect may emerge.

No. 5 Increase in the Deposit rate by 2 per cent

Although the deposit rate rises by 2 %, a rise in the cost of debt capital (i.e. LR) is lower by 53 basis points in S1 and by 13 basis points in S2, and so this does not appear to cause any significant contractionary effect in the flow of loanable funds. The impact on the cost of equity capital (i.e. RS) is, however, quite large. As opposed to LR and RS, GSY falls, leading financial institutions to disinvest in the government sector. A flow of funds in the household sector reveals a substitution effect between risk-free assets; an increase in HDEP is countered by a reduction in HCUR. The additional inflow in the form of deposits in the financial institutions may contribute to releasing loanable funds. (Note that an increase in disposable income leads banks to increase loans in the simulation of CRR.) The major contribution to the increase in PCBLA and HLA is again from the OFIs sector. Overall, the impact of this policy change is quite desirable.

No. 6 Real devaluation by 10 per cent

In India, the exchange rate evolved from a basket-linked managed float to a market-based system in 1993, yet it is still worthwhile to see the effect of devaluation on a flow of funds. The devaluation is in real terms since domestic and foreign prices are fixed.

i) With respect to the demand for money, there is hardly any effect on currency (i.e. HCUR) in both S1 and S2. Therefore, the effect of exchange rates on the demand for narrow money is weak. The interdependent behaviour among sectors is contrasted with that of the single sector study.

ii) The devaluation leads to a large increase in RS and this has an expansionary effect on the banking sector's investment in BCS and on the OFIs' issuing shares; this could also be due to a positive perception that the economy gains price-competitiveness by devaluation.

iii) There appears to be easy money in the credit market; both HLA and PCBLA increase, though the cost of debt tends to be upwards.

iv) By contrast, due to falling share prices the corporate sector contracts in issuing new shares and the risk-averse household sector disinvests in company securities. It may be that firms see devaluation as an indication of inflation risk, and that they are cautious in not expanding their long-term investment by equity finance.

No. 7 Rise in nominal GDP by 10% with 8% inflation rate

With an inflation rate of 8%, all AIDS prices and the real exchange rate are adjusted accordingly. This is not a direct policy variable, but this kind of model is useful, in particular, in exploring the financial implications of a particular GDP projection.

i) There is a relatively large fall in RS, implying rising share prices. This is quite plausible; as GDP increases, the stock market prospers. Yet, against GDP growth of 10%, the impact on share prices (which is reflected in the fall in RS by 75 % in S1 and by 83 % in S2[13]) seems to be overheated. This demonstrates that share prices in India are prone to deviate from the fundamentals, and tend to be driven by speculative movements.

ii) The economy is booming, but a fall in RS leads the financial institutions to switch from risky assets to risk-free government securities. An increase in OFIGD and a substantial fall in OFILA are largely responsible for a fall in PCBLA and HLA. In this sense, a large fall in RS seems to exert a significant contractionary behaviour in the financial institutions, even if there is a positive outlook for the economy.

iii) As opposed to such a contractionary behaviour in the financial institutions, the growth in GDP stimulates the PCB sector to issue new shares (PCBCS substantially increases by nearly 70-80 % in both S1 and S2, and this is also indicated in SE-adjusted in the lower table in Appendix 9.3c). This is expected; remember that equity finance is elastic with respect to aggregate income in the PCB sector study. The newly issued company securities are mainly subscribed to by the household sector.

iv) The dampening effect of S1 regime on interest rates is observed in this simulation (and also in the next simulation) as the endogenous interest rates change more in S2 than in S1. Accordingly, the magnitude of the change in the portfolio in each sector is larger in S2 than in S1. This is contrasted with the change in policy instruments, where the dampening effect is not particularly obvious.

[13] In the SE-adjusted, RS falls by 38% in S1 and 41% in S2 (Appendix 9.3c).

No. 8 Rise in nominal GDP by 10% without inflation

In order to examine the movement of interest rates, an additional simulation is conducted involving a rise in GDP without inflation. Without the inflation rate, the AIDS prices can be interpreted as being nominal prices, hence the GSY, LR and RS in the market solution imply nominal interest rates as well.

i) The reshuffle of the flow of funds within and between sectors are broadly similar to the previous simulation of No.7: the banking and OFIs sectors' behaviour is contractionary, whereas that of the PCB sector is expansionary in the stock market.

ii) The nominal GDP growth raises the nominal lending rate (LR). The outcome of both simulations No.7 and No.8 would give us an interesting insight into the proposition of the Fisher effect[14]. The proposition appears to be supported in that the simulated inflation rate of 8 % in No. 7 is compensated for by an almost equal increase in the nominal lending rate in this simulation:

7.34% (simulation No. 8) - 0.05% (simulation No.7) = 7.29% in S1, and

8.46% (simulation No. 8) - 0.58% (simulation No.7) = 7.88% in S2. Hence the real cost of debt capital would remain the same in the context of the Indian economy.

iii) With respect to RS, there is quite a difference between the real RS (in No.7) and the nominal RS (in No. 8); the nominal RS is higher by around 20 to 30 % than the real RS, again exhibiting a volatile behaviour.

No. 9 Inflation rate 8% without any growth in GDP

With an inflation rate of 8% without any accompanying growth in the economy, such a condition stagnates economic activities as a whole. There is rarely a flow of funds between and across sectors, depicting financial repression in India. An increase in real lending rates may somewhat suppress inflation, but at the same time accelerate the onset of recession, as it depresses loan demand.

[14] The Fisher effect postulates that, in order to maintain the invariance in the real economy to inflation, the nominal interest rate rises to the same extent as the rate of inflation, so that the real interest rate remains constant.

In the household sector study, we find that the government debt is the safest hedge against inflation. However, such an activity appears to be thin in the system-wide mode. It may be more likely that the household sector invests in unproductive inflation hedges such as land and property, rather than in financial investment.

9.5 Contractionary Policy Effects

The potential contractionary simulation experiments are conducted for the same policy shocks from Simulations No. 1 to No.6 by reversing the sign but with the same magnitude. Such that:

1. CRR: CRR increases by 2%
2. Bank rate: Bank rate increase by 2%
3. SLR: SLR increases by 2%

4(S1). GSY: GSY increases by 2%

4(S2). OMO: OMO 2% sales

5. Deposit rate: Deposit rate decreases by 2%
6. Revaluation: Revaluation by 10 %

The results that are based on the perfect tracking solution in Original are shown in the upper part of Table 9.7a and 9.7b, in which the expansionary simulation results are reproduced (from Table 9.6) in the lower table for a comparative study. It is shown that the signs of the policy effects are almost in the opposite direction between the contractionary and expansionary simulations. However, there are some differences in the magnitude of the policy effects. Some features are briefly summarised as follows:

i) CRR: The magnitude of the policy effect is less in the contractionary simulation (Contractionary, hereafter) in the regime S1, as compared with that of the expansionary simulation (Expansionary, hereafter). On the contrary, in S2 larger policy effects emerged in Contractionary.

ii) Bank rate: A substitution effect is observed between BER and BGD as in the case of Expansionary. A similar scale of the policy effect in the opposite direction is found between Contractionary and Expansionary.

iii) SLR: There is an increase in PCBLA and HLA with a 2% rise in SLR. This reinforces the result obtained in Expansionary that the fall in SLR is contractionary in releasing loanable funds toward the non-financial private sectors. The magnitude of the policy effect is less in Contractionary for both S1 and S2 than that in Expansionary.

iv) GSY and OMO: Overall the quantitative size of the policy effect is again less in Contractionary for both S1 and S2.

v) Deposit and Revaluation: The magnitude of the policy effect is less in Contractionary for S1, while it is similar between Contractionary and Expansionary in S2.

The quantitative policy effect (in particular, the effect on credit, i.e. PCBLA and HLA) is less in Contractionary than in Expansionary in the policy change of CRR, Deposit and Revalution for S1, and in the policy change of SLR, GSY and OMO for both S1 and S2. This suggests that in order to achieve a similar magnitude of policy effect in the opposite direction, the policy change in Contractionary should be numerically larger than that in Expansionary. It may, in general, illustrate the difficulty of conducting contractionay policy.

9.6 Summary and Concluding Remarks

In this chapter, simulation policy experiments were undertaken in order to highlight the effect of policy changes on the financial sector in India. The system-wide model does attempt to specify the mechanics by which each policy variable works in the various financial markets, which are not captured in a single sector study. The following represents the summary and the policy implications drawn from the simulation experiments:

i) The dampening effect by controlling the government securities' yields seems to be ambiguous in the policy simulation experiments. This suggests that whether the government securities yields are controlled or not may not matter in the policy effectiveness.

ii) The risk-free substitution effect between BER and BGD in the banking sector is observed in the change in the Bank rate, government securities' yields and open market purchase. These imply that increases in such as the government deficit exert a detrimental effect in implementing otherwise viable policy instruments.

iii) The *reduction* in the SLR counter-intuitively has an adverse effect by reducing loans for economic activities. It could be argued that the reduction in SLR is the consequence of the fall in government expenditure, hence it is exerting a contractionary effect on the economy. However, this channel may be weak since in the main government spending is for their own consumption in India. We would rather be inclined to assume that commercial banks' involuntary subscription to government-*approved* securities issued by the OFIs under this regulation may bring about a desirable effect in assuring loans to the PCB sector.

iv) The expansionary effect in the open market purchases on a flow of loanable funds was found in the financial institutions. The behaviour of the household sector is, however, unexpected as it turns out to be an increase in government securities. Although our system-wide model simulation has not explicitly specified the thin securities market, this may be perhaps taken with qualification, that in countries where the government securities market is under-developed, open market operations rarely function as a viable policy, especially in the private sector (Thaker, 1985), and that further development of the government securities market is a priority for India.

v) We find that the lower CRR exerts an effective expansionary effect by releasing funds from the banking sector to the industrial and household sectors, without incurring the risk-free substitution effects in the banking sector that is frequently found in other policy instruments. We also find that as the real deposit rate rises, financial saving increases in the household sector, and they are made available to non-financial private sectors with a relatively small increase in the cost of borrowing. It appears that the reduction in CRR and also the increase in the real deposit rate are the desirable policies in achieving the target of delivering funds to the PCB and household sectors for economic activities. (Note that the simulation GSY and Devaluation have also shown preferable impact on loans, but they are largely market-determined in the post-reform period.)

vi) The effects of a policy change on the RS are quite volatile. Such a great uncertainty in the Indian stock market appears to distort the potency of economic growth. It is seen that with an increase in GDP (simulation No. 7 and No.8), but due to a large fall in RS, the behaviour of the financial institutions are contractionary.

vii) It seems that the Keynesian Paradigm of an interest rate channel for boosting the economy is more or less supported, as the fall in the cost of borrowing by the policy change tends to lead to an increase in loans. However, in India, for the PCB and household sectors the alternatives to bank credit, issuance of shares and moneylenders respectively, are costly, hence, it is more likely that the credit market is determined by the supply-side, and that the disruption to the flow of credit in financial institutions has significant effects on the economy. For example, by the reduction of SLR, OFILA falls substantially, and this in turn reduces PCBLA and HLA substantially, though the loan rate falls. This rationalizes government intervention in credit rationing towards vulnerable sectors, to some degree, as in currently existing priority sector lending requirements.

viii) In general, OFIs sector is more responsive to the policy change, rather than the banking sector in the system-wide model, being consistent with the single sector study. This restates that the OFIs sector can potentially play a crucial role in linking the policy effects in the economy.

Table 9.6a Policy effects (69-93): Original (Rs. Crores for Actual changes)

	1. CRR 2% reduction				2. Bank Rate 2% reduction				3. SLR 2% reduction			
	S1		S2		S1		S2		S1		S2	
	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	-34.19	-1433.01	-16.99	-711.89	-14.02	-587.40	-11.88	-497.99	8.00	335.34	2.41	101.05
BGD	-0.27	-55.51	-0.79	-162.77	2.75	565.55	1.06	218.93	8.35	1720.36	10.71	2205.75
BCS	19.06	1593.41	13.54	1132.01	0.19	15.67	2.51	210.27	-27.54	-2302.88	-29.68	-2481.71
BLA	3.51	1544.24	3.16	1391.79	0.01	6.18	0.16	68.78	0.56	247.21	0.40	174.94
OFIGD	-6.90	-1873.83	-6.52	-1770.00	-0.06	-16.63	-2.15	-583.27	15.20	4127.10	17.95	4874.15
OFICS (-)	74.86	2640.24	51.85	1828.71	0.61	21.45	11.20	395.10	-101.19	-3568.94	-111.47	-3931.60
OFILA	20.98	4514.10	16.72	3598.73	0.18	38.08	4.55	978.37	-35.77	-7696.08	-40.92	-8805.79
PCBCS (-)	-67.41	-3143.70	-45.27	-2111.34	-0.46	-21.50	-10.68	-497.87	82.66	3854.87	92.88	4331.42
PCBLA (-)	9.10	3220.94	6.60	2338.33	0.06	22.55	1.47	521.20	-12.18	-4313.30	-13.68	-4844.84
PCBDEP	1.93	77.25	5.68	227.00	0.03	1.05	0.58	23.34	-11.47	-458.42	-12.85	-513.42
HCUR	-6.68	-1504.90	7.93	1788.32	-0.05	-10.16	1.96	442.42	9.77	2202.44	4.79	1080.56
HDEP	0.69	467.51	0.51	346.74	0.00	2.80	0.05	33.25	-0.91	-618.03	-0.98	-667.17
HGD	9.80	5971.65	3.17	1931.77	0.07	44.80	0.60	363.33	-12.00	-7308.76	-11.62	-7080.90
HCS	-14.46	-2096.87	-9.75	-1414.63	-0.11	-15.72	-2.16	-313.04	17.85	2588.82	19.87	2881.53
HLA (-)	6.87	2837.39	6.42	2652.19	0.05	21.71	1.27	525.95	-7.59	-3135.57	-9.16	-3786.01
GER	-34.19	-1433.01	-16.99	-711.89	-14.02	-587.40	-11.88	-497.99	8.00	335.34	2.41	101.05
DEP	0.61	544.75	0.64	573.74	0.00	3.86	0.06	56.59	-1.20	-1076.45	-1.31	-1180.58
GGD/GSY%	5.15	4042.30		-1.73	0.76	593.71		-0.40	-1.86	-1461.31		0.63
LR %		-0.46		-1.69		0.00		-0.24		-0.48		-0.06
RS %		44.66		53.68		0.44		8.49		-85.00		-91.45

- % and actual change: mean values of the proportionate and actual changes respectively in holding assets by simulated policy changes for the period of 1969-93.
- CRR 2% reduction increases the mean value of BW by around 1649 Rs. crores during the period of 1969-93.
- GGD for S1 and GSY for S2
- Rs.crore=10 million rupees

Table 9.6b Policy effects (69-93): Original (Rs. Crores for Actual changes)

	4. GSY 2 % reduction		4. OMO 2% purchases		5. Deposit Rate 2% increase				6. Real Devaluation 10%			
	S1		S2		S1		S2		S1		S2	
	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	6.79	284.39	7.25	303.75	-7.13	-298.87	-0.40	-16.63	-8.10	-339.35	-6.62	-277.37
BGD	-10.29	-2118.91	-8.28	-1704.65	-6.16	-1269.39	-4.67	-961.33	-5.72	-1177.02	-3.51	-723.07
BCS	16.46	1376.50	11.36	950.29	16.23	1357.11	10.71	895.75	18.76	1568.28	13.88	1160.98
BLA	1.04	458.00	1.02	450.59	0.48	211.13	0.19	82.20	-0.12	-51.93	-0.36	-160.57
OFIGD	-13.30	-3613.18	-10.64	-2890.67	-11.52	-3128.54	-8.95	-2430.05	-10.43	-2833.23	-7.30	-1982.47
OFICS (-)	73.78	2602.10	50.83	1792.86	74.98	2644.52	50.81	1792.09	86.31	3044.04	64.89	2288.58
OFILA	28.88	6215.30	21.77	4683.54	26.83	5773.09	19.62	4222.16	27.31	5877.30	19.85	4271.07
PCBCS (-)	-72.92	-3400.66	-48.43	-2258.56	-73.69	-3436.33	-50.09	-2336.05	-61.44	-2865.31	-40.49	-1888.07
PCBLA (-)	9.85	3489.32	6.68	2365.23	10.16	3596.78	7.23	2558.46	8.74	3093.14	6.02	2131.69
PCBDEP	2.22	88.67	2.67	106.67	4.02	160.46	5.57	222.42	5.70	227.84	6.10	243.63
HCUR	5.62	1266.59	6.23	1405.06	-15.76	-3552.87	-9.61	-2167.35	-0.08	-18.71	1.69	380.16
HDEP	0.51	348.25	1.77	1198.09	3.08	2092.90	2.89	1962.58	-0.32	-218.25	-0.51	-345.40
HGD	6.14	3744.20	4.97	3025.27	9.84	5996.30	5.56	3390.36	7.15	4358.72	4.44	2704.53
HCS	-15.00	-2175.06	-9.76	-1416.00	-14.82	-2148.91	-9.93	-1439.71	-9.58	-1389.54	-5.24	-760.47
HLA (-)	7.70	3183.98	6.70	2768.91	5.78	2387.44	4.22	1745.89	6.61	2732.23	4.79	1978.81
GER	6.79	284.39	7.25	303.75	-7.13	-298.87	-0.40	-16.63	-8.10	-339.35	-6.62	-277.37
DEP	0.49	436.92	1.45	1304.76	2.50	2253.37	2.43	2185.00	0.01	9.60	-0.11	-101.76
GGD/GSY%	-2.53	-1987.90		-1.33	2.04	1598.37		-0.48	0.44	348.47		0.35
LR %		-1.05		-0.54		0.53		0.13		0.07		0.19
RS %		49.76		28.58		60.57		55.60		66.13		51.25

- % and actual change: mean values of the proportionate and actual changes respectively in holding assets by simulated policy changes for the period of 1969-93.
- OMO 2% purchases increase the mean value of HW by around 1444 Rs. crores during the period of 1969-93.
- GGD for S1 and GSY for S2
- Rs.crore=10 million rupees

Table 9.6c Policy effects (69-93): Original (Rs. Crores for Actual changes)

	7. Nominal GDP 10% up with inflation rate 8%				8. Nominal GDP 10% up with no inflation rate				9. Inflation rate 8%			
	S1		S2		S1		S2		S1		S2	
	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	5.47	229.35	-1.35	-56.64	-0.73	-30.74	-14.44	-605.20	3.24	135.77	5.26	220.46
BGD	5.19	1069.56	8.17	1682.66	3.08	634.68	9.22	1899.43	0.43	88.60	-0.98	-201.91
BCS	-19.14	-1600.13	-21.86	-1827.98	-14.19	-1186.10	-19.80	-1655.51	-3.31	-277.16	-1.37	-114.89
BLA	0.68	301.24	0.46	201.98	1.32	582.15	0.82	361.27	0.12	52.79	0.22	96.34
OFIGD	11.43	3103.80	14.86	4036.76	7.83	2125.44	14.73	4001.65	0.46	125.40	-1.35	-366.57
OFICS (-)	-95.07	-3353.01	-108.06	-3811.12	-60.30	-2126.74	-86.46	-3049.22	-19.69	-694.54	-10.67	-376.30
OFILA	-30.01	-6456.85	-36.47	-7847.93	-19.76	-4252.17	-32.77	-7050.87	-3.81	-819.95	-0.05	-9.74
PCBCS (-)	76.78	3580.82	89.73	4184.47	58.78	2741.07	85.04	3965.99	1.60	74.39	-6.97	-324.94
PCBLA (-)	-10.17	-3600.09	-12.06	-4271.92	-6.95	-2462.38	-10.81	-3827.10	-0.75	-265.13	0.45	157.62
PCBDEP	-0.48	-19.27	-2.19	-87.45	6.97	278.69	3.48	138.88	-4.77	-190.73	-4.19	-167.32
HCUR	10.29	2319.22	4.12	928.55	14.75	3325.84	2.58	580.97	-1.00	-225.75	0.93	209.10
HDEP	-1.07	-724.94	-1.15	-783.44	0.05	37.10	-0.17	-113.64	-0.41	-279.17	-0.39	-261.24
HGD	-9.81	-5977.71	-9.39	-5720.43	-10.46	-6371.01	-9.69	-5902.09	0.57	345.87	0.93	567.48
HCS	12.60	1827.95	15.18	2201.33	12.41	1800.43	17.74	2572.27	-2.37	-343.00	-4.04	-586.36
HLA (-)	-6.18	-2555.51	-8.16	-3374.02	-2.92	-1207.64	-6.93	-2862.50	-1.21	-502.04	-0.17	-71.02
GER	5.47	229.35	-1.35	-56.64	-0.73	-30.74	-14.44	-605.20	3.24	135.77	5.26	220.46
DEP	-0.83	-744.21	-0.97	-870.89	0.35	315.78	0.03	25.24	-0.52	-469.90	-0.48	-428.56
GGD/GSY%	-2.30	-1804.36		1.64	-4.60	-3610.90		10.59	0.71	559.87		0.34
LR %		0.05		0.58		7.34		8.46		1.44		1.14
RS %		-75.36		-83.83		-47.29		-65.56		-8.57		0.58

- % and actual change: mean values of the proportionate and actual changes respectively in holding assets by simulated policy changes for the period of 1969-93.
- GGD for S1 and GSY for S2
- Rs.crore=10 million rupees

Table 9.7a Contractionary vs Expansionary Policy Effects (69-93): Original (Rs. Crores for Actual changes)

Contract	1. CRR: S1		1. CRR: S2		2. Bank rate: S1		2. Bank rate: S2		3. SLR: S1		3. SLR: S2	
	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	32.74	1372.36	21.46	899.25	14.00	586.74	11.89	498.47	-4.36	-182.84	-0.13	-5.50
BGD	-1.43	-293.62	4.14	853.48	-2.76	-567.36	-0.98	-201.47	-6.60	-1358.98	-5.93	-1220.91
BCS	-10.38	-868.10	-16.16	-1351.05	-0.17	-14.56	-2.75	-229.68	23.11	1932.36	19.02	1590.23
BLA	-4.23	-1859.77	-4.66	-2050.81	-0.01	-4.82	-0.15	-67.32	-0.89	-390.56	-0.83	-363.83
OFIGD	0.63	171.14	7.26	1972.39	0.06	15.44	2.28	619.15	-12.74	-3459.94	-10.74	-2918.09
OFICS (-)	-41.13	-1450.65	-68.62	-2420.15	-0.55	-19.41	-12.16	-428.85	78.17	2756.91	60.94	2149.22
OFILA	-7.54	-1621.80	-20.41	-4392.57	-0.16	-34.85	-4.87	-1048.01	28.89	6216.88	23.55	5067.33
PCBCS (-)	33.85	1578.45	60.94	2842.08	0.41	19.10	11.47	535.06	-63.65	-2968.18	-47.18	-2200.03
PCBLA (-)	-4.78	-1691.11	-8.67	-3069.65	-0.06	-20.14	-1.57	-557.28	9.74	3448.08	7.73	2736.66
PCBDEP	-2.82	-112.65	-5.69	-227.56	-0.03	-1.03	-0.56	-22.21	12.01	479.91	13.43	536.63
HCUR	1.66	375.13	-8.81	-1985.45	0.04	9.37	-1.95	-438.57	-9.95	-2243.48	-5.39	-1215.31
HDEP	-0.36	-241.97	-0.49	-334.34	0.00	-2.58	-0.05	-36.65	1.08	733.37	1.01	685.21
HGD	-4.79	-2919.51	-4.64	-2826.88	-0.07	-40.56	-0.69	-418.70	9.90	6031.97	6.79	4137.99
HCS	6.87	995.91	12.22	1772.98	0.10	14.25	2.32	335.89	-14.78	-2143.62	-11.32	-1641.04
HLA (-)	-4.33	-1790.45	-8.16	-3373.73	-0.05	-19.53	-1.35	-558.04	5.75	2378.25	4.76	1966.84
GER	32.74	1372.36	21.46	899.25	14.00	586.74	11.89	498.47	-4.36	-182.84	-0.13	-5.50
DEP	-0.39	-354.62	-0.62	-561.91	0.00	-3.61	-0.07	-58.86	1.35	1213.28	1.36	1221.84
GGD/GSY%	-3.88	-3042.00		1.71	-0.76	-592.48		0.40	1.55	1213.04		-0.52
LR %		0.80		1.91		0.00		0.24		0.73		0.26
RS %		-30.05		-51.32		-0.40		-8.64		90.16		80.46
Expansion	**1. CRR: S1**		**1. CRR: S2**		**2. Bank rate: S1**		**2. Bank rate: S2**		**3. SLR: S1**		**3. SLR: S2**	
	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	-34.19	-1433.01	-16.99	-711.89	-14.02	-587.40	-11.88	-497.99	8.00	335.34	2.41	101.05
BGD	-0.27	-55.51	-0.79	-162.77	2.75	565.55	1.06	218.93	8.35	1720.36	10.71	2205.75
BCS	19.06	1593.41	13.54	1132.01	0.19	15.67	2.51	210.27	-27.54	-2302.88	-29.68	-2481.71
BLA	3.51	1544.24	3.16	1391.79	0.01	6.18	0.16	68.78	0.56	247.21	0.40	174.94
OFIGD	-6.90	-1873.83	-6.52	-1770.00	-0.06	-16.63	-2.15	-583.27	15.20	4127.10	17.95	4874.15
OFICS (-)	74.86	2640.24	51.85	1828.71	0.61	21.45	11.20	395.10	-101.19	-3568.94	-111.47	-3931.60
OFILA	20.98	4514.10	16.72	3598.73	0.18	38.08	4.55	978.37	-35.77	-7696.08	-40.92	-8805.79
PCBCS (-)	-67.41	-3143.70	-45.27	-2111.34	-0.46	-21.50	-10.68	-497.87	82.66	3854.87	92.88	4331.42
PCBLA (-)	9.10	3220.94	6.60	2338.33	0.06	22.55	1.47	521.20	-12.18	-4313.30	-13.68	-4844.84
PCBDEP	1.93	77.25	5.68	227.00	0.03	1.05	0.58	23.34	-11.47	-458.42	-12.85	-513.42
HCUR	-6.68	-1504.90	7.93	1788.32	-0.05	-10.16	1.96	442.42	9.77	2202.44	4.79	1080.56
HDEP	0.69	467.51	0.51	346.74	0.00	2.80	0.05	33.25	-0.91	-618.03	-0.98	-667.17
HGD	9.80	5971.65	3.17	1931.77	0.07	44.80	0.60	363.33	-12.00	-7308.76	-11.62	-7080.90
HCS	-14.46	-2096.87	-9.75	-1414.63	-0.11	-15.72	-2.16	-313.04	17.85	2588.82	19.87	2881.53
HLA (-)	6.87	2837.39	6.42	2652.19	0.05	21.71	1.27	525.95	-7.59	-3135.57	-9.16	-3786.01
GER	-34.19	-1433.01	-16.99	-711.89	-14.02	-587.40	-11.88	-497.99	8.00	335.34	2.41	101.05
DEP	0.61	544.75	0.64	573.74	0.00	3.86	0.06	56.59	-1.20	-1076.45	-1.31	-1180.58
GGD/GSY%	5.15	4042.30		-1.73	0.76	593.71		-0.40	-1.86	-1461.31		0.63
LR %		-0.46		-1.69		0.00		-0.24		-0.48		-0.06
RS %		44.66		53.68		0.44		8.49		-85.00		-91.45

- CRR 2% reduction (increase) increases (reduces) the mean value of BW by around 1649 Rs. crores in the expansionary (contractionary) policy simulation during the period of 1969-93.
- Expansionary policy effects reproducd from Table 9.6. - Rs.crore=10 million rupees

Table 9.7b Contractionary vs Expansionary Policy Effects (69-93): Original (Rs. Crores for Actual changes)

Contract	4. GSY: S1		4. OMO: S2		5. Deposit: S1		5. Deposit: S2		6. Revaluation: S1		6. Revaluation: S2	
	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	-10.71	-449.00	-7.50	-314.20	4.74	198.54	1.10	46.27	5.99	251.03	7.59	318.21
BGD	6.87	1414.40	6.12	1259.30	3.93	809.29	5.73	1179.29	3.40	699.90	2.66	548.48
BCS	-8.64	-722.54	-7.91	-661.50	-11.33	-947.47	-13.19	-1103.10	-15.19	-1270.17	-14.43	-1206.94
BLA	-0.55	-242.85	-0.64	-283.60	-0.14	-60.35	-0.28	-122.44	0.73	319.25	0.77	340.26
OFIGD	8.32	2259.91	7.91	2148.28	8.38	2277.19	10.48	2845.52	8.36	2270.50	7.47	2027.78
OFICS (-)	-39.43	-1390.59	-36.03	-1270.66	-54.04	-1905.79	-62.70	-2211.36	-73.85	-2604.49	-70.21	-2476.15
OFILA	-16.96	-3650.51	-15.89	-3418.94	-19.44	-4183.00	-23.50	-5056.90	-22.66	-4875.02	-20.93	-4503.95
PCBCS (-)	38.11	1777.04	31.74	1480.01	51.73	2412.36	60.26	2810.07	44.12	2057.55	40.61	1893.74
PCBLA (-)	-5.34	-1889.42	-4.47	-1581.40	-7.30	-2584.84	-8.53	-3019.18	-6.55	-2317.95	-6.03	-2136.07
PCBDEP	-2.81	-112.38	-2.54	-101.38	-4.32	-172.47	-5.23	-209.10	-6.52	-260.39	-6.06	-242.32
HCUR	-9.90	-2232.66	-6.77	-1526.21	12.54	2826.65	9.25	2085.73	-4.46	-1004.91	-2.98	-672.16
HDEP	-0.18	-122.71	-1.58	-1069.74	-2.78	-1887.52	-2.83	-1921.86	0.87	590.41	0.88	597.28
HGD	-1.24	-757.55	-3.02	-1839.54	-6.65	-4051.65	-6.61	-4025.81	-4.18	-2546.55	-4.23	-2577.27
HCS	7.65	1108.99	6.00	870.86	10.03	1454.04	11.73	1701.81	4.99	723.23	4.31	624.54
HLA (-)	-4.85	-2003.94	-5.13	-2121.13	-4.01	-1658.51	-5.23	-2160.15	-5.41	-2237.82	-4.91	-2027.62
GER	-10.71	-449.00	-7.50	-314.20	4.74	198.54	1.10	46.27	5.99	251.03	7.59	318.21
DEP	-0.26	-235.09	-1.30	-1171.12	-2.29	-2059.99	-2.37	-2130.97	0.37	330.02	0.39	354.96
GGD/GSY%	3.72	2916.75		1.27	-1.23	-965.18		0.44	0.54	423.85		-0.46
LR %		1.23		0.59		-0.36		-0.08		0.15		-0.15
RS %		-31.99		-23.69		-45.05		-50.58		-59.06		-53.61
Expansion	**4. GSY: S1**		**4. OMO: S2**		**5. Deposit: S1**		**5. Deposit: S2**		**6. Devaluation: S1**		**6. Devaluation: S2**	
	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	6.79	284.39	7.25	303.75	-7.13	-298.87	-0.40	-16.63	-8.10	-339.35	-6.62	-277.37
BGD	-10.29	-2118.91	-8.28	-1704.65	-6.16	-1269.39	-4.67	-961.33	-5.72	-1177.02	-3.51	-723.07
BCS	16.46	1376.50	11.36	950.29	16.23	1357.11	10.71	895.75	18.76	1568.28	13.88	1160.98
BLA	1.04	458.00	1.02	450.59	0.48	211.13	0.19	82.20	-0.12	-51.93	-0.36	-160.57
OFIGD	-13.30	-3613.18	-10.64	-2890.67	-11.52	-3128.54	-8.95	-2430.05	-10.43	-2833.23	-7.30	-1982.47
OFICS (-)	73.78	2602.10	50.83	1792.86	74.98	2644.52	50.81	1792.09	86.31	3044.04	64.89	2288.58
OFILA	28.88	6215.30	21.77	4683.54	26.83	5773.09	19.62	4222.16	27.31	5877.30	19.85	4271.07
PCBCS (-)	-72.92	-3400.66	-48.43	-2258.56	-73.69	-3436.33	-50.09	-2336.05	-61.44	-2865.31	-40.49	-1888.07
PCBLA (-)	9.85	3489.32	6.68	2365.23	10.16	3596.78	7.23	2558.46	8.74	3093.14	6.02	2131.69
PCBDEP	2.22	88.67	2.67	106.67	4.02	160.46	5.57	222.42	5.70	227.84	6.10	243.63
HCUR	5.62	1266.59	6.23	1405.06	-15.76	-3552.87	-9.61	-2167.35	-0.08	-18.71	1.69	380.16
HDEP	0.51	348.25	1.77	1198.09	3.08	2092.90	2.89	1962.58	-0.32	-218.25	-0.51	-345.40
HGD	6.14	3744.20	4.97	3025.27	9.84	5996.30	5.56	3390.36	7.15	4358.72	4.44	2704.53
HCS	-15.00	-2175.06	-9.76	-1416.00	-14.82	-2148.91	-9.93	-1439.71	-9.58	-1389.54	-5.24	-760.47
HLA (-)	7.70	3183.98	6.70	2768.91	5.78	2387.44	4.22	1745.89	6.61	2732.23	4.79	1978.81
GER	6.79	284.39	7.25	303.75	-7.13	-298.87	-0.40	-16.63	-8.10	-339.35	-6.62	-277.37
DEP	0.49	436.92	1.45	1304.76	2.50	2253.37	2.43	2185.00	0.01	9.60	-0.11	-101.76
GGD/GSY%	-2.53	-1987.90		-1.33	2.04	1598.37		-0.48	0.44	348.47		0.35
LR %		-1.05		-0.54		0.53		0.13		0.07		0.19
RS %		49.76		28.58		60.57		55.60		66.13		51.25

- OMO 2% purchases (sales) increase (reduces) the mean value of HW by around 1444 Rs. crores in the expansionary (contractionary) policy simulation during the period of 1969-93.
- Expansionary policy effects reproducd from Table 9.6.
- Rs.crore=10 million rupees

Appendix 9.1: SE-adjusted behavioural equations

Standard error (SE) of the CS equation (from Table 9.3):

Banking sector	0.0083
PCB sector	0.0392
OFIs sector	0.0399
Household sector	0.0106

Banking sector	$\ln p_1^{\tau}$ (PER)	$\ln p_2^{\tau}$ (PGD)	$\ln p_3^{\tau}$ (PCS)	$\ln p_4^{\tau}$ (PLA)
1. ER				
2. GD			0.0083 + SE	
3. CS		0.0083+SE	-0.0245 – SEx2	0.0131 +SE
4. LA			0.0131 + SE	

PCB Sector	$\ln p_1^{\tau}$ (PCS)	$\ln p_2^{\tau}$ (PLA)	$\ln p_3^{\tau}$ (PDEP)
1. CS (-)	- 0.1239 – SEx2	1.3074 + SE	-1.5956 + SE
2. LA (-)	0.1239 + SEx2		
3.DEP			

OFI sector	$\ln p_1^{\tau}$ (PGD)	$\ln p_2^{\tau}$ (PCS)	$\ln p_3^{\tau}$ (PLA)
1. GD		0.0772 –SE	
2. CS (-)	0.0772 –SE	0.0862 + SEx2	-0.1634 –SE
3. LA		-0.1634–SE	

House-hold sector	$\ln p_1^{\tau}$ (PCUR)	$\ln p_2^{\tau}$ (PDEP)	$\ln p_3^{\tau}$ (PGD)	$\ln p_4^{\tau}$ (PCS)	$\ln p_5^{\tau}$ (PLA)
1. CUR					
2. DEP					
3. GD				-0.0573–SE	
4. CS			-0.0573–SE	0.0203 + SEx2	0.0304–SE
5. LA (-)				0.0304 –SE	

- SE adjusted behavioural equations are derived by adding or deducting 2SE to the own-price coefficients in the CS equation and also adding or deducting SE to the surrounding cross price coefficients. Other price coefficients remain unchanged. But in this case, the adding-up constraint fails in other prices by the equivalent of SE, e.g. in the household sector the adding-up fails in PGD and also in PLA by SE (i.e. 0.0106). Restoring the adding-up by further adjusting other price coefficients leads to empirically poor results as it involves the changes in the significant coefficients. Hence, though the SE adjusted equations contribute to obtaining less volatile PCS than the original set of equations, they can be no more than the supplements.

Appendix 9.2 Mean base run (the actual mean values) for the period 1969-93 in the holdings of financial assets and market solutions

Rs. Crores

Financial assets and real interest rates	Mean base run
BER	4192.14
BGD	20596.22
BCS	8357.85
BLA	43995.12
OFIGD	27167.18
OFICS (-)	3519.74
OFILA	21504.08
PCBCS(-)	4671.13
PCBLA(-)	35400.46
PCBDEP	3995.73
HCUR	22535.13
HDEP	67860.08
HGD	60919.46
HCS	14507.20
HLA (-)	41324.25
GER	4192.14
DEP	89981.44
GGD	78452.05
GSY %	-1.27
LR %	4.03
RS %	1.03

(-) liabilities
GSY: Real government securities yields, LR: Real lending rate and RS: Real return on shares
Rs.crore=10 million rupees

Appendix 9.3a Policy effects (69-93): Perfect Solution

(Rs. Crores for Actual changes)

	1. CRR 2% reduction				2. Bank Rate 2% reduction				3. SLR 2% reduction			
	S1		S2		S1		S2		S1		S2	
Original	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	-34.19	-1433.01	-16.99	-711.89	-14.02	-587.40	-11.88	-497.99	8.00	335.34	2.41	101.05
BGD	-0.27	-55.51	-0.79	-162.77	2.75	565.55	1.06	218.93	8.35	1720.36	10.71	2205.75
BCS	19.06	1593.41	13.54	1132.01	0.19	15.67	2.51	210.27	-27.54	-2302.88	-29.68	-2481.71
BLA	3.51	1544.24	3.16	1391.79	0.01	6.18	0.16	68.78	0.56	247.21	0.40	174.94
OFIGD	-6.90	-1873.83	-6.52	-1770.00	-0.06	-16.63	-2.15	-583.27	15.20	4127.10	17.95	4874.15
OFICS (-)	74.86	2640.24	51.85	1828.71	0.61	21.45	11.20	395.10	-101.19	-3568.94	-111.47	-3931.60
OFILA	20.98	4514.10	16.72	3598.73	0.18	38.08	4.55	978.37	-35.77	-7696.08	-40.92	-8805.79
PCBCS (-)	-67.41	-3143.70	-45.27	-2111.34	-0.46	-21.50	-10.68	-497.87	82.66	3854.87	92.88	4331.42
PCBLA (-)	9.10	3220.94	6.60	2338.33	0.06	22.55	1.47	521.20	-12.18	-4313.30	-13.68	-4844.84
PCBDEP	1.93	77.25	5.68	227.00	0.03	1.05	0.58	23.34	-11.47	-458.42	-12.85	-513.42
HCUR	-6.68	-1504.90	7.93	1788.32	-0.05	-10.16	1.96	442.42	9.77	2202.44	4.79	1080.56
HDEP	0.69	467.51	0.51	346.74	0.00	2.80	0.05	33.25	-0.91	-618.03	-0.98	-667.17
HGD	9.80	5971.65	3.17	1931.77	0.07	44.80	0.60	363.33	-12.00	-7308.76	-11.62	-7080.90
HCS	-14.46	-2096.87	-9.75	-1414.63	-0.11	-15.72	-2.16	-313.04	17.85	2588.82	19.87	2881.53
HLA (-)	6.87	2837.39	6.42	2652.19	0.05	21.71	1.27	525.95	-7.59	-3135.57	-9.16	-3786.01
GER	-34.19	-1433.01	-16.99	-711.89	-14.02	-587.40	-11.88	-497.99	8.00	335.34	2.41	101.05
DEP	0.61	544.75	0.64	573.74	0.00	3.86	0.06	56.59	-1.20	-1076.45	-1.31	-1180.58
GGD/GSY%	5.15	4042.30		-1.73	0.76	593.71		-0.40	-1.86	-1461.31		0.63
LR %		-0.46		-1.69		0.00		-0.24		-0.48		-0.06
RS %		44.66		53.68		0.44		8.49		-85.00		-91.45
SE adj	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	-27.96	-1171.81	-17.09	-716.43	-13.96	-585.05	-11.68	-489.56	4.12	172.53	0.66	27.87
BGD	4.05	833.42	-8.82	-1816.02	2.78	572.16	1.62	333.23	7.65	1574.35	9.03	1859.37
BCS	8.72	729.02	28.65	2395.46	0.10	8.17	1.35	112.64	-23.62	-1975.32	-24.76	-2070.11
BLA	2.87	1261.58	4.11	1808.82	0.01	4.73	0.11	47.34	0.53	232.85	0.41	181.93
OFIGD	1.75	474.90	-6.69	-1815.70	0.02	6.49	-0.83	-225.90	6.17	1676.41	7.27	1974.92
OFICS (-)	34.43	1214.35	136.73	4822.46	0.27	9.68	6.82	240.47	-93.72	-3305.30	-99.86	-3521.82
OFILA	3.40	731.06	30.56	6575.27	0.01	3.17	2.12	456.11	-23.21	-4994.32	-25.53	-5494.12
PCBCS (-)	-28.81	-1343.74	-134.66	-6279.79	-0.18	-8.29	-6.88	-321.01	80.95	3775.10	87.41	4076.19
PCBLA (-)	3.82	1352.75	17.23	6101.31	0.02	8.52	0.91	320.46	-11.37	-4025.18	-12.25	-4336.29
PCBDEP	0.39	15.61	-4.09	-163.26	0.01	0.26	0.06	2.36	-6.01	-240.05	-6.37	-254.67
HCUR	-0.28	-63.67	10.67	2404.71	0.00	0.94	2.13	480.64	5.57	1254.69	2.40	540.63
HDEP	0.12	84.44	0.08	54.04	0.00	0.08	-0.01	-3.60	-0.44	-299.56	-0.45	-303.82
HGD	2.41	1471.42	5.96	3630.71	0.01	5.12	-0.18	-108.34	-6.80	-4145.84	-6.29	-3835.30
HCS	-5.92	-858.41	-26.57	-3852.79	-0.05	-6.77	-1.33	-193.18	16.86	2445.12	18.10	2624.48
HLA (-)	1.55	639.89	5.52	2282.78	0.00	-0.63	0.44	182.99	-1.78	-736.30	-2.36	-975.91
GER	-27.96	-1171.81	-17.09	-716.43	-13.96	-585.05	-11.68	-489.56	4.12	172.53	0.66	27.87
DEP	0.11	100.05	-0.12	-109.22	0.00	0.34	0.00	-1.24	-0.60	-539.62	-0.62	-558.49
GGD/GSY%	3.54	2779.73		-1.84	0.74	583.77		-0.35	-1.14	-895.10		0.40
LR %		-0.59		-1.43		0.00		-0.21		-0.61		-0.35
RS %		14.65		41.31		0.10		2.83		-43.50		-45.56

- % and actual change: mean values of the proportionate and actual changes respectively in holding assets by simulated policy changes for the period of 1969-93.
- CRR 2% reduction increases the mean value of BW by around 1649 Rs. crores during the period of 1969-93.
- GGD for S1 and GSY for S2
- Rs.crore=10 million rupees

Appendix 9.3b Policy effects (69-93): Perfect Solution

(Rs. Crores for Actual changes)

	4. GSY 2 % reduction		4. OMO 2% purchases		5. Deposit Rate 2% increase				6. Real Devaluation 10%			
	S1		S2		S1		S2		S1		S2	
Original	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	6.79	284.39	7.25	303.75	-7.13	-298.87	-0.40	-16.63	-8.10	-339.35	-6.62	-277.37
BGD	-10.29	-2118.91	-8.28	-1704.65	-6.16	-1269.39	-4.67	-961.33	-5.72	-1177.02	-3.51	-723.07
BCS	16.46	1376.50	11.36	950.29	16.23	1357.11	10.71	895.75	18.76	1568.28	13.88	1160.98
BLA	1.04	458.00	1.02	450.59	0.48	211.13	0.19	82.20	-0.12	-51.93	-0.36	-160.57
OFIGD	-13.30	-3613.18	-10.64	-2890.67	-11.52	-3128.54	-8.95	-2430.05	-10.43	-2833.23	-7.30	-1982.47
OFICS (-)	73.78	2602.10	50.83	1792.86	74.98	2644.52	50.81	1792.09	86.31	3044.04	64.89	2288.58
OFILA	28.88	6215.30	21.77	4683.54	26.83	5773.09	19.62	4222.16	27.31	5877.30	19.85	4271.07
PCBCS (-)	-72.92	-3400.66	-48.43	-2258.56	-73.69	-3436.33	-50.09	-2336.05	-61.44	-2865.31	-40.49	-1888.07
PCBLA (-)	9.85	3489.32	6.68	2365.23	10.16	3596.78	7.23	2558.46	8.74	3093.14	6.02	2131.69
PCBDEP	2.22	88.67	2.67	106.67	4.02	160.46	5.57	222.42	5.70	227.84	6.10	243.63
HCUR	5.62	1266.59	6.23	1405.06	-15.76	-3552.87	-9.61	-2167.35	-0.08	-18.71	1.69	380.16
HDEP	0.51	348.25	1.77	1198.09	3.08	2092.90	2.89	1962.58	-0.32	-218.25	-0.51	-345.40
HGD	6.14	3744.20	4.97	3025.27	9.84	5996.30	5.56	3390.36	7.15	4358.72	4.44	2704.53
HCS	-15.00	-2175.06	-9.76	-1416.00	-14.82	-2148.91	-9.93	-1439.71	-9.58	-1389.54	-5.24	-760.47
HLA (-)	7.70	3183.98	6.70	2768.91	5.78	2387.44	4.22	1745.89	6.61	2732.23	4.79	1978.81
GER	6.79	284.39	7.25	303.75	-7.13	-298.87	-0.40	-16.63	-8.10	-339.35	-6.62	-277.37
DEP	0.49	436.92	1.45	1304.76	2.50	2253.37	2.43	2185.00	0.01	9.60	-0.11	-101.76
GGD/GSY%	-2.53	-1987.90		-1.33	2.04	1598.37		-0.48	0.44	348.47		0.35
LR %		-1.05		-0.54		0.53		0.13		0.07		0.19
RS %		49.76		28.58		60.57		55.60		66.13		51.25
SE adj	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	12.18	510.65	7.93	332.16	-3.72	-155.80	-0.04	-1.50	-3.95	-165.68	-5.73	-240.21
BGD	-6.78	-1396.29	-5.06	-1041.38	-4.96	-1020.94	-12.33	-2540.01	-4.00	-824.61	-2.57	-529.59
BCS	7.80	651.79	5.46	456.18	12.65	1057.86	24.91	2082.50	14.21	1188.25	12.20	1020.26
BLA	0.58	253.48	0.60	264.91	0.26	114.58	1.05	462.00	-0.45	-199.35	-0.58	-254.89
OFIGD	-4.92	-1335.78	-4.13	-1122.02	-4.29	-1163.93	-9.17	-2489.67	-2.09	-566.77	-1.13	-307.97
OFICS (-)	40.81	1439.20	28.61	1009.17	67.78	2390.65	132.72	4680.82	76.55	2699.97	66.35	2340.19
OFILA	12.64	2719.51	9.75	2097.47	16.58	3566.88	33.28	7161.80	15.20	3270.74	12.36	2660.70
PCBCS (-)	-41.82	-1950.10	-26.84	-1251.66	-68.65	-3201.63	-137.48	-6411.54	-53.83	-2510.57	-43.51	-2029.27
PCBLA (-)	5.45	1928.78	3.53	1249.89	9.08	3214.40	17.73	6276.24	7.19	2545.40	5.87	2079.22
PCBDEP	-0.15	-6.07	0.15	5.91	-0.63	-25.22	-4.33	-172.99	0.79	31.72	1.12	44.77
HCUR	11.58	2609.48	7.60	1713.09	-11.00	-2480.64	-7.02	-1583.05	5.83	1314.63	4.08	920.09
HDEP	-0.04	-26.11	1.36	923.21	2.50	1697.61	2.52	1708.68	-1.05	-715.18	-1.05	-711.48
HGD	-0.68	-417.07	0.97	593.35	5.13	3127.98	8.25	5028.66	1.52	928.35	1.37	836.55
HCS	-8.02	-1162.68	-4.82	-698.67	-12.89	-1868.84	-26.29	-3813.21	-6.89	-998.85	-4.89	-709.35
HLA (-)	2.53	1044.21	2.69	1112.49	1.13	467.06	3.26	1347.56	1.27	525.99	0.79	326.59
GER	12.18	510.65	7.93	332.16	-3.72	-155.80	-0.04	-1.50	-3.95	-165.68	-5.73	-240.21
DEP	-0.04	-32.18	1.03	929.12	1.86	1672.40	1.71	1535.69	-0.76	-683.46	-0.74	-666.71
GGD/GSY%	-4.01	-3149.15		-1.15	1.20	943.09		-0.58	-0.59	-463.03		0.46
LR %		-1.15		-0.49		0.56		0.39		0.07		0.32
RS %		17.09		9.66		29.48		41.44		32.36		27.28

- % and actual change: mean values of the proportionate and actual changes respectively in holding assets by simulated policy changes for the period of 1969-93.
- OMO 2% purchases increase the mean value of HW by around 1444 Rs. crores during the period of 1969-93.
- GGD for S1 and GSY for S2
- Rs.crore=10 million rupees

Appendix 9.3c Policy effects (69-93): Perfect Solution

(Rs. Crores for Actual changes)

	7. Nominal GDP 10% up with inflation rate 8%				8. Nominal GDP 10% up with no inflation rate				9. Inflation rate 8%			
	S1		S2		S1		S2		S1		S2	
Original	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	5.47	229.35	-1.35	-56.64	-0.73	-30.74	-14.44	-605.20	3.24	135.77	5.26	220.46
BGD	5.19	1069.56	8.17	1682.66	3.08	634.68	9.22	1899.43	0.43	88.60	-0.98	-201.91
BCS	-19.14	-1600.13	-21.86	-1827.98	-14.19	-1186.10	-19.80	-1655.51	-3.31	-277.16	-1.37	-114.89
BLA	0.68	301.24	0.46	201.98	1.32	582.15	0.82	361.27	0.12	52.79	0.22	96.34
OFIGD	11.43	3103.80	14.86	4036.76	7.83	2125.44	14.73	4001.65	0.46	125.40	-1.35	-366.57
OFICS (-)	-95.07	-3353.01	-108.06	-3811.12	-60.30	-2126.74	-86.46	-3049.22	-19.69	-694.54	-10.67	-376.30
OFILA	-30.01	-6456.85	-36.47	-7847.93	-19.76	-4252.17	-32.77	-7050.87	-3.81	-819.95	-0.05	-9.74
PCBCS (-)	76.78	3580.82	89.73	4184.47	58.78	2741.07	85.04	3965.99	1.60	74.39	-6.97	-324.94
PCBLA (-)	-10.17	-3600.09	-12.06	-4271.92	-6.95	-2462.38	-10.81	-3827.10	-0.75	-265.13	0.45	157.62
PCBDEP	-0.48	-19.27	-2.19	-87.45	6.97	278.69	3.48	138.88	-4.77	-190.73	-4.19	-167.32
HCUR	10.29	2319.22	4.12	928.55	14.75	3325.84	2.58	580.97	-1.00	-225.75	0.93	209.10
HDEP	-1.07	-724.94	-1.15	-783.44	0.05	37.10	-0.17	-113.64	-0.41	-279.17	-0.39	-261.24
HGD	-9.81	-5977.71	-9.39	-5720.43	-10.46	-6371.01	-9.69	-5902.09	0.57	345.87	0.93	567.48
HCS	12.60	1827.95	15.18	2201.33	12.41	1800.43	17.74	2572.27	-2.37	-343.00	-4.04	-586.36
HLA (-)	-6.18	-2555.51	-8.16	-3374.02	-2.92	-1207.64	-6.93	-2862.50	-1.21	-502.04	-0.17	-71.02
GER	5.47	229.35	-1.35	-56.64	-0.73	-30.74	-14.44	-605.20	3.24	135.77	5.26	220.46
DEP	-0.83	-744.21	-0.97	-870.89	0.35	315.78	0.03	25.24	-0.52	-469.90	-0.48	-428.56
GGD/GSY%	-2.30	-1804.36		1.64	-4.60	-3610.90		10.59	0.71	559.87		0.34
LR %		0.05		0.58		7.34		8.46		1.44		1.14
RS %		-75.36		-83.83		-47.29		-65.56		-8.57		0.58
SE adj	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	1.76	73.67	-3.03	-126.82	-3.84	-160.96	-15.22	-637.76	2.35	98.57	5.25	220.12
BGD	4.37	899.18	6.33	1303.35	1.84	378.61	6.59	1356.16	-0.06	-13.14	-1.47	-303.33
BCS	-15.40	-1288.07	-17.03	-1424.11	-10.96	-916.05	-14.94	-1249.60	-1.95	-162.98	-0.47	-39.39
BLA	0.69	305.28	0.52	230.21	1.35	592.70	0.93	407.87	0.13	57.98	0.24	107.65
OFIGD	3.33	903.85	4.87	1322.62	2.31	628.72	5.98	1624.21	-0.94	-254.21	-2.01	-545.05
OFICS (-)	-87.58	-3088.89	-96.35	-3398.31	-53.43	-1884.30	-74.67	-2633.40	-14.81	-522.20	-6.96	-245.46
OFILA	-18.42	-3964.49	-21.71	-4671.47	-10.29	-2213.93	-18.16	-3908.29	-0.99	-212.40	1.59	342.14
PCBCS (-)	74.54	3476.05	83.79	3907.71	55.47	2587.00	77.93	3634.47	-2.36	-109.97	-10.38	-483.86
PCBLA (-)	-9.25	-3275.87	-10.51	-3720.67	-5.46	-1931.96	-8.50	-3010.10	-0.05	-18.62	1.01	357.14
PCBDEP	4.45	178.00	3.97	158.49	10.48	418.60	9.33	372.95	-4.31	-172.35	-4.17	-166.69
HCUR	6.49	1462.61	2.04	460.01	11.50	2592.49	1.04	235.04	-1.76	-396.14	0.95	214.32
HDEP	-0.66	-445.83	-0.66	-449.37	0.42	283.18	0.39	262.76	-0.35	-240.80	-0.36	-246.44
HGD	-5.01	-3053.24	-4.31	-2626.98	-6.50	-3963.32	-4.89	-2981.38	1.66	1012.49	1.39	847.36
HCS	11.55	1675.22	13.33	1933.51	11.16	1618.75	15.52	2250.67	-3.24	-469.19	-4.76	-689.92
HLA (-)	-0.93	-383.33	-1.74	-720.59	0.75	310.73	-1.19	-490.32	-0.33	-135.80	0.22	92.65
GER	1.76	73.67	-3.03	-126.82	-3.84	-160.96	-15.22	-637.76	2.35	98.57	5.25	220.12
DEP	-0.30	-267.84	-0.32	-290.88	0.78	701.78	0.71	635.71	-0.46	-413.15	-0.46	-413.13
GGD/GSY%	-1.59	-1250.21		1.41	-3.77	-2955.99		10.26	0.95	745.13		0.32
LR %		-0.06		0.30		7.31		8.17		1.45		1.14
RS %		-37.96		-41.00		-19.17		-26.70		-2.72		1.17

% and actual change: mean values of the proportionate and actual changes respectively in holding assets by simulated policy changes for the period of 1969-93.
Rs.crore=10 million rupees

Chapter 10 Simulation Experiments by Endogenising the Deposit Rate (PDEP Endogenous Model)

10.1 Introduction

This chapter is inspired by the 'financial repressionist' view of McKinnon (1973) and Shaw (1973). They assert that interest rate ceilings in developing countries have caused destabilizing portfolio shifts from financial to tangible assets when inflation accelerates, and consequently such a reaction magnifies the initial inflationary shock. Therefore the real deposit rates of interest are often negative. The McKinnon-Shaw school considers that low real interest rates are major impediments to financial deepening, capital formation and economic growth. This may well be the case for India since the mean real deposit rate is negative being −1.45% over the period 1969-93. See in Appendix 10.1 (in which the mean of the other real interest rates are also presented as they are useful later). Further the simulation of removing the deposit rate ceiling (i.e. an increase in the deposit rate) in Chapter 9 reveals that private saving and the flow of loanable funds are sensitive to changes in the real deposit rate which is supportive of the financial repressionist view.

McKinnon (1988) illustrates that positive real interest rates are closely related to real financial growth leading to higher real economic growth in less developed countries, and, according to the McKinnon-Shaw school, the growth-maximizing deposit rate of interest is the competitive free-market equilibrium rate, since the competitive rate is likely to be raised, thus increasing the supply of credit.

This chapter is designed to investigate further the idea of the McKinnon-Shaw school by liberalising the deposit rate. In Chapter 9, the removal of the deposit rate ceiling was modelled by an exogenous rise in the deposit rate. In this chapter we consider instead an institutional removal of the deposit rate ceiling: the deposit rate is fully liberated within simulations and that banks are permitted to adjust *pari-passu* with changes in the key market interest rates. This is based on the argument that any market-determined change in the rates on bank assets would create premiums on interest rates on the liability side in the banking sector, i.e. on deposit rates. As lending rates rise, banks may wish to raise deposit rates above their 'ceilings' in order to attract funds to lend to the private sector.

In the general equilibrium system, lending rates are determined in the loan market, and liberated deposit rates are hypothesized to be determined by the banking sector. We then analyse how our proposed simulation experiments affect the flow of funds and the endogenous interest rates comparing exogenous deposit rates with endogenous deposit rates. In the former, bank profits passively change as market-determined lending rates change, whereas in the latter, since banks actively manage deposit rates to encourage or discourage deposit flows as loan rates change, the profits can be influenced.

The model covered in this chapter is termed as 'PDEP endogenous model' as the price of deposit (PDEP) enters in simulation as an endogenous variable, whereas the model covered in the previous chapter is termed as 'PDEP exogenous model'.

This chapter is structured in the following manner. In Section 10.2, PDEP is estimated by OLS and the results are presented. In Section 10.3, historical simulations are presented and evaluated, incorporating the deposit rate equation. Simulation experiments are implemented with the perfect tracking solution technique based on the original share equations[1], and the results are analysed comparing the PDEP exogenous model and PDEP endogenous model in Section 10.4. We will examine the effect of credit rationing and financial reforms on the endogenous interest rates in Section 10.5. We then conclude the impact of simulated liberalisation in deposit rates in the Indian financial sector, hence in the economy as a whole in Section 10.6. The notation in this chapter is that of Table 9.1, in Chapter 9.

10.2 Econometric Estimation and Result of the PDEP Equation

The price of deposits (PDEP) was regressed on the price of loans and advances (PLA) and SLR using the same data series for the period 1951-93 as for the behavioural

[1] Likewise Chapter 9, simulations with the SE-adjusted share equations are also conducted together with Original. The direction of the policy effects is almost the same between them, providing some robustness in Original. We do not, however, present the SE-adjusted results here because of space constraint.

equations. Table 10.1 shows the estimation results by OLS[2]. The PDEP equation indicates the statistically significant coefficients of PLA and SLR. Functional form, normality and homoscedasticity are all satisfactory as indicated in the lower part of the table. The chow test conducted by dividing the period into 1951-68 and 1969-93 satisfies the parameter stability (F-test statistics = 0.851463 [Prob. 0.475]).

This equation, however, suffers from serial correlation, therefore the Cochrane-Orcutt method is employed to take account of autocorrelated errors[3]. The error terms are generated as given by (in the case of first order autoregressive process),

$$u_t = \rho u_{t-1} + \varepsilon_t \qquad (10.1)$$

where ε_t is a white noise. The estimation is often called the quasi-difference transformed, such that

$$PDEP_t - \rho PDEP_{t-1} = \alpha(1-\rho) + \beta_0(PLA_t - \rho PLA_{t-1}) + \beta_1(SLR_t - \rho SLR_{t-1}) + \varepsilon_t \qquad (10.2)$$

ρ is estimated by iterative procedures. The results are shown in Table 10.2. $\hat{\rho} = 0.64$ has a t-ratio of 4.92 and so clearly it is significantly positive. Given the DW-statistic of 2.08, autocorrelation has been eradicated from the residuals with the first order error process. As compared with the OLS estimates, the coefficient estimate of the constant

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[2] We have regressed an I(0) variable of PDEP on I(1) variables of PLA and SLR. In this case residuals should resemble the properties of the regressand, i.e. stationary (Dorado, Gonzalo and Marmol, 2001). Indeed, we have found the stationarity of residuals: the Engle-Granger cointegration test statistic is 6.33.

[3] Dealing with autocorrelation might be to include lagged dependent and (or) independent variables as additional regressors. However, the inclusion of lagged variables did not solve the problems in the current study. Alternatively the model may be re-specified, yet the inclusion of potential explanatory variables, CRR and dummy variables did not fit the data well. Further another approach is the first-difference method. This can be specified by the first-difference transformation of the variables in the equation. This is quite a popular methodology. However, this transformation rests on the strong assumption that the disturbances are perfectly positively correlation: if we assume that the error term (u_t) follows the first-order autoregressive process in equation (10.1) above, this approach implies that ρ =1. Therefore, Cochrane-Orcutt methodology is utilised to deal with autocorrelation problems. This method uses the estimated residuals $\hat{u}_t$ to obtain information about the unknown ρ.

term is now statistically significant. There is also improvement of R-bar-squared and the standard error of regression.

Table 10.1 PDEP Equation by OLS

43 observations from 1951-52 to 1993-94

$$PDEP_t = -0.0315 + 0.9822\ PLA_t + 0.0030\ SLR_t$$

(t-ratio) (-1.17) (39.59) (12.55)

R-Squared = 0.975, R-Bar-Squared = 0.974,
S.E.of Regression = 0.0107, DW-statistic = 0.832

Diagnostic Tests	test statistics [Prob]
LM Serial Correlation	CHSQ(1)= 15.313 [.000]
LM Heteroscedasticity	CHSQ(1)= 0.000 [.998]
Ramsey's RESET test	CHSQ(1)= 0.439 [.508]
Normality	CHSQ(2)= 0.271 [.873]

Table 10.2 PDEP Equation by Cochrane-Orcutt Method AR(1)

43 observations from 1951-52 to 1993-94

$$PDEP_t - \rho PDEP_{t-1} = -0.056(1-\rho) + 1.011(PLA_t - \rho PLA_{t-1}) + 0.0029(SLR_t - \rho SLR_{t-1}) + \varepsilon_t$$

(t-ratio) (-2.20) (50.37) (5.56)

$$u_t = 0.642 u_{t-1} + \varepsilon_t$$

(t-ratio) (4.920)

R-Squared = 0.984, R-Bar-Squared = 0.983,
S.E. of Regression = 0.0087, DW-statistic = 2.082

The estimates derived from the Cochrane-Orcutt method are statistically and economically significant. With the coefficient of PLA, 1.01, it is not significantly different from unitary relationship between PDEP and PLA. With respect to SLR, an increase in the ratio leads to an increase in PDEP or a fall in deposit rates. This can be shown in more sophisticated way: Given a unitary relationship in Table 10.2, we have $(PDEP_t - \rho PDEP_{t-1}) - (PLA - \rho PLA_{t-1}) = -0.056(1-\rho) + 0.0029(SLR_t - \rho SLR_{t-1})$. Since the AIDS prices are the inverse of the real interest rate, it can be re-formulated as given: $(LR_t - \rho LR_{t-1}) - (DR - \rho DR_{t-1}) = -0.056(1-\rho) + 0.0029(SLR_t - \rho SLR_{t-1})$. This implies that a loan-deposit rates (LR-DR) margin varies directly with SLR. This is rational behaviour: As SLR increases, banks have to subscribe to more government securities and government approved securities at a lower rate than the market rate, and this adversely affects their profitability. Consequently, the margin increases.

(Note that this is an ad-hoc way of endogenising PDEP and not based on a theory of bank behaviour: it aims to mimic likely movements over time in loan-deposit margin to assure profitability of competitive banking system.)

10.3 Historical Simulation and the Evaluation

With the same methodology as in the previous chapter, historical simulation is conducted by augmenting the system-wide model with the PDEP equation[4]. The tracking performance of the share of holding of financial assets, market solutions and PDEP is presented in the following tables:

Table 10.3a	S1 (GGD endogenous)
	10.3b	S2 (PGD endogenous)
Table 10.4	Market solutions and PDEP

In the government debt market, government debt (GGD) is endogenous in Simulation 1 (S1), and the price of government debt (PGD) is endogenous in Simulation 2 (S2).

When the results of PDEP endogenous model are compared with those of PDEP exogenous model, *Uv* (variance) of S2 for OFIGD and OFILA have substantially fallen. Other than that generally the results of PDEP endogenous model are broadly similar to those of PDEP exogenous model.

In the market solutions, given PDEP being endogenous, DEP's RMS error has worsened. However, PDEP endogenous model outperforms PDEP exogenous model in solving PCS, in particular in S2, the Theil's *U* falling from 0.31 (in Table 9.4e,

[4] Given $\rho = 0.64$ in the deposit rate equation, this implies the inclusion of the dynamic element in the system-wide model.

Chapter 9) to 0.24 (in Table 10.4). The tracking performance of PGD and PLA is as good as that in PDEP exogenous model, and the historical simulation of PDEP also performs well.

These results imply that by endogenising the PDEP, the tracking performance is no worse than that of the PDEP exogenous model.

Table 10.3a Tracking Performance for the share of the financial assets in static simulations: S1 (PDEP endogenous)

Variables	RMS error	RMS error % of mean	RMS error % of S.D.	Mean Error	Theil's *U*	*Um*	*Uv*	*Uc*
BER	0.0125	39.99	43.76	-0.0002	0.1533	0.0002	0.1225	0.8744
BGD	0.0333	12.89	82.32	-0.0009	0.0637	0.0007	0.0230	0.9763
BCS	0.0132	18.71	40.85	0.0015	0.0851	0.0125	0.0835	0.9040
BLA	0.0349	5.45	59.36	-0.0004	0.0272	0.0001	0.1482	0.8517
PCBCS	0.0677	18.79	26.65	-0.0061	0.0763	0.0081	0.0132	0.9787
PCBLA	0.0741	9.94	30.83	0.0067	0.0475	0.0083	0.0163	0.9754
PCBDEP	0.0165	15.66	52.41	-0.0006	0.0754	0.0015	0.0035	0.9950
OFIGD	0.0649	9.93	100.49	-0.0077	0.0490	0.0139	0.2313	0.7547
OFICS	0.0491	86.09	71.69	-0.0057	0.3517	0.0134	0.0060	0.9806
OFILA	0.1023	29.65	94.61	0.0133	0.1415	0.0170	0.1392	0.8438
HCUR	0.0390	11.41	27.50	-0.0015	0.0526	0.0015	0.0025	0.9961
HDEP	0.0350	8.47	32.47	0.0007	0.0369	0.0004	0.0020	0.9976
HGD	0.0497	10.24	111.76	0.0038	0.0512	0.0058	0.0012	0.9931
HCS	0.0166	17.39	68.82	-0.0014	0.0839	0.0067	0.0028	0.9906
HLA	0.0195	5.09	51.37	-0.0017	0.0254	0.0072	0.0007	0.9921

Table 10.3b Tracking Performance for the share of the financial assets in static simulations: S2 (PDEP endogenous)

Variables	RMS error	RMS error % of mean	RMS error % of S.D.	Mean Error	Theil's *U*	*Um*	*Uv*	*Uc*
BER	0.0097	31.03	33.95	-0.0001	0.1152	0.0001	0.0000	0.9998
BGD	0.0394	15.25	97.41	-0.0008	0.0753	0.0004	0.0004	0.9992
BCS	0.0131	18.64	40.69	0.0012	0.0847	0.0088	0.0720	0.9192
BLA	0.0371	5.79	63.07	-0.0004	0.0289	0.0001	0.1355	0.8644
PCBCS	0.0662	18.37	26.05	-0.0054	0.0746	0.0066	0.0140	0.9793
PCBLA	0.0726	9.75	30.24	0.0059	0.0465	0.0065	0.0164	0.9771
PCBDEP	0.0166	15.75	52.73	-0.0005	0.0758	0.0008	0.0072	0.9921
OFIGD	0.0649	9.93	100.46	-0.0065	0.0490	0.0099	0.3144	0.6756
OFICS	0.0484	84.85	70.66	-0.0048	0.3506	0.0099	0.0023	0.9879
OFILA	0.1007	29.19	93.14	0.0113	0.1387	0.0125	0.1629	0.8246
HCUR	0.0424	12.42	29.93	-0.0007	0.0573	0.0003	0.0114	0.9883
HDEP	0.0408	8.86	33.97	0.0004	0.0429	0.0001	0.0019	0.9980
HGD	0.0362	7.47	81.47	0.0027	0.0373	0.0056	0.0001	0.9942
HCS	0.0165	17.27	68.37	-0.0011	0.0835	0.0046	0.0041	0.9914
HLA	0.0205	5.36	54.08	-0.0015	0.0267	0.0053	0.0001	0.9946

Table10.4 Tracking Performance for the share of the market solutions and PDEP in static simulations: (PDEP endogenous)

Variables	RMS error	RMS error % of mean	RMS error % of S.D.	Mean Error	Theil's *U*	*Um*	*Uv*	*Uc*
S1:								
GER	1623.25	66.43	40.29	-9.6972	0.1768	0.0000	0.0136	0.9863
GGD	2794.93	5.99	3.58	96.9262	0.0156	0.0012	0.0820	0.9168
DEP	6465.00	12.14	7.37	681.6761	0.0314	0.0111	0.1724	0.8165
PCS	0.5669	55.90	358.01	-0.0614	0.2529	0.0117	0.5233	0.4650
PLA	0.0195	2.00	28.01	-0.0005	0.0100	0.0007	0.0007	0.9923
PDEP	0.0202	1.99	30.43	-0.0010	0.0099	0.0026	0.0230	0.9744
S2:								
GER	1392.90	57.00	34.58	29.1475	0.1517	0.0004	0.0227	0.9769
PGD	0.0237	2.35	34.33	0.0002	0.0117	0.0001	0.0314	0.9668
DEP	7416.22	13.93	8.46	688.1957	0.0359	0.0086	0.1828	0.8086
PCS	0.5493	54.16	346.88	-0.0512	0.2469	0.0087	0.5104	0.4809
PLA	0.0251	2.57	36.06	-0.0002	0.0128	0.0000	0.0059	0.9940
PDEP	0.0219	2.16	32.97	-0.0007	0.0108	0.0009	0.0322	0.9669

- GER, GGD and DEP are in terms of Rs. crore (=10million rupees).

10.4 Policy Analyses by Simulation

We conduct the same simulation experiments for the period 1969-93 as in the PDEP exogenous model based on the perfect tracking solution (i.e. residual-in) using the original long-run model in Table 9.3, such that:

1. CRR 2 % reduction
2. Bank Rate 2 % reduction
3. SLR 2 % reduction

4(S1). Government Securities Yields (GSY) 2 % reduction

4(S2). Open market purchase of government securities by 2 %

5. Devaluation by 10 %
6. GDP 10 % increase with a 8 % inflation rate
7. GDP 10 % increase with a zero inflation rate
8. Inflation rate 8% without any growth in GDP

The first five simulations are associated with the financial reform programme, and the rest, with potential shocks from the real sector. Tables 10.5a, 10.5b and 10.5c present the results of PDEP endogenous model in the upper part and those of PDEP exogenous model in the lower part (the same one as in Table 9.6 in Chapter 9). (Table 10.5 is found after Section 10.6 Concluding remarks.) The discussion is centred around PDEP endogenous model-specific features, in particular endogenous interest rates, comparing with PDEP exogenous model. The interest rates and devaluation are all in real terms unless otherwise noted.

No. 1 Reduction of CRR by 2%

In comparison with PDEP exogenous model in the lower table, the policy effect on lending rates (LR) in PDEP endogenous model in the upper table is slightly larger, whereas it is smaller on Government securities' yields (GSY). A relatively large fall in deposit rates (DR) in S2 reduces the holding of deposits (HDEP), as we expect, and increases substantially the holding of narrow money (HCUR) as a substitute in the household sector. In the stock market, there is a sharp fall in the increase of the return on shares (RS) from by 44 % in S1 and 53 % in S2 in the lower table to by 16% and 6% respectively in the upper table.

The fall of the growth in RS leads to a lesser increase in BCS in the banking sector. Banks instead increase BGD, hence the substitution effect between risk-free assets of BER and BGD emerges in the upper table. This is adverse, because the funds tend to stay in the government sector. Yet, the magnitude of the policy effect in bank lending (i.e. BLA) remains the same as in PDEP exogenous model, such that, there is no marked difference between the PDEP endogenous and exogenous models in delivering loanable funds.

In the OFIs sector, it is surprising that a flow of funds is considerably suppressed in the upper table; especially a rise of OFILA in S2 falls significantly. This could be due to the fact that OFILA becomes highly sensitive to the fall of LR from by -1.69% in the lower table to by -1.80% in the upper table. On the other hand, OFIGD becomes insensitive to the fall in GSY. The contraction of lending in the OFIs sector appears to be responsible for the smaller increase in debt finance in the corporate sector (i.e. PCBLA) and also borrowing in the household sector (i.e. HLA) in PDEP endogenous model. This may also be indirectly caused by the fall in HDEP, reducing the available funds in the financial institutions. These results suggest a somewhat undesirable effect on the flow of loanable funds by endogenising the deposit rate.

No. 2 Reduction of the Bank Rate by 2 per cent

The magnitude of the policy effect is trivial, and the substitution effect between risk-free assets in the banking sector is persistent. Besides, the influence of the bank rate on endogenous interest rates is very small, even though deposit rates are now liberalised. These results are similar to those of the PDEP exogenous model, emphasizing the policy ineffectiveness.

No. 3 Reduction of SLR by 2 per cent

With this policy experiment, the impact on DR is not in line with that on LR: LR falls whereas DR rises, in other words, the loan-deposit margin falls, as SLR falls. This may be that with the fall in the liquidity reserve requirement, banks' profitability can potentially improve as discussed in Section 10.2, and that it is affordable to raise DR. This behaviour is contrasted with the effect of lowering the cash reserve requirement in simulation No.1, in which the margin is maintained.

However, with the low level of increase in DR (10 basis in S1 and 53 basis in S2) there is hardly any difference in the flow of funds between PDEP endogenous and PDEP exogenous models; a substantial contraction of loanable funds is observed across sectors.

No. 4 (S1) Reduction in Government Securities Yields by 2 per cent

The endogenous interest rates are quite responsive to the change in GSY (government securities yields); there is a fall in LR by 1.54 % and DR by 1.56 %, and the fall in LR is more than the one in PDEP exogenous model. This is sharply contrasted with the lack of sensitivity of interest rates to a change in the bank rate.

There is a drastic fall in the change of RS from by 49.76 % in the lower table to by –6.09 % in the upper table, implying a rising stock market as deposit rates are transferred from the administered to the liberalised regime. This, a relatively large fall in deposit rates as against a rise in share prices, may be explained in that, when deposit rates fall in line with government securities yields and lending rates, the household sector may be attracted to the stock market as an alternative investment opportunity, thereby pushing share prices upwards. This is evidenced by the positive sign on HCS in the upper table from the negative sign in the lower table.

An increase in OFILA is extremely small, and this leads to an adverse effect in the credit market: there is a substantial decline in the change in PCBLA and HLA as compared with PDEP exogenous model; in particular the effect on PCBLA turns into a negative from by 9.85% in the lower table to by –0.96% in the upper table. These results are very similar to the one found in the simulation of CRR in S2, so that the similar reason may apply: the OFILA becomes highly sensitive to the lending rate, when LR falls further from by –1.05 in PDEP exogenous model to by –1.54 in PDEP endogenous model. The household sector's disinvestment in deposits may also contribute to a reduction in loans in the credit market.

No.4 (S2) Open Market Purchases by 2 per cent

With respect to the open market purchases, given only a small fall in DR by 56 basis points, the direction and magnitude of the flow of funds are broadly the same as in PDEP exogenous model. It seems that the policy is not particularly affected by the liberalisation of deposit rates as in the case of the Bank rate.

No. 5 Real Devaluation by 10 per cent

The policy effect on the interest rates is a broadly similar in the upper and lower tables. The effect of devaluation on the DR is numerically marginal. Yet, the loan market seems to be dampened in PDEP endogenous model: demand for and supply of loans both fall as compared with PDEP exogenous model.

No. 6 Rise in Nominal GDP by 10 per cent with Inflation rate 8 per cent

Between the upper and lower tables, there is no marked difference in the flow of funds, yet this simulation provides some insight into the behaviour in the banking sector on DR and its consequences. In S1, although DR falls only marginally by 6 basis points, the fall in HDEP is more than twice that in PDEP exogenous model. This may be due to the following reasons. The actual mean inflation rate for the period 1969-93 is 8.33%. Thus, with the assumption of the rate of inflation at 8% in this simulation, a 0.33% rise in the real deposit rate is expected, if the banking sector maintains the nominal deposit rate. This is satisfied in S2 regime where DR rises by 57 basis points, however, in the S1 regime, DR falls by 6 basis points, implying that banks reduce the nominal deposit rate in order to maintain the loan-deposit margin as GDP increases. This consequently discourages deposits in the household sector. At the same time this implies that the portfolio behaviour in the household sector may be sensitive not only to the *real* rates, but also to the *nominal* rates.

No.7 Rise in Nominal GDP 10 per cent with Zero Inflation rate

In the case of the simulated shock of a 10% increase in GDP without inflation, DR itself may be seen as the nominal rate. Thus the actual mean inflation rate of 8.33% is to be raised in DR if the banking sector is to maintain nominal deposit rates. This is satisfied in S2 with an increase of by 8.54%, but in S1 regime, DR increases by 7.21%, being less than the actual inflation rate, hence HDEP falls more in S1 than in S2. This again shows that banks reduce the nominal deposit rate as GDP rises in S1.

No.8 Inflation Rate 8 per cent without any Growth in GDP

With an inflation rate of 8%, there is an increase in real deposit rate by 2.10% in S1 and by 1.08% in S2. However, this does not necessarily mean that the real deposit rate is positive. The actual mean real deposit rate over the period 1969-93 is –1.45%; in S1 the real deposit rate is now positive, but in S2 it is still negative. The case of S2 may be a classical case for a developing economy as the McKinnon-Shaw school asserts: the financial sector is framed with strict regulations interacting with price inflation and negative real deposit rates, preventing financial deepening. Yet, there are two conflicting features of our results from their assertion: First, their argument is based on administered deposit rates, whereas our simulation results are based on liberalised deposit rates. Second, with the inflation rate of 8 %, the financial flow is relatively active across sectors in PDEP endogenous model; this seems to be caused by a drastic increase in RS in the upper table.

10.5 The Impact of Credit Rationing and Financial Reforms on the Endogenous Interest Rates in PDEP Exogenous Model and PDEP Endogenous Model

The effects of credit rationing and financial reforms on the endogenous interest rates of GSY, LR, RS and DR are examined for both PDEP exogenous and PDEP endogenous models. This is easily conducted by undoing the dummy 69 and dummy 90 from the behavioural equations in simulation. By deleting dummy 69, the simulated values in the post-1969 period can be regarded as being the values in the case where there existed no credit rationing (or no priority sector lending requirements). Similarly, by deleting dummy 90, the simulation values in the post-1990 period can be interpreted as being the values in the case where there were no financial reforms. In both cases, the perfect tracking solutions (i.e. residuals-in) of Original are applied. Since the real AIDS prices enter in the simulation, the results are converted into the real interest rates.

Table 10.6 presents the mean values of the difference between the actual values and simulated values by undoing dummies for the period 1969-93 and 1990-93 for the credit rationing and financial reform respectively. The figures are quite large reflecting the substantial impact of the two financial shifts on the whole financial sector. The salient features are as follows:

Table 10.6 Effects of the Credit Rationing (1969) and the Financial Reforms (1990) on the Real Interest Rates (mean values in %): Original, Perfect solution

a) PDEP exogenous model

	S1		S2		
	RS	LR	RS	LR	GSY
Credit Rationing	-90.22	4.81	-68.80	6.97	2.70
Financial Reforms	-100.50	-7.78	41.90	-12.63	-8.45

b) PDEP endogenous model

	S1			S2			
	RS	LR	DR	RS	LR	GSY	DR
Credit Rationing	86.55	6.84	6.92	89.44	7.70	1.22	7.86
Financial Reforms	-57.45	-7.17	-7.25	-60.04	-12.89	-7.69	-13.04

Notes: Mean value = Actual values – Simulated values, for the period 1969-93 and 1990-93.
RS: Real return on shares, LR: Real lending rate, DR: Real deposit rate, GSY: Real government securities' yields

i) Common to both models, the mean values in S1 are smaller than those of S2 for LR and DR, and the mean values of GSY are much smaller than those of LR. The former is perhaps due to the fact that the exogenous government securities' yields, to some extent, suppress the results in S1, whereas the latter may be due to the fact that the variation of LR is larger than that of GSY[5].

ii) It is also evident in both tables that, in general, the impact of financial reform is larger than that of credit rationing. This can be explained in that India experienced a higher rate of inflation in the post-reform period (from 6% in 1989 rising to 14% in 1991) and this may in part have contributed to the large fall in real interest rates.

iii) Elsewhere, the impact on RS is very volatile and the direction of the effect is mixed between PDEP exogenous and PDEP endogenous model: The credit rationing lowers RS in PDEP exogenous, whereas it raises RS in PDEP endogenous. The latter is intuitively plausible in that credit control dampens the stock market, leading to a rise in RS. With respect to the effect of the financial reforms, in PDEP exogenous model, RS falls in S1 and rises in S2, whereas in the PDEP endogenous model it falls in both S1 and S2. The fall in RS is more plausible as it implies that the financial liberalisation is associated with the growth in the stock market as experienced in India. Overall, given a volatile movement and some evidence of the counter-intuitive results, this reiterates the view that the stock market is prone to be driven by the speculative movement.

iv) For other interest rates, we have obtained similar result between the two models, and the outcome is quite sensible: Credit rationing increases these interest rates as indicated in a positive way, whereas the financial reforms lower them as suggested in a negative way[6]. This implies that credit rationing exerts a contractionary effect, whereas the financial reforms exert an expansionary effect in the economy. The higher loan rates under the regime of credit rationing may be explained by the fact that directed credit programs reduce the financial system's flexibility, whilst increasing its fragility (Fry, 1995). Firstly, in that the funds available for *discretionary* bank lending are reduced; Secondly the banks increase their risk exposure with no compensating return[7]. This consequently pushes up loan rates, and the economic efficiency of resource allocation is largely distorted through credit rationing. Financial reforms may

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[5] The variance of nominal lending rate is 29.20, whereas that of nominal GSY is 8.77 (Table 4.6a in Chapter 4).

[6] With respect to the government securities' yields, there is a need for clarification. In the post-reform period, government securities' yields were market-determined and the yields were raised. In this section, we are not comparing the controlled securities' yields with the market-determined yields, but the market-determined yields without financial reforms vs. those with financial reforms. We find here that the market-determined yields would have been higher without financial reforms.

[7] Directed credit programs are partly responsible for the alarming amount of non-performing assets in many financial institutions in developing countries (Fry, 1995).

have been successful on this point, since the reforms have contributed to lowering the loan rate, reflecting the lessening of credit control.

v) In PDEP endogenous model in Table 10.6b there emerges some trade-off effect between the expansionary effect and saving-accumulation. With credit rationing DR rises in line with LR exerting a desirable impact in increasing deposits in the household sector, whereas, with the financial reform DR falls in line with LR and this exerts an adverse effect on saving accumulation.

10.6 Concluding Remarks

It is evident that the GSY as a policy instrument in S1 has a significant influence on the endogenous interest rates in the financial markets. Such a strong impact of the GSY seems to impede the flow of loanable funds, as a fall in administered GSY also leads to a fall in DR, and this in turn reduces the loanable funds. This is contrasted with the desirable policy effect of GSY found in PDEP exogenous model. In this respect, the controlled GSY combined with the de-regulated deposit rate exerts an adverse effect on a flow of loanable funds. A similar detrimental effect is also observed by lowering CRR in S2.

Being associated with the policy change in GSY and CRR, it is noticeable that the OFIs sector becomes highly sensitive, when there is a large fall in lending rates. This may be due to the fact that, while the banking sector is able to maintain their profitability in the liberalised deposit rate regime, the OFIs sector have to obtain funds from other sources, which may not be directly linked with the level of lending rates, and profitability may decline as lending rates fall. This may subsequently force the OFIs to take prudential measures against falling lending rates.

Overall, in the expansionary policy simulation, the deposit rates fall in line with the lending rates, so that banks maintain loan-deposit margins, however, this discourages deposit savings in the household sector. This, coupled with the OFIs' risk-averse behaviour, adversely affects the credit market. In this respect, market-determined deposit rates may be no better (if not worse) than the administered rates. This result may be taken to suggest evidence of financial repression in *market-determined* deposit rates, though, according to the McKinnon-Shaw school, financial repression is associated with *regulated* deposit rates.

The simulation experiments therefore raise the question of leaving the interest rates in a free market environment or totally at banks' discretion, as a policy prescription to improve the real interest rate structure. In the case of India, it may be that nominal deposit rates are better off regulated and should be raised high, to the point where this would lead to a positive real interest rate. However, this in turn implies that, with the administered deposit rates, banks' profits may be squeezed and that this incurs cost in the banking sector.

Table 10.5a PDEP Endogenous Model vs PDEP Exogenous Model Policy Effects (69-93): Perfect Solution (Original) (Rs. Crores for Actual changes)

	1. CRR 2% reduction				2. Bank Rate 2% reduction				3. SLR 2% reduction			
	S1		S2		S1		S2		S1		S2	
Endogenous	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	-30.45	-1276.38	-17.07	-715.50	-13.98	-585.90	-11.64	-488.03	8.17	342.23	2.27	95.01
BGD	2.68	551.09	2.44	502.64	2.77	571.10	2.22	457.51	8.54	1758.80	10.05	2069.58
BCS	11.52	963.01	5.57	465.80	0.11	9.06	-0.03	-2.74	-27.96	-2338.12	-27.76	-2321.09
BLA	3.21	1411.41	3.17	1396.21	0.01	5.73	0.08	33.25	0.54	237.11	0.36	156.52
OFIGD	-2.28	-619.29	0.30	82.20	-0.02	-4.71	-0.24	-64.21	15.60	4237.48	16.26	4416.50
OFICS (-)	41.71	1471.14	14.42	508.49	0.27	9.55	-0.62	-21.85	-103.37	-3645.68	-101.69	-3586.35
OFILA	9.71	2090.44	1.98	426.29	0.07	14.26	0.20	42.35	-36.63	-7883.20	-37.19	-8002.89
PCBCS (-)	-36.12	-1684.33	-8.46	-394.52	-0.16	-7.66	0.63	29.59	85.13	3970.05	83.72	3904.13
PCBLA (-)	4.97	1758.89	1.20	424.27	0.03	9.03	-0.09	-31.10	-12.54	-4441.36	-12.34	-4368.59
PCBDEP	1.87	74.57	0.74	29.76	0.03	1.38	-0.04	-1.50	-11.79	-471.30	-11.62	-464.45
HCUR	-2.75	-620.58	16.33	3680.89	-0.02	-4.33	3.12	702.74	10.70	2412.02	2.65	597.61
HDEP	0.22	150.50	-1.98	-1344.98	0.00	1.74	-0.31	-212.18	-1.13	-766.82	-0.33	-227.13
HGD	5.56	3389.24	-0.96	-585.85	0.03	20.73	-0.65	-394.31	-12.33	-7512.40	-10.65	-6487.09
HCS	-8.11	-1176.20	-2.43	-351.82	-0.05	-7.17	0.07	10.48	18.36	2662.49	18.20	2638.87
HLA (-)	4.22	1742.96	3.38	1398.23	0.03	10.96	0.26	106.71	-7.75	-3204.74	-8.41	-3477.78
GER	-30.45	-1276.38	-17.07	-715.50	-13.98	-585.90	-11.64	-488.03	8.17	342.23	2.27	95.01
DEP	0.25	225.07	-1.46	-1315.22	0.00	3.12	-0.24	-213.68	-1.38	-1238.12	-0.77	-691.59
GGD/GSY%	4.23	3321.04		-1.34	0.75	587.12		-0.32	-1.93	-1516.13		0.57
LR %		-0.69		-1.80		0.00		-0.25		-0.48		-0.05
RS %		16.31		6.52		0.21		-0.59		-83.63		-82.51
DR %		-0.69		-1.82		0.00		-0.25		0.10		0.53
Exogenous	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	-34.19	-1433.01	-16.99	-711.89	-14.02	-587.40	-11.88	-497.99	8.00	335.34	2.41	101.05
BGD	-0.27	-55.51	-0.79	-162.77	2.75	565.55	1.06	218.93	8.35	1720.36	10.71	2205.75
BCS	19.06	1593.41	13.54	1132.01	0.19	15.67	2.51	210.27	-27.54	-2302.88	-29.68	-2481.71
BLA	3.51	1544.24	3.16	1391.79	0.01	6.18	0.16	68.78	0.56	247.21	0.40	174.94
OFIGD	-6.90	-1873.83	-6.52	-1770.00	-0.06	-16.63	-2.15	-583.27	15.20	4127.10	17.95	4874.15
OFICS (-)	74.86	2640.24	51.85	1828.71	0.61	21.45	11.20	395.10	-101.19	-3568.94	-111.47	-3931.60
OFILA	20.98	4514.10	16.72	3598.73	0.18	38.08	4.55	978.37	-35.77	-7696.08	-40.92	-8805.79
PCBCS (-)	-67.41	-3143.70	-45.27	-2111.34	-0.46	-21.50	-10.68	-497.87	82.66	3854.87	92.88	4331.42
PCBLA (-)	9.10	3220.94	6.60	2338.33	0.06	22.55	1.47	521.20	-12.18	-4313.30	-13.68	-4844.84
PCBDEP	1.93	77.25	5.68	227.00	0.03	1.05	0.58	23.34	-11.47	-458.42	-12.85	-513.42
HCUR	-6.68	-1504.90	7.93	1788.32	-0.05	-10.16	1.96	442.42	9.77	2202.44	4.79	1080.56
HDEP	0.69	467.51	0.51	346.74	0.00	2.80	0.05	33.25	-0.91	-618.03	-0.98	-667.17
HGD	9.80	5971.65	3.17	1931.77	0.07	44.80	0.60	363.33	-12.00	-7308.76	-11.62	-7080.90
HCS	-14.46	-2096.87	-9.75	-1414.63	-0.11	-15.72	-2.16	-313.04	17.85	2588.82	19.87	2881.53
HLA (-)	6.87	2837.39	6.42	2652.19	0.05	21.71	1.27	525.95	-7.59	-3135.57	-9.16	-3786.01
GER	-34.19	-1433.01	-16.99	-711.89	-14.02	-587.40	-11.88	-497.99	8.00	335.34	2.41	101.05
DEP	0.61	544.75	0.64	573.74	0.00	3.86	0.06	56.59	-1.20	-1076.45	-1.31	-1180.58
GGD/GSY%	5.15	4042.30		-1.73	0.76	593.71		-0.40	-1.86	-1461.31		0.63
LR %		-0.46		-1.69		0.00		-0.24		-0.48		-0.06
RS %		44.66		53.68		0.44		8.49		-85.00		-91.45

% and actual change: mean values of the proportionate and actual changes respectively in holding assets by simulated policy changes for the period of 1969-93.

Exogenous: PDEP Exogenous Model, reproduced from Table 9.6 in Chapter 9. Rs. crore = 10 million rupees.

CRR 2% reduction increases the mean value of BW by around 1649 Rs. crores during the period of 1969-93.

Table 10.5b PDEP Endogenous Model vs PDEP Exogenous Model Policy Effects (69-93): Perfect Solution (Original) (Rs. Crores for Actual changes)

	4. GSY 2 % reduction (S1) / OMO 2% purchases (S2)				5. Devaluation 10%				6. Nominal GDP 10% up with inflation rate 8%			
	S1		S2		S1		S2		S1		S2	
Endogenous	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	14.98	627.73	7.32	306.96	-4.55	-190.71	-6.40	-268.22	6.87	287.89	-1.31	-54.98
BGD	-3.34	-687.78	-8.07	-1662.00	-2.72	-560.45	-2.36	-486.25	6.40	1317.59	8.50	1750.01
BCS	-1.36	-113.83	10.17	850.66	11.88	993.19	12.13	1014.50	-22.96	-1919.58	-22.69	-1896.97
BLA	0.40	173.88	1.15	504.38	-0.55	-242.05	-0.59	-260.05	0.71	314.12	0.46	201.95
OFIGD	-1.12	-303.91	-9.57	-2599.67	-6.26	-1699.69	-6.19	-1681.66	14.74	4003.84	15.67	4255.46
OFICS (-)	-7.69	-271.35	44.77	1578.98	56.37	1988.00	57.57	2030.61	-114.70	-4045.54	-112.41	-3964.63
OFILA	0.15	32.55	19.42	4178.66	17.14	3687.71	17.25	3712.29	-37.41	-8049.43	-38.20	-8220.13
PCBCS (-)	6.90	321.95	-43.32	-2020.31	-31.52	-1469.77	-32.77	-1528.21	96.00	4476.95	94.09	4387.70
PCBLA (-)	-0.96	-339.80	5.84	2067.31	4.91	1737.99	5.08	1798.79	-12.99	-4600.77	-12.71	-4502.06
PCBDEP	-0.45	-17.84	1.18	47.00	6.71	268.23	6.77	270.59	-3.10	-123.81	-2.86	-114.36
HCUR	20.18	4549.43	8.50	1916.80	3.41	768.61	0.77	174.23	16.40	3697.57	5.21	1174.24
HDEP	-2.03	-1374.41	1.09	742.82	-0.55	-376.10	-0.26	-175.56	-2.58	-1753.04	-1.48	-1003.89
HGD	-4.58	-2793.19	4.42	2691.63	2.94	1790.13	3.56	2166.90	-12.19	-7430.03	-9.86	-6006.49
HCS	1.13	164.43	-8.91	-1291.99	-3.27	-474.96	-3.53	-512.11	16.21	2351.00	16.00	2320.04
HLA (-)	1.32	546.23	6.33	2615.73	4.13	1707.67	4.00	1653.45	-7.58	-3134.54	-8.51	-3516.12
GER	14.98	627.73	7.32	306.96	-4.55	-190.71	-6.40	-268.22	6.87	287.89	-1.31	-54.98
DEP	-1.55	-1392.25	0.88	789.82	-0.12	-107.88	0.11	95.02	-2.09	-1876.85	-1.24	-1118.24
GGD/GSY%	-4.82	-3784.89		-1.23	-0.60	-470.01		0.35	-2.69	-2108.62		1.67
LR %		-1.54		-0.55		-0.07		0.21		-0.06		0.57
RS %		-6.09		15.57		51.90		53.17		-90.01		-88.38
DR %		-1.56		-0.56		-0.07		0.21		-0.06		0.57
Exogenous	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	6.79	284.39	7.25	303.75	-8.10	-339.35	-6.62	-277.37	5.47	229.35	-1.35	-56.64
BGD	-10.29	-2118.91	-8.28	-1704.65	-5.72	-1177.02	-3.51	-723.07	5.19	1069.56	8.17	1682.66
BCS	16.46	1376.50	11.36	950.29	18.76	1568.28	13.88	1160.98	-19.14	-1600.13	-21.86	-1827.98
BLA	1.04	458.00	1.02	450.59	-0.12	-51.93	-0.36	-160.57	0.68	301.24	0.46	201.98
OFIGD	-13.30	-3613.18	-10.64	-2890.67	-10.43	-2833.23	-7.30	-1982.47	11.43	3103.80	14.86	4036.76
OFICS (-)	73.78	2602.10	50.83	1792.86	86.31	3044.04	64.89	2288.58	-95.07	-3353.01	-108.06	-3811.12
OFILA	28.88	6215.30	21.77	4683.54	27.31	5877.30	19.85	4271.07	-30.01	-6456.85	-36.47	-7847.93
PCBCS (-)	-72.92	-3400.66	-48.43	-2258.56	-61.44	-2865.31	-40.49	-1888.07	76.78	3580.82	89.73	4184.47
PCBLA (-)	9.85	3489.32	6.68	2365.23	8.74	3093.14	6.02	2131.69	-10.17	-3600.09	-12.06	-4271.92
PCBDEP	2.22	88.67	2.67	106.67	5.70	227.84	6.10	243.63	-0.48	-19.27	-2.19	-87.45
HCUR	5.62	1266.59	6.23	1405.06	-0.08	-18.71	1.69	380.16	10.29	2319.22	4.12	928.55
HDEP	0.51	348.25	1.77	1198.09	-0.32	-218.25	-0.51	-345.40	-1.07	-724.94	-1.15	-783.44
HGD	6.14	3744.20	4.97	3025.27	7.15	4358.72	4.44	2704.53	-9.81	-5977.71	-9.39	-5720.43
HCS	-15.00	-2175.06	-9.76	-1416.00	-9.58	-1389.54	-5.24	-760.47	12.60	1827.95	15.18	2201.33
HLA (-)	7.70	3183.98	6.70	2768.91	6.61	2732.23	4.79	1978.81	-6.18	-2555.51	-8.16	-3374.02
GER	6.79	284.39	7.25	303.75	-8.10	-339.35	-6.62	-277.37	5.47	229.35	-1.35	-56.64
DEP	0.49	436.92	1.45	1304.76	0.01	9.60	-0.11	-101.76	-0.83	-744.21	-0.97	-870.89
GGD/GSY%	-2.53	-1987.90		-1.33	0.44	348.47		0.35	-2.30	-1804.36		1.64
LR %		-1.05		-0.54		0.07		0.19		0.05		0.58
RS %		49.76		28.58		66.13		51.25		-75.36		-83.83

% and actual change: mean values of the proportionate and actual changes respectively in holding assets by simulated policy changes for the period of 1969-93.
Exogenous: PDEP Exogenous Model, reproduced from Table 9.6 in Chapter 9.
OMO 2% purchases increase the HW by around 1444 Rs. crores. Rs. crore = 10 million rupees.

Table 10.5c PDEP Endogenous Model vs PDEP Exogenous Model Policy Effects (69-93): Perfect Solution (Original) (Rs. Crores for Actual changes)

	7. Nominal GDP 10% up with no inflation rate				8. Inflation rate 8%			
	S1		S2		S1		S2	
Endogenous	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	1.89	79.19	-14.37	-602.23	-5.65	-236.87	3.12	130.84
BGD	5.33	1097.88	9.57	1970.71	-6.63	-1364.78	-9.29	-1912.12
BCS	-21.01	-1756.85	-20.64	-1726.02	15.69	1311.96	16.35	1366.74
BLA	1.32	579.78	0.81	357.54	0.66	289.67	0.94	414.52
OFIGD	13.57	3684.44	15.53	4218.32	-12.00	-3259.73	-13.68	-3715.01
OFICS (-)	-94.68	-3339.35	-90.90	-3206.10	66.92	2360.27	68.95	2431.69
OFILA	-32.64	-7023.79	-34.50	-7424.42	26.12	5620.03	28.57	6146.72
PCBCS (-)	92.49	4313.20	89.49	4173.49	-79.98	-3730.03	-81.99	-3823.59
PCBLA (-)	-11.92	-4219.48	-11.47	-4062.78	10.25	3630.37	10.49	3713.00
PCBDEP	2.35	93.72	2.77	110.70	-2.49	-99.66	-2.77	-110.58
HCUR	25.82	5820.92	3.72	838.88	-13.05	-2941.77	-0.90	-202.68
HDEP	-2.68	-1820.59	-0.51	-346.34	1.49	1013.75	0.27	183.42
HGD	-14.70	-8955.55	-10.16	-6190.04	11.31	6889.04	9.23	5626.12
HCS	18.83	2730.70	18.57	2693.41	-18.49	-2681.71	-19.02	-2758.65
HLA (-)	-5.38	-2224.53	-7.27	-3004.10	5.51	2279.33	6.89	2848.23
GER	1.89	79.19	-14.37	-602.23	-5.65	-236.87	3.12	130.84
DEP	-1.92	-1726.87	-0.26	-235.64	1.02	914.09	0.08	72.83
GGD/GSY%	-5.32	-4173.25		10.63	2.89	2264.52		-0.51
LR %		7.13		8.44		2.07		1.07
RS %		-74.09		-70.74		88.44		89.96
DR %		7.21		8.54		2.10		1.08
Exogenous	% change	Actual	% change	Actual	% change	Actual	% change	Actual
BER	-0.73	-30.74	-14.44	-605.20	3.24	135.77	5.26	220.46
BGD	3.08	634.68	9.22	1899.43	0.43	88.60	-0.98	-201.91
BCS	-14.19	-1186.10	-19.80	-1655.51	-3.31	-277.16	-1.37	-114.89
BLA	1.32	582.15	0.82	361.27	0.12	52.79	0.22	96.34
OFIGD	7.83	2125.44	14.73	4001.65	0.46	125.40	-1.35	-366.57
OFICS (-)	-60.30	-2126.74	-86.46	-3049.22	-19.69	-694.54	-10.67	-376.30
OFILA	-19.76	-4252.17	-32.77	-7050.87	-3.81	-819.95	-0.05	-9.74
PCBCS (-)	58.78	2741.07	85.04	3965.99	1.60	74.39	-6.97	-324.94
PCBLA (-)	-6.95	-2462.38	-10.81	-3827.10	-0.75	-265.13	0.45	157.62
PCBDEP	6.97	278.69	3.48	138.88	-4.77	-190.73	-4.19	-167.32
HCUR	14.75	3325.84	2.58	580.97	-1.00	-225.75	0.93	209.10
HDEP	0.05	37.10	-0.17	-113.64	-0.41	-279.17	-0.39	-261.24
HGD	-10.46	-6371.01	-9.69	-5902.09	0.57	345.87	0.93	567.48
HCS	12.41	1800.43	17.74	2572.27	-2.37	-343.00	-4.04	-586.36
HLA (-)	-2.92	-1207.64	-6.93	-2862.50	-1.21	-502.04	-0.17	-71.02
GER	-0.73	-30.74	-14.44	-605.20	3.24	135.77	5.26	220.46
DEP	0.35	315.78	0.03	25.24	-0.52	-469.90	-0.48	-428.56
GGD/GSY%	-4.60	-3610.90		10.59	0.71	559.87		0.34
LR %		7.34		8.46		1.44		1.14
RS %		-47.29		-65.56		-8.57		0.58

% and actual change: mean values of the proportionate and actual changes respectively in holding assets by simulated policy changes for the period of 1969-93.
Exogenous: PDEP Exogenous Model, reproduced from Table 9.6 in Chapter 9. Rs. crore = 10 million rupees.

Appendix 10.1 Mean values of the real interest rates (%) over the respective periods

Period	51-93	69-93	90-93
GSY	-0.98	-1.27	1.40
LR	2.44	4.03	5.27
RS	-1.41	1.03	10.67
DR	-1.39	-1.45	-0.75

GSY: Real government securities yields, LR: Real lending rate, RS: Real return on shares and DR: Real deposit rates

Chapter 11 Stochastic Simulation on a System-wide Flow of Funds Model: Policy Implications

11.1. Introduction

This chapter is inspired by Brainard (1967), who argues that optimal policy in the presence of uncertainty is found to differ significantly from optimal policy in a world of certainty. This implies that the actual response of endogenous variables (or target variables) to policy action may differ from the expected value of the response coefficient that is estimated. This is because in *deterministic* simulations, the error process of the model is ignored, and that the uncertainty element is assumed away (Murinde and Rarawa, 1996). The deterministic policy impact therefore remains a crude criterion.

In this chapter, a *stochastic* simulation technique is implemented to uncover the properties of the error term of the model or the stochastic nature of policy effects (Hall 1986). The uncertainty that is attached to policy effects can be reckoned by comparing the results with those in the deterministic simulation obtained in Chapter 9 (PDEP Exogenous Model). The policy experiments are therefore as before expansionary in terms of a flow of loanable funds. We specifically consider the uncertainty, which is embedded in the financial institutions, as their portfolio behaviour has a major influence on the financial sector.

The study in this chapter has important implications for the robustness of policies and at the same time for the estimated model itself, in the sense, that if policy effects are insensitive to the true structure of the model (i.e. there is no large deviation in results between deterministic and stochastic simulations), then the policy undertaken is robust and also the model is robust. But if policy effects are sensitive (i.e. there is a large deviation), then either the policy or the model, or both may not be robust.

The contribution of this chapter is twofold. First, the simulation experiments go beyond the single-shot policy experiments, as we apply the simulation techniques to multiple policy experiments. These experiments can be interpreted as the impact of a 'policy package'. The idea is that we want to measure the interdependent policy effects in deterministic and stochastic experiments. Second is associated with the scale of the stochastic simulation. The application of stochastic simulation for developing economies is found in Murinde (1992) and Murinde and Rarawa (1996) in a dynamic macroeconomic model. Our approach to stochastic simulation is static as the model is based on a long-run equilibrium model. However, the scale of the stochastic model far exceeds that of Murinde and Murinde and Rarawa: they use only three equations for simulation, whereas we employ fifteen behavioural equations and five market clearing conditions. To the best of our knowledge, stochastic simulation has never previously been applied to such a large scale system model for developing economies.

The remainder of this chapter is structured into 4 sections. Section 11.2 deals with the methodology of stochastic simulation. In Section 11.3, the results of stochastic simulations together with those of deterministic simulations are reported. In this section, we have taken a unique selective presentation by segregating the policy effects into mainly the credit market, the equity market, the government securities' market and the currency market. In this way, a comparative analysis of the different policies is specifically conducted for each market. This means that individual policy effects are not discussed[1]. Section 11.4 summarises the results with concluding remarks.

For notation in this chapter, refer to Table 9.1 in Chapter 9.

11.2 Methodology

11.2.1 Error Term in the Model

The error term in the model is specified in the work of Hall (1986, p.182), who sets up a formal framework for analysing the forecasting error.

We define

$$Y = Y(X, A, U) \qquad (11.1)$$

[1] We believe that this is suffice as we have already discussed the policy effects in depth for each policy instrument in Chapter 9 and 10.

as a general economic model in usual notation, where U = error term.

$$\hat{Y} = \widetilde{Y}(\hat{X}, \hat{A}, \varepsilon) \qquad (11.2)$$

as the deterministic model forecasts, where $\widetilde{Y}$ = functional form estimated, $\hat{X}$ = the estimated exogenous variables, $\hat{A}$ = the estimated set of coefficients and ε = residuals. By definition the model's error is given by $\hat{Y} - Y$.

We may now define

$$\widetilde{Y} = \widetilde{Y}(\hat{X}, A, \varepsilon) \qquad (11.3)$$

as the forecast of Y given by the true parameters but with the estimated functional form and the estimated exogenous variables,

$$\overline{Y} = Y(\hat{X}, A, \varepsilon) \qquad (11.4)$$

as the forecast of Y given by the true parameters and the true functional form, but the exogenous variables are estimated,

$$Y^* = Y(X, A, \varepsilon) \qquad (11.5)$$

as the forecast of Y given by the true model structure and the parameters with the true exogenous variables.

Then we can decompose the error of the model into four parts as given by

$$\hat{Y} - Y = (\hat{Y} - \widetilde{Y}) + (\widetilde{Y} - \overline{Y}) + (\overline{Y} - Y^*) + (Y^* - Y) \qquad (11.6)$$

where

$(\hat{Y} - \widetilde{Y})$ = the error caused by incorrect parameter estimates

$(\widetilde{Y} - \overline{Y})$ = the error caused by mis-specified functional form

$(\overline{Y} - Y^*)$ = the error caused by incorrectly forecast estimated exogenous variables

$(Y^* - Y)$ = the error caused by implicit additive error term

Hall (1986) comments that there is no uniquely recognised approach to stochastic simulation experiments. What we consider about uncertainty is associated with the incorrect parameter estimates[2] i.e. the component of $(\hat{Y}-\tilde{Y})$ in equation (11.6). In particular, we focus on random effects on the *interest rate parameters* in the portfolio behaviour of *financial institutions* in India, assuming away other error processes. This will enable us to isolate the uncertainty in portfolio behaviour of the financial institutions in India from other types of uncertainty. The reason for concentrating on financial institutions is that there are the intermediaries in the economy, and the impact of interest rate is particularly important in understanding their portfolio behaviour and hence the overall movement in interest rates.

11.2.2 Specification of the Random Variables

We specify a probability distribution for the price coefficients. The coefficients are assumed to follow a joint normal distribution where the mean of each coefficient is given by the estimated value and the standard deviation of each coefficient is given by its estimated standard error. To simulate the distributions, one-half the estimated standard errors are used as standard deviations[3].

The random shocks are applied additively to the price coefficients of the banking and OFIs sectors. Hence the slope coefficients are no longer deterministic. We maintain homogeneity and symmetry (and therefore adding-up constraints) in random elements, rather than taking into account the covariances between coefficients[4]. This means that we conduct stochastic simulations, while maintaining the theoretical restrictions on the model. Table 11.1 presents how the restrictions are respected.

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[2] Murinde (1992) and Murinde and Rarawa (1996) consider incorrect parameter estimates and additive error terms as uncertain elements in their models.

[3] The usage of the whole standard errors produced very volatile results, and that in order to keep the results reasonable we scale down the standard error by half.

[4] Ignoring the covariances between coefficients tends to over-emphasize the size of the model's forecast error, as there is significant possibility that all the shocks in an equation may be applied in the same direction (Hall, 1986 and Pindyck and Rubinfeld, 1991). Given covariance, if one parameter falls then another will move in a compensating fashion so that the level of the dependent variable is maintained within 'sensible' bounds. Homogeneity and symmetry impositions on random elements will to some degree take the place of the role of covariance.

Table 11.1 Random variables of the price coefficients in the banking and OFIs sectors

a. Banking sector (symmetry and homogeneity imposed)

	$\ln p_1^{\tau}$ (PER)	$\ln p_2^{\tau}$ (PGD)	$\ln p_3^{\tau}$ (PCS)	$\ln p_4^{\tau}$ (PLA)
1. BER	-0.38 *	0.3670 ± B12	0.0031 ± B13	0.0099 ± B14
2. BGD	0.3670 ± B12	-1.0866 ± B22	0.0083 ± B23	0.7113 ± B24
3. BCS	0.0031 + B13	0.0083 ± B23	-0.0245 ± B33	0.0131 ± B34
4. BLA	0.0099 ± B14	0.7113 ± B24	0.0131 ± B34	-0.7343 ± B44

-0.38 is imposed.

b. OFI sector (symmetry and homogeneity imposed)

	$\ln p_1^{\tau}$ (PGD)	$\ln p_2^{\tau}$ (PCS)	$\ln p_3^{\tau}$ (PLA)
1. OFIGD	-2.9578 ± OF11	0.0772 ± OF12	2.8806 ± OF13
2. OFICS (-)	0.0772 ± OF12	0.0862 ± OF22	-0.1634 ± OF23
3. OFILA	2.8806 ± OF13	-0.1634 ± OF23	-2.717 ± OF33

- Entry in each cell is the random variable consisting of the mean (=the estimated price coefficients) and the standard deviation (=half of the standard error of the price coefficients). The standard deviation is given by:
B12=0.0896, B13=0.0091, B22=0.1322, B23=0.0128, B33=0.004
B14=-(B12+B13)
B24=-(B12+B22+B23)
B34=-(B13+B23+B33)
B44=-(B14+B24+B34)

OF11=0.1566, OF12=0.0286, OF22=0.0215
OF13=-(OF11+OF12)
OF23=-(OF12+OF22)
OF33=-(OF13+OF23)

In Table 11.1, homogeneity and symmetry are reconciled with the random draws by treating BLA and OFILA share equations as the residuals in the model[5]: The row sums zero, hence satisfying homogeneity, while symmetry is self-explanatory.

[5] Random variables are generated by TSP 4.5.

11.2.3 Stochastic Simulation

We, first, obtain a mean of the stochastic one-period-ahead forecast of the endogenous variables for the period of 1969-93 (25 years) using the Gauss-Seidel method. 500 of the simulations are performed; in each simulation, the error terms are chosen at random from the corresponding probability distributions[6].

Then, the mean value as well as the standard error of the forecast of the 500 mean values are calculated. In order to qualify the uncertainty effects, we compare the deterministic and stochastic solutions. The policy effects (δ) are derived as given by ((11.7) is reproduced from (9.6) in Chapter 9):

$$\delta_i^D = D_i^{simu} - D_i^{base} \quad (11.7)$$

$$\delta_i^S = S_i^{simu} - S_i^{base} \quad (11.8)$$

where

δ_i^D = a deterministic mean estimate for the period 1969-93 of the policy effect that a simulated change in exogenous variables has on the i'th endogenous variable

D_i^{base} = a deterministic mean for the period 1969-93 with a base set of exogenous variables (deterministic base run)

D_i^{simu} = a deterministic mean for the period 1969-93 with a simulated change in exogenous variables (deterministic simulated run)

δ_i^S = a stochastic mean estimate for the period 1969-93 of the policy effect that a simulated change in exogenous variables has on the i'th endogenous variable

S_i^{base} = a stochastic mean of the 500 means for the period 1969-93 with a base set of exogenous variables (stochastic base run)

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[6] Throughout this study, each set of stochastic simulations has involved 500 replications. It is expected that as the number of repetitions becomes large, the resulting estimate of the mean and standard error of each endogenous variable will approach the 'true' value if the model is linear (Hall, 1986, Pindyck and Rubinfeld, 1991 and Murinde and Rarawa, 1996). Hall further comments that less than 300 replications give highly unreliable results in the sense that a change in the number of replications gives different outcomes.

S_i^{simu} = a stochastic mean of the 500 means for the period 1969-93 with a simulated change in exogenous variables (stochastic simulated run)

Both deterministic and stochastic simulations are run including the residuals of the behavioural equations, such that D_i^{base} generates a perfect tracking solution, i.e. a mean of the actual time series. As before, we conduct the simulation in the two regimes of:
S1 = the government debt endogenous in the government debt market
S2 = the government securities yields endogenous in the government debt market

In the deterministic simulation, $\ln(W^{\tau} / P^{*\tau})$ in the AIDS model was treated as being endogenous[7]. In the stochastic simulation it is however assumed to be exogenous, because in the simulation, $P^{*\tau}$ sometimes fails to be positive given a random shock to the AIDS price coefficients, then the AIDS wealth in the form of log becomes unobtainable. This is perhaps permissible that W itself, as the major element of $\ln(W^{\tau} / P^{*\tau})$, is an exogenous variable[8].

11.3 Simulation Results

11.3.1 Base Run

Table 11.2 presents the base run in deterministic (D_i^{base}) and stochastic (S_i^{base}) simulations and standard error (SE) of the stochastic solution. (The share of holding assets is converted into actual values in Rs. crore.) Further, standard error (SE) is scaled by the mean, as the relative SE is more meaningful than the absolute SE. Since D_i^{base} is the actual mean of the time series, S1 and S2 are the same. The first fifteen endogenous variables are the holding of financial assets and liabilities and the last six endogenous variables are the market clearing solutions. The AIDS prices are converted into real interest rates (throughout this chapter, interest rates are all in real terms).

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[7] Recall that the sector wealth (= W^{τ}) is exogenous, but the price (= $P^{*\tau}$) is endogenous, and that we treated $\ln(W^{\tau} / P^{*\tau})$ as an endogenous variables in deterministic simulation.
[8] With this assumption, PCBDEP is unchanged in stochastic simulation, except a change in deposit rate, since PCBDEP is independent of any endogenous AIDS prices and other policy variables.

It is shown that stochastic simulations almost replicates their deterministic simulations' counterpart. In general the relative SE is very small, except for that of the return on shares (RS). The bias due to stochastic simulation appears to be small in the base run. However, so long as there is a difference between D_i^{base} and S_i^{base}, it should be borne in mind the stochastic nature of the model (Murinde and Rarawa, 1996).

Table 11.2 Base Run: Deterministic and Stochastic means for the period (69-93) (Rs. Crores)

	Deterministic	Stochastic (500)	SE	Relative SE	Stochastic (500)	SE	Relative SE
		S1			S2		
BER	4192.14	4263.37	10.97	0.003	4224.22	16.13	0.004
BGD	20596.22	20755.93	57.60	0.003	21002.88	63.68	0.003
BCS	8357.85	8238.83	105.07	0.013	7936.01	89.39	0.011
BLA	43995.12	43898.85	57.53	0.001	43993.85	43.89	0.001
OFIGD	27167.18	27346.61	262.13	0.010	28176.43	229.11	0.008
OFICS (-)	3519.74	3282.69	173.94	0.053	2703.00	162.67	0.060
OFILA	21504.08	21087.33	435.56	0.021	19677.81	390.38	0.020
PCBCS(-)	4671.13	4933.53	215.66	0.044	5648.02	194.89	0.035
PCBLA(-)	35400.46	35138.05	215.66	0.006	34423.57	194.89	0.006
PCBDEP	3995.73	3995.73	0.00	0.000	3995.73	0.00	0.000
HCUR	22535.13	22506.29	45.16	0.002	22332.60	31.59	0.001
HDEP	67860.08	67908.05	46.68	0.001	68046.02	38.40	0.001
HGD	60919.46	60505.44	403.59	0.007	59503.54	291.84	0.005
HCS	14507.20	14651.57	146.29	0.010	15089.19	121.37	0.008
HLA (-)	41324.25	41073.64	166.68	0.004	40473.62	161.48	0.004
GER	4192.14	4263.37	10.97	0.003	4224.22	16.13	0.004
DEP	89981.44	90029.41	46.68	0.001	90167.39	38.40	0.000
GGD	78452.05	78377.18	84.64	0.001			
GSY %	-1.27				-1.12	0.04	0.032
LR %	4.03	4.10	0.05	0.012	4.13	0.03	0.007
RS %	1.03	-7.26	3.30	0.455	-17.70	4.43	0.250

Rs. crore = 10 million rupees

(-) liabilities

GSY=Real government securities yields, LR=Real lending rate, RS=Real return on shares.

- Deterministic mean is the actual time series for the period 69-93.
- Stochastic mean is a mean of 500 runs for the period 69-93.
- SE: Standard Error, SE = SD / $\sqrt{500}$ and SD = Standard Deviation of the stochastic mean
- Relative Standard Error = SE / Stochastic mean

11.3.2 Simulated Run

The potentially expansionary single-shot policy simulations that are conducted in Chapter 9 for the deterministic simulations are replicated here. Such that,

1.	CRR	CRR 2% reduction
2.	Bank rate	Bank rate 2% reduction
3.	SLR	SLR 2% reduction
4.	GSY(S1)	Government Securities Yields (GSY) 2% reduction
	OMO(S2)	Open Market Purchases 2 %
5.	Deposit	Deposit rate 2 % increase
6.	Devaluation	Devaluation 10 %

Multiple-policy simulations are introduced as follows, in which two or three policy instruments are undertaken concurrently to examine the policy effects.

1.	CRR/Bank rate	CRR 2% reduction + Bank rate 2% reduction
2.	CRR/SLR	CRR 2% reduction + SLR 2% reduction
3.	CRR/Deposit	CRR 2% reduction + Deposit rate 2% increase
4.	CRR/GSY(S1)	CRR 2% reduction + GSY 2% reduction
	CRR/OMO(S2)	CRR 2% reduction + Open Market Purchases 2%
5.	Deposit/Bank rate	Deposit rate 2% reduction + Bank Rate 2% reduction
6.	Deposit/SLR	Deposit rate 2% reduction + SLR 2% reduction
7.	Deposit/GSY(S1)	Deposit rate 2% reduction + GSY 2% reduction
	Deposit/OMO(S2)	Deposit rate 2% reduction + Open Market Purchases 2%
8.	CRR/Deposit/SLR	CRR2% reduction + Deposit rate 2% reduction + SLR 2% reduction

The multiple policy simulations revolve around CRR and Deposit rates for the following reasons. First, in Chapter 9 preferable expansionary effects are found in particular in CRR and Deposit rates. Second, CRR is the one commonly used as a monetary policy in India. Furthermore, the removal of the ceiling on the deposit rates would change the structure of financial markets and that it is interesting to see the policy effects in different circumstances. CRR/Deposit/SLR is the combination of policies which the financial reformers in India attempted; the reduction in the reserve ratio and SLR with the removal of the interest rate ceiling were intended to create a more competitive and efficient environment in the banking sector (see Chapter 3).

The policy effects (δ_i) for deterministic and stochastic simulations are presented in Appendicies 11.1a-11.1c and 11.2a-11.2d. Absolute SE (SE itself) and relative SE are attached to the stochastic simulation. The report on the deterministic simulation in the single-policy shock is the reproduction of Table 9.6 in Chapter 9. Based on the results in the appendices, a number of tables are created to specify the policy effects in the area of:

-the stability in stochastic simulation
-the sign consistency in policy effects between deterministic simulation (D hereafter) and stochastic simulation (S hereafter)
-the credit market
-the equity market
-the government securities market
-the inflation effect.

The overall discussions are left to the conclusion.

Stability in Stochastic Simulations

Table 11.3 indicates the number of relative SE that is above one out of 20 endogenous variables in each policy shock. There is no obvious difference between single and multiple policy changes. But this is not the case between S1 and S2. Comparing S1, more endogenous variables display relatively large SE in S2[9]. This indicates the instability of the endogenous variables in policy changes in the uncertainty, and that policies tend to be risky in S2.

[9] Bank rate in S1 indicates 15. This is largely due to the very small policy effects: in a majority of cases the change is less than 1%.

Table 11.3 Stability in stochastic simulation

Single policy	Number of relative SE above one	
	S1	S2
1. CRR	1	9
2. Bank rate	15	10
3. SLR	3	12
4. GSY(S1)/OMO(S2)	3	10
5. Deposit	3	11
6. Devaluation	7	8

Multiple policy	Number of relative SE above one	
	S1	S2
1.CRR/Bank Rate	1	9
2. CRR/SLR	4	18
3. CRR/Deposit	4	8
4. CRR/GSY(S1) /OMO(S2)	1	7
5. Deposit/Bank Rate	4	11
6. Deposit/SLR	2	10
7. Deposit/GSY(S1)/OMO(S2)	5	12
8. CRR/Deposit/SLR	1	11

Number of relative SE above one out of 20 endogenous variables.

Sign Consistency in Policy Effects Between Deterministic and Stochastic Simulations

Table 11.4 shows the number of endogenous variables with different signs between D and S on the policy effects out of twenty endogenous variables. In S1 as a whole, the number of inconsistent signs is relatively small, whereas in S2 in some policies there are quite a large number of endogenous variables, which have inconsistent signs, in particular SLR and Deposits/OMO(S2). The results in Table 11.3 and Table 11.4 are the overall indication that the uncertainty due to the coefficient estimates is more likely to alter the effectiveness of policies in the regime S2 of market-determined government securities' yields. Now we see more specifically this tendency in each market.

Table 11.4 Different simulated policy effects between Deterministic (D) and Stochastic (S) for the period 69-93

Single policy	Number of D ≠ S on sign	
	S1	S2
1. CRR	2	4
2. Bank rate	2	10
3. SLR	5	15
4. GSY(S1)/OMO(S2)	0	9
5. Deposit	2	14
6. Devaluation	4	13

Multiple policy	Number of D ≠ S on sign	
	S1	S2
1.CRR/Bank Rate	0	2
2. CRR/SLR	5	2
3. CRR/Deposit	4	5
4. CRR/GSY(S1) /OMO(S2)	1	5
5. Deposit/Bank Rate	2	13
6. Deposit/SLR	2	13
7. Deposit/GSY(S1)/OMO(S2)	5	16
8. CRR/Deposit/SLR	0	2

D=Deterministic simulation, S=Stochastic simulation
Number of D ≠ S on the sign of the % (or actual) change out of twenty endogenous variables.
% change less than 1% for both D and S is set at zero, except interest rates.

Credit Market

For the credit market, we present three types of tables, first for the policy effect on lending rates, second the impact on the flow of loans, and third the relevant relative SE.

Table 11.5 shows the simulated policy effect on lending rates (LR). Given an expansionary policy, the effect on LR in the main is negative. When S1 and S2 are compared, there is some dampening effect on LR observed in the controlled GSY (S1 regime) in D of multiple policies: LR falls more in S2 rather than in S1. In S, this is vigorously observed both in single and multiple policies, in particular, in CRR/Deposit the fall in LR increases by from 1.47% in S1 to 6.13% in S2. The implication is that policy uncertainty coupled with multiple policies has exerted a stronger expansionary effect with respect to loan rates in S2.

Table 11.5 Simulated policy effects on Lending rate (LR) for the period 69-93

Single policy (%)	S1		S2	
	D	S	D	S
1. CRR	– 0.46	– 1.02	– 1.69	– 3.80
2. Bank rate	0.00	– 0.01	– 0.24	– 0.43
3. SLR	– 0.48	1.35	– 0.06	3.98
4. GSY(S1)/OMO(S2)	– 1.05	– 1.90	– 0.54	– 1.10
5. Deposit	0.53	– 0.60	0.13	– 1.91
6. Devaluation	0.07	– 1.12	0.19	– 1.59

Multiple policy (%)	S1		S2	
	D	S	D	S
1.CRR/Bank Rate	– 0.47	– 1.03	– 1.91	– 4.29
2. CRR/SLR	– 1.21	– 0.03	– 1.81	– 4.19
3. CRR/Deposit	– 0.12	– 1.47	– 1.51	– 6.13
4. CRR/GSY(S1) /OMO(S2)	– 1.74	– 1.03	– 2.20	– 0.40
5. Deposit/Bank Rate	0.53	– 0.61	– 0.10	– 2.34
6. Deposit/SLR	– 0.22	0.75	0.01	2.07
7. Deposit/GSY(S1)/OMO(S2)	– 0.72	– 2.50	– 0.39	– 3.01
8. CRR/Deposit/SLR	– 0.91	– 0.48	– 1.74	– 2.21

D=Deterministic simulation, S=Stochastic simulation

Table 11.6a (single policy) and 11.6b (multiple policy) show the effects on the flow of loanable funds from both aspects of supply and demand. With BLA and OFILA, positive sign implies that they increase the supply of loans. With PCBLA and OFILA, positive sign implies an increase in their demand or in loan availability. The sign * indicates the magnitude.

In S1, both in single and multiple policies, S (stochastic simulation) almost replicates D (deterministic simulation). Therefore, the preferable instruments are the same for D and S, and they are those, which are not associated with SLR: the effect of lowering SLR is contractionary as indicated by the negative sign in both supply of and demand for loans.

However, in S2 a different outcome is observed in some policy instruments between D and S. In the single policy, the direction of the effect by SLR, Deposit and Devaluation is opposite between D and S. This is also observed in Bank rate and OMO but in a lesser degree. Likewise, multiple policies that are combined with Deposit, namely Deposit/Bank rate, Deposit/SLR and Deposit/OMO(S2) exhibit the opposite sign. Random shock in the model has reversed these policy effects, which have arrived at D, implying that these policies are sensitive to the true parameters of the model. Yet, there are desirable expansionary policy instruments in S2 that are robust in the uncertainty; these are the ones which involve CRR, but without SLR, namely CRR in a single policy and CRR/Bank Rate, CRR/Deposit and CRR/OMO(S2) in a multiple policy. In particular, CRR/OMO(S2) in S exhibits quite a large impact on loans as compared with D: the uncertainty has brought a larger expansionary effect.

There are some other general features, which are common to S1 and S2. First, the effect of Bank rate in single policy is weak even in S as shown with zeros. Second, in deterministic simulation, the OFIs played a leading role in releasing (or tightening) loans, rather than banks in India, as indicated with more * marks on OFILA. The evidence is also true in the uncertain world as Table 11.6a and 11.6b uncover the larger reshuffle in OFILA as compared with BLA. Third, evidence of the contractionary effect by lowering SLR in single policy is also found in multiple policy: the effect of CRR/SLR, Deposit/SLR and CRR/Deposit/SLR is largely dominated by SLR and therefore contractionary. In this respect, the policy impact of SLR is quite strong suppressing other policy effects in the loan market. Fourth, the gain from using more than one instrument is observed in CRR/Deposit and CRR/OMO(S2), in particular in S, rather than in CRR as a sole policy instrument. This is displayed with the increased number of * marks.

Table 11.6a Simulated policy effects on the flow of Loans for the period 69-93

Single policy		S1		S2	
		D	S	D	S
1. CRR	BLA	+	+	+	+
	OFILA	+ **	+ **	+ *	+ *
	PCBLA	+	+	+	+
	HLA	+	+	+	+
2. Bank Rate	BLA	0	0	0	0
	OFILA	0	0	+	–
	PCBLA	0	0	+	0
	HLA	0	0	+	0
3. SLR	BLA	0	–	0	– *
	OFILA	– ***	– ***	– ***	+ ***
	PCBLA	– *	– **	– *	+ *
	HLA	–	– *	–	+ *
4. GSY(S1)/OMO(S2)	BLA	+	+	+	+
	OFILA	+ **	+ **	+ *	–
	PCBLA	+	+	+	–
	HLA	+	+	+	0
5. Deposit	BLA	0	+	0	+
	OFILA	+ **	+ ***	+ *	– ***
	PCBLA	+ *	+ *	+	–
	HLA	+	+	+	–
6. Devaluation	BLA	0	+	0	+
	OFILA	+ **	+ ***	+ *	– ***
	PCBLA	+	+ *	+	–
	HLA	+	+	+	–

D=Deterministic simulation, S=Stochastic simulation

*, **, ***: more than 10%, 20% and 30% change respectively

0: less than 1% change

Table 11.6b. Simulated policy effects on the flow of Loans for the period 69-93

Multiple policy		S1 D	S1 S	S2 D	S2 S
1. CRR/Bank Rate	BLA	+	+	+	+
	OFILA	+ **	+ **	+ *	+ *
	PCBLA	+	+	+	+
	HLA	+	+	+	+
2. CRR/SLR	BLA	+	+	+	+
	OFILA	– ***	– ***	– **	– ***
	PCBLA	–	– ***	–	– *
	HLA	–	– *	–	–
3. CRR/Deposit	BLA	+	+	+	+ *
	OFILA	+ **	+ ***	+ *	+ ***
	PCBLA	+	+ **	+	+ *
	HLA	+	+ *	+	+ *
4. CRR/GSY(S1) CRR/OMO(S2)	BLA	+	+	+	– **
	OFILA	+ **	+ **	+ **	+ ***
	PCBLA	+	+	+	+ ***
	HLA	+	+	+	+ ***
5. Deposit/Bank Rate	BLA	0	+	0	+
	OFILA	+ **	+ ***	+ **	– ***
	PCBLA	+ *	+ *	+	–
	HLA	+	+	+	–
6. Deposit/SLR	BLA	0	–	0	–
	OFILA	– **	– ***	– **	+ ***
	PCBLA	–	– *	–	+
	HLA	–	–	–	+
7. Deposit/GSY(S1) Deposit/OMO(S2)	BLA	0	+	0	+
	OFILA	+ **	+ ***	+ **	– ***
	PCBLA	+ *	+ **	+	–
	HLA	+	+ *	+	–
8. CRR/Deposit/SLR	BLA	+	+	+	+
	OFILA	– *	– ***	–	–
	PCBLA	–	– *	0	0
	HLA	–	–	+	0

D=Deterministic simulation, S=Stochastic simulation
*, **, ***: more than 10%, 20% and 30% change respectively
0: less than 1% change

Table 11.7 shows the relative SE of the stochastic simulation policy effects on the flow of loans in the financial institutions. In general, the relative SE is above one in S2, as we expect from the overall result in Table 11.3[10].

The relative SE of OFILA tends to be larger than that of BLA, especially in S2 in the main the relative SE is above one, implying the instability of OFILA. In other words, although we have found the leading role of OFIs in terms of supplying loans, the

[10] Bank rate in S1 shows relatively high SEs for BLA and OFILA in Table 11.7. This is due to virtually no policy effect as indicated '0' (less than 1% change) in Table 11.6a.

policies are risky in OFILA. This may not be unreasonable for the less regulated other financial institutions.

Being associated with OFILA in S2, when policies are compared to each other, the relatively risky policies are CRR/SLR with the SE at 2.77, Deposit/OMO(S2) at 2.2 and CRR/Deposit/SLR at 3.1 in the multiple policy, whereas the most risky policy is OMO(S2) at 5.3 in the single policy. The latter is not surprising; this could be due to the underdeveloped capital market in the conduct of open market operations.

By contrast, less risky policies are associated with BLA in S2 and they are CRR (with the SE at 0.1), CRR/Bank rate (at 0.1) and CRR/Deposit (0.12). This again indicates the robustness of CRR in the uncertainty with respect to the relative SE.

Table 11.7 Relative SE of the simulated policy effects on the flow of Loans

Single policy		S1	S2
1. CRR	BLA OFILA	0.307 0.839	0.101 1.861
2. Bank Rate	BLA OFILA	6.044 15.948	0.334 1.355
3. SLR	BLA OFILA	0.335 0.591	0.238 1.158
4. GSY(S1)/OMO(S2)	BLA OFILA	0.556 0.571	0.558 5.378
5. Deposit	BLA OFILA	0.844 0.610	0.246 1.244
6. Devaluation	BLA OFILA	1.296 0.642	0.307 1.102

Multiple policy		S1	S2
1. CRR/Bank Rate	BLA OFILA	0.313 0.858	0.104 1.847
2. CRR/SLR	BLA OFILA	1.408 0.609	1.048 2.772
3. CRR/Deposit	BLA OFILA	0.746 0.699	0.126 1.644
4. CRR/GSY(S1) CRR/OMO(S2)	BLA OFILA	0.313 0.858	1.311 0.967
5. Deposit/Bank Rate	BLA OFILA	0.843 0.619	0.241 1.228
6. Deposit/SLR	BLA OFILA	0.987 0.602	0.245 1.101
7. Deposit/GSY(S1) Deposit/OMO(S2)	BLA OFILA	0.685 0.577	0.475 2.230
8. CRR/Deposit/SLR	BLA OFILA	0.391 0.549	0.242 3.180

Stock market

Table 11.8 presents the policy effects on RS. The sign between D and S is almost identical in S1. This is not true in S2. There is a tendency that RS is more volatile in the multiple policies, in particular, in S of S2, RS exhibits a extremely volatile movement in CRR/SLR and CRR/OMO(S2). Such a volatility in RS (or share prices) may not be implausible in India; in the post-reform era there is an unprecedented upsurge of activity experienced in the stock market and the BSE (Bombay Stock Exchange) Sensex recorded the increase by 266.9% (in 1992-93). It seems that the multiple policies, when given a stochastic shock, will bring a magnifying volatility to the already volatile share prices in India.

Table 11.8 Simulated policy effects on Return on Shares (RS) for the period 69-93

Single policy (%)	S1		S2	
	D	S	D	S
1. CRR	44.66	59.26	53.68	-26.12
2. Bank rate	0.44	-0.50	8.49	-8.32
3. SLR	-85.00	-118.15	-91.45	118.75
4. GSY(S1)/OMO(S2)	49.76	28.57	28.58	-45.58
5. Deposit	60.57	53.95	55.60	-54.18
6. Devaluation	66.13	68.23	51.25	-43.52

Multiple policy (%)	S1		S2	
	D	S	D	S
1.CRR/Bank Rate	45.04	58.75	56.69	-30.67
2. CRR/SLR	-68.23	-212.65	-57.90	-829.03
3. CRR/Deposit	83.57	189.46	73.86	-59.62
4. CRR/GSY(S1) /OMO(S2)	68.44	58.75	67.21	616.05
5. Deposit/Bank Rate	60.79	53.45	59.01	-62.75
6. Deposit/SLR	-50.72	-64.20	-55.16	64.57
7. Deposit/GSY(S1)/OMO(S2)	84.44	82.51	71.15	-247.39
8. CRR/Deposit/SLR	-29.61	-82.44	-7.24	-117.84

D=Deterministic simulation, S=Stochastic simulation

Government Securities Market

Table 11.9 is associated with the government securities' market. S1 presents the policy effects on the total government debt (GGD), whereas S2 presents the effects on government securities yields (GSY).

For both D and S, the proportionate change on GGD is less than 10% with a mixed sign of positive and negative impact, though more positive signs than negative signs are observed. This suggests the popularity of government securities in that investors are reluctant to disinvest government debt, even though, in general, policy action is intended to release funds from the government sector.

With respect to the change in GSY, on average, the yields tend to fall. There is some marked difference between D and S in CRR/OMO(S2) and CRR/SLR. CRR/OMO(S2) shows a large fall in GSY by 7.02% in S in comparison with 2.86% in D. CRR/SLR exhibits an increase of 5.43% in S as against a fall of 0.90% in D. The results indicate that GSY is vulnerable to these policy instruments. It is noteworthy that the two multiple policies also led to a volatile movement in RS as discussed above, indicating the sensitiveness to the uncertainty with respect to these interest rates.

Tables 11.10a (single policy) and 11.10b (multiple policy) present the simulated policy effects on excess reserves (ER) and government debt (GD) sector-wise. This is to examine how the funds in the government sector are released in each sector by the policy changes. The presentation of BER and BGD will uncover the substitution effects between the risk-free assets in the banking sector. As is consistent with GGD in Table 11.9, overall more positive signs are found in GD, in particular HGD in a single policy. In D, the substitution effects (given by the opposite sign between BER and BGD) are observed in 13 out of 28 cases. In the case of S, especially in regime S2, the substitution effects are found in almost all policy changes.

Table 11.9 Simulated policy effects on the total Government Debt (GGD) and Government Securities' Yields (GSY) for the period 69-93

Single policy	S1 (GGD)		S2 (GSY: %)	
	D	S	D	S
1. CRR	+	+	-1.73	-1.13
2. Bank rate	0	0	-0.40	-0.27
3. SLR	–	–	0.63	-0.81
4. GSY(S1)/OMO(S2)	–	–	-1.33	-0.61
5. Deposit	+	+	-0.48	0.33
6. Devaluation	0	0	0.35	1.08

Multiple policy	S1 (GGD)		S2 (GSY: %)	
	D	S	D	S
1.CRR/Bank Rate	+	+	-2.09	-1.43
2. CRR/SLR	+	–	-0.90	5.43
3. CRR/Deposit	+	+	-1.85	-0.93
4. CRR/GSY(S1) /OMO(S2)	0	+	-2.86	-7.02
5. Deposit/Bank Rate	+	+	-0.83	0.07
6. Deposit/SLR	–	–	0.35	-0.48
7. Deposit/GSY(S1)/OMO(S2)	–	–	-1.65	1.19
8. CRR/Deposit/SLR	+	+	-1.34	-0.39

D=Deterministic simulation, S=Stochastic simulation
GGD: They are all less than 10 %.
0: less than 1% change

Table 11.10a. Simulated policy effects on Excess Reserves (ER) and Government Debt (GD) for the period 69-93

Single policy		S1		S2	
		D	S	D	S
1. CRR	BER	– ***	– ***	– *	– ***
	BGD	0	+	0	+
	OFIGD	–	–	–	0
	HGD	+	+	+	0
2. Bank Rate	BER	– *	– *	– *	– *
	BGD	+	+	+	+
	OFIGD	0	0	–	+
	HGD	0	0	0	–
3. SLR	BER	+	+ ***	+	+ ***
	BGD	+	+ *	+ *	– *
	OFIGD	+ *	+ **	+ *	– ***
	HGD	– *	– **	– *	+ **
4. GSY(S1)/OMO(S2)	BER	+	+	+	+
	BGD	– *	–	–	–
	OFIGD	– *	–	– *	+
	HGD	+	+	+	+
5. Deposit	BER	–	– *	0	– **
	BGD	–	–	–	+
	OFIGD	– *	– *	–	+ *
	HGD	+	+ *	+	– *
6. Devaluation	BER	–	– **	–	– **
	BGD	–	–	–	+
	OFIGD	– *	– *	–	+ *
	HGD	+	+	+	– *

D=Deterministic simulation, S=Stochastic simulation

*, **, ***: more than 10%, 20% and 30% change respectively

0: less than 1% change

Table 11.10b Simulated policy effects on Excess Reserves and Government Securities Market for the period 69-93

Multiple policy		S1		S2	
		D	S	D	S
1. CRR/Bank Rate	BER	– ***	– ***	– **	– ***
	BGD	+	+	+	+
	OFIGD	–	–	–	0
	HGD	+	+	+	0
2. CRR/SLR	BER	– *	+	– *	–
	BGD	+ *	+ **	+ *	+ *
	OFIGD	+ *	+ ***	+ *	+ *
	HGD	–	– **	–	– *
3. CRR/Deposit	BER	– ***	– ***	– *	– ***
	BGD	+	–	0	–
	OFIGD	–	– **	–	–
	HGD	+	+ **	+	+
4. CRR/GSY(S1) CRR/OMO(S2)	BER	– *	– ***	– *	+ ***
	BGD	– *	–	–	– ***
	OFIGD	– *	–	–	– ***
	HGD	+	+	+	+ ***
5. Deposit/Bank Rate	BER	– **	– ***	– *	– ***
	BGD	–	–	–	+
	OFIGD	– *	– *	–	+ **
	HGD	+	+	+	– *
6. Deposit/SLR	BER	+	+ **	+	+ **
	BGD	+	+	+	–
	OFIGD	+	+ *	+ *	– **
	HGD	–	– *	–	+ *
7. Deposit/GSY(S1) Deposit/OMO(S2)	BER	+	– *	+	– *
	BGD	–	– *	–	+
	OFIGD	– *	– **	– *	+ *
	HGD	+	+ *	+	– *
8. CRR/Deposit/SLR	BER	– **	– *	– *	– *
	BGD	+ *	+ *	+	+
	OFIGD	+	+ *	+	+
	HGD	–	– *	–	–

D=Deterministic simulation, S=Stochastic simulation

*, **, ***: more than 10%, 20% and 30% change respectively

0: less than 1% change

Inflationary Effects

The policy simulation has been focused on an expansionary policy. India, like many other developing economies, has however been implementing stabilization policy-packages aimed at restoring macroeconomic balance. It is therefore important to see how these policies affect the rate of inflation. The inflationary effect can be measured by observing the flow of currency in the household sector caused by the policy shock, though this is a crude manner. This is associated with Monetarist view that when an increase in the rate of growth in the quantity of money exceeds that in output, the rate of inflation would be higher than otherwise. See Table 11.11.

Table 11.11 Simulated policy effects on holding Narrow Money (HCUR) for the period 69-93

Single policy	S1		S2	
	D	S	D	S
1. CRR	–	+	+	+ *
2. Bank rate	0	0	+	+
3. SLR	+	–	+	–
4. GSY(S1)/OMO(S2)	+	+ *	+	+
5. Deposit	– *	–	–	–
6. Devaluation	–	+ *	+	+

Multiple policy	S1		S2	
	D	S	D	S
1.CRR/Bank Rate	–	+	+	+ *
2. CRR/SLR	+	+	+ *	+
3. CRR/Deposit	– *	–	–	+ *
4. CRR/GSY(S1) /OMO(S2)	+	+	+ *	+ ***
5. Deposit/Bank Rate	– *	–	–	–
6. Deposit/SLR	–	–	–	–
7. Deposit/GSY(S1)/OMO(S2)	–	+	–	+
8. CRR/Deposit/SLR	–	–	–	+

D=Deterministic simulation, S=Stochastic simulation
*, **, ***: more than 10%, 20% and 30% change respectively
0: less than 1% change

The inflationary effect by these policy changes is generally modest, given by less * marks on the positive sign. The policies, which involve Deposit rates tend to contain the inflationary effect as, in many cases, indicated by the negative sign[11]. In this respect, policies incorporating the removal of a ceiling on deposit rates may exert an expansionary effect with potentially the least cost of inflation, even in a world of uncertainty. An increase in deposit rates in order to contain the rate of inflation, this policy action was actually taken in Korea (during 1964-70) and Taiwan (in the 1960's) with some fruitful results (McKinnon, 1973). By contrast, there is a warning against the policy choice CRR/OMO(S2) given by a more than 30% increase in S. This multiple policy may induce higher rates of inflation faced with the uncertainty.

11.4 Summary and Concluding Remarks

Stochastic simulation is conducted by incorporating random shocks to the estimated price coefficients of the financial institutions, and the results are compared with those of deterministic simulation. The results obtained with the stochastic simulations help distinguish between unfavourable and favourable policy instruments in a more vigorous manner than do deterministic simulations only. The stochastic simulations have uncovered evidence, which deterministic simulations have not brought out, as some of the policy effects have been reversed in S2. This procedure models an important aspect of the uncertainty in policy-making, and the results support the argument that policy must be more cautious if there is policy uncertainty.

We summarise the main results in policy instrument in terms of the effectiveness to a flow of loanable funds in Table 11.12.

[11] This outcome is consistent with that in the single sector study for the household sector. Given a substitution effect between deposits and currency, as deposit rates increase, the holdings of currency fall in the household sector.

Table 11.12 Effectiveness to a flow of loanable funds by policy shock

Policy	Effectiveness to a flow of loanable funds
CRR	-Desirable effects are found in a single and multiple policies (except CRR/SLR). - Policy is robust in the uncertainty. -CRR/SLR and CRR/OMO(S2) in S2 led to volatile change in RS and also a lesser degree in government securities' yields in stochastic simulation. -CRR/OMO(S2) and CRR/Deposit have a potency to exert a large preferable impact in stochastic simulation, but the former is with the cost of a potential higher rate of inflation.
Bank rate	- The policy effect is persistently weak even in stochastic simulations.
SLR	- In S1, the effects of a decrease in SLR are contractionary in both deterministic and stochastic simulations. - In multiple policy, it suppresses other expansionary policy effects. - In S2 the policy is sensitive in a sense that uncertainty reverses the results arrived at deterministic simulation, but this in turn brings an expansionary effect.
GSY(S1)	-Desirable effects are found, and the policy is insensitive to the uncertainty. -However, the substitution effects between BER and BGD may dilute the preferable effect.
OMO(S2)	-Desirable effects are found in deterministic simulations, but sensitive to the true structure of the model. -This policy turns out to be the most risky policy instrument among others with respect to the relative SE.
Deposit	-In S1, desirable effects are found for the single and multiple policies (except with SLR) with an additional preferable effect by potentially suppressing a rate of inflation. -But in S2, uncertainty reverse results obtained in the deterministic simulations.
Devaluation	-The impact is desirable, but in S2 uncertainty reverse results arrived at deterministic simulations.

Empirical evidence provides a number of policy implications.

i) With respect to delivering funds in the private sector, we have found that CRR and Deposit policy instrument were the most desirable policies in Chapter 9. The stochastic simulation experiments reveal that CRR is robust to the true parameters, whereas Deposit is sensitive to the true parameters in S2, hence the true structure of the Indian economy. But when CRR and Deposit are combined, the policy becomes more robust, in that, not only is it insensitive to the uncertainty in S2, but also the magnitude of the effect increases. Further, in terms of the instability (measured by the relative SE) in the uncertainty, CRR/Deposit proved to be less risky policy (Table 11.7)[12]. In this respect, in order to achieve the target of increasing a flow of loanable funds to private sectors, CRR/Deposit of multiple policy may be the most desirable policy instrument in the spectrum of our study.

ii) The study also reveals that in the uncertainty, multiple-policies such as CRR/Deposit and CRR/OMO(S2) have generated better results than a single-policy by augmenting the expansionary effect in the credit market. On the other hand, a multiple-policy of CRR/SLR and CRR/OMO(S2) has disturbed the financial markets with the extremely volatile movement of the return on shares. The latter may be taken as a warning in implementing multiple instruments, as Brainard (1967) hinted that a multiple-policy stance could lead to an unexpected volatility in the world of uncertainty.

iii) In the deterministic simulation in Chapter 9, there is not a marked difference in policy change between S1 and S2. However, in stochastic simulation, there is a considerable difference between the two regimes. Evidence suggests that the contribution of the uncertainty of the coefficient estimates to the effectiveness of policies is relatively small in S1. By contrast, in S2 this is large; further the relative SE tends to indicate the instability of the endogenous variables in S2. This demonstrates that the estimated system-wide model may be robust in S1, but exposes some weakness in S2. Alternatively, it can be argued that the policies are robust in S1, whereas they are unstable in S2. If the latter argument is true rather than the former, there is some awareness in the liberalisation of interest rates in terms of the effectiveness of policies. In particular, new evidence suggests that in an environment, where GSY are completely liberalised (i.e. S2 regime) with the removal of the deposit rate ceiling, policy instruments become sensitive to the uncertainty, which exists in the financial institutions in India.

[12] Specifically, while the average relative SE of BLA, OFILA, PCBLA and HLA for CRR is 0.8925 and that for Deposit 1.2115, it is 0.877 when both policies are simultaneously conducted (Appendices 11.1a, 11.1c and 11.2b).

iv) The stochastic policy experiments emphasise the popularity of government securities and a substitution effect between risk-free assets in the banking sector. The latter is founds to be stronger in the uncertainty.

Appendix 11.1a Simulated Expansionary Policy Effects: Deterministic and Stochastic (500) means for the period 69-93 (Rs. Crores for Actual changes)

CRR	S1: Deterministic		S1: Stochastic		Standard Error		S2: Deterministic		S2: Stochastic		Standard Error	
	% change	Actual	% change	Actual	Absolute	Relative	% change	Actual	% change	Actual	Absolute	Relative
BER	-34.19	-1433.01	-35.56	-1516.05	41.57	0.027	-16.99	-711.89	-38.40	-1622.18	110.77	0.068
BGD	-0.27	-55.51	3.10	643.79	479.72	0.745	-0.79	-162.77	1.13	236.74	787.43	3.326
BCS	19.06	1593.41	14.36	1183.04	876.29	0.741	13.54	1132.01	0.91	72.36	1023.71	14.147
BLA	3.51	1544.24	3.05	1338.69	410.44	0.307	3.16	1391.79	6.73	2962.67	300.68	0.101
OFIGD	-6.90	-1873.83	-5.47	-1495.36	2070.99	1.385	-6.52	-1770.00	-0.23	-64.46	2595.15	40.263
OFICS (-)	74.86	2640.24	83.59	2743.93	1486.87	0.542	51.85	1828.71	89.59	2421.57	2042.65	0.844
OFILA	20.98	4514.10	20.10	4239.32	3556.40	0.839	16.72	3598.73	12.63	2486.03	4627.01	1.861
PCBCS (-)	-67.41	-3143.70	-60.26	-2972.90	1778.13	0.598	-45.27	-2111.34	-50.32	-2842.15	2422.62	0.852
PCBLA (-)	9.10	3220.94	8.46	2972.90	1778.13	0.598	6.60	2338.33	8.26	2842.15	2422.62	0.852
PCBDEP	1.93	77.25	0.00	0.00	0.00	0.000	5.68	227.00	0.00	0.00	0.00	0.000
HCUR	-6.68	-1504.90	1.83	411.25	302.21	0.735	7.93	1788.32	15.40	3439.73	445.21	0.129
HDEP	0.69	467.51	-0.69	-471.57	372.05	0.789	0.51	346.74	-0.25	-167.97	445.67	2.653
HGD	9.80	5971.65	6.74	4077.36	3216.93	0.789	3.17	1931.77	-0.29	-172.28	3381.25	19.626
HCS	-14.46	-2096.87	-9.64	-1412.00	1161.97	0.823	-9.75	-1414.63	-3.27	-492.94	1401.83	2.844
HLA (-)	6.87	2837.39	6.34	2605.11	1384.17	0.531	6.42	2652.19	6.44	2606.56	1969.34	0.756
GER	-34.19	-1433.01	-35.56	-1516.05	41.57	0.027	-16.99	-711.89	-38.40	-1622.18	110.77	0.068
DEP	0.61	544.75	-0.52	-471.57	372.05	0.789	0.64	573.74	-0.19	-167.97	445.67	2.653
GGD/GSY%	5.15	4042.30	4.12	3225.79	667.15	0.207		-1.73		-1.13	0.52	0.463
LR %		-0.46		-1.02	0.52	0.511		-1.69		-3.80	0.30	0.079
RS %		44.66		59.26	47.25	0.797		53.68		-26.12	65.13	2.494
Bank rate	**S1: Deterministic**		**S1: Stochastic**		**Standard Error**		**S2: Deterministic**		**S2: Stochastic**		**Standard Error**	
	% change	Actual	% change	Actual	Absolute	Relative	% change	Actual	% change	Actual	Absolute	Relative
BER	-14.02	-587.40	-13.74	-585.95	11.76	0.020	-11.88	-497.99	-13.67	-577.35	27.55	0.048
BGD	2.75	565.55	2.80	581.46	61.80	0.106	1.06	218.93	2.79	586.99	179.91	0.306
BCS	0.19	15.67	-0.07	-5.70	113.07	19.838	2.51	210.27	-3.39	-268.76	239.17	0.890
BLA	0.01	6.18	0.02	10.34	62.53	6.044	0.16	68.78	0.59	259.29	86.58	0.334
OFIGD	-0.06	-16.63	0.08	22.58	281.19	12.454	-2.15	-583.27	1.81	510.43	636.69	1.247
OFICS (-)	0.61	21.45	-0.20	-6.70	186.38	27.801	11.20	395.10	-11.29	-305.28	470.04	1.540
OFILA	0.18	38.08	-0.14	-29.28	466.99	15.948	4.55	978.37	-4.15	-815.71	1105.04	1.355
PCBCS (-)	-0.46	-21.50	0.22	10.74	230.67	21.469	-10.68	-497.87	6.00	338.63	571.85	1.689
PCBLA (-)	0.06	22.55	-0.03	-10.74	230.67	21.469	1.47	521.20	-0.98	-338.63	571.85	1.689
PCBDEP	0.03	1.05	0.00	0.00	0.00	0.000	0.58	23.34	0.00	0.00	0.00	0.000
HCUR	-0.05	-10.16	0.02	5.37	48.57	9.050	1.96	442.42	2.14	478.91	96.31	0.201
HDEP	0.00	2.80	0.00	3.05	50.03	16.421	0.05	33.25	0.14	98.62	107.69	1.092
HGD	0.07	44.80	-0.04	-26.35	432.62	16.421	0.60	363.33	-1.84	-1097.42	815.96	0.744
HCS	-0.11	-15.72	0.07	9.74	156.82	16.101	-2.16	-313.04	2.00	302.11	339.72	1.124
HLA (-)	0.05	21.71	-0.02	-8.19	178.55	21.794	1.27	525.95	-0.54	-217.79	462.61	2.124
GER	-14.02	-587.40	-13.74	-585.95	11.76	0.020	-11.88	-497.99	-13.67	-577.35	27.55	0.048
DEP	0.00	3.86	0.00	3.05	50.03	16.420	0.06	56.59	0.11	98.62	107.69	1.092
GGD/GSY%	0.76	593.71	0.74	577.69	90.63	0.157		-0.40		-0.27	0.08	0.306
LR %		0.00		-0.01	0.06	6.890		-0.24		-0.43	0.05	0.114
RS %		0.44		-0.50	4.07	8.109		8.49		-8.32	10.24	1.231

% and actual change: mean values of the proportionate and actual changes respectively by simulated policy changes over the period of 1969-93. Since the deterministic simulation consists of a single run, the deterministic mean is a straight mean, whereas the stochastic mean is a mean of 500 runs. Standard Error: SE = SD / $\sqrt{500}$ and SD = Standard Deviation of the stochastic change, Relative Standard Error = SE / Stochastic change. CRR 2% reduction increases the mean value of BW by around 1649 Rs. crores during the period of 1969-93.
Deterministic simulation is the reproduction of Table 9.6 in Chapter 9. Rs. crores = 10 million rupees.

Appendix 11.1b Simulated Expansionary Policy Effects: Deterministic and Stochastic (500) means for the period 69-93 (Rs. Crores for Actual changes)

SLR	S1: Deterministic		S1: Stochastic		Standard Error		S2: Deterministic		S2: Stochastic		Standard Error	
	% change	Actual	% change	Actual	Absolute	Relative	% change	Actual	% change	Actual	Absolute	Relative
BER	8.00	335.34	39.98	1704.32	150.27	0.088	2.41	101.05	46.68	1972.07	364.13	0.185
BGD	8.35	1720.36	12.40	2573.52	1234.33	0.480	10.71	2205.75	-10.40	-2183.26	3120.08	1.429
BCS	-27.54	-2302.88	-35.39	-2915.39	2359.05	0.809	-29.68	-2481.71	58.35	4630.56	3999.57	0.864
BLA	0.56	247.21	-3.10	-1362.41	1205.36	0.885	0.40	174.94	-10.05	-4419.29	1053.67	0.238
OFIGD	15.20	4127.10	27.14	7421.73	5548.09	0.748	17.95	4874.15	-40.46	-11399.61	10653.95	0.935
OFICS (-)	-101.19	-3568.94	-264.00	-8666.27	3972.11	0.458	-111.47	-3931.60	186.04	5028.64	8410.78	1.673
OFILA	-35.77	-7696.08	-76.29	-16088.07	9511.24	0.591	-40.92	-8805.79	83.49	16428.36	19031.32	1.158
PCBCS (-)	82.66	3854.87	208.31	10277.24	4694.03	0.457	92.88	4331.42	-108.29	-6116.16	10126.11	1.656
PCBLA (-)	-12.18	-4313.30	-29.25	-10277.24	4694.03	0.457	-13.68	-4844.84	17.77	6116.16	10126.11	1.656
PCBDEP	-11.47	-458.42	0.00	0.00	0.00	0.000	-12.85	-513.42	0.00	0.00	0.00	0.000
HCUR	9.77	2202.44	-1.47	-330.16	816.46	2.473	4.79	1080.56	-0.88	-195.90	1838.77	9.386
HDEP	-0.91	-618.03	2.19	1486.87	984.19	0.662	-0.98	-667.17	-2.61	-1776.23	1816.63	1.023
HGD	-12.00	-7308.76	-21.25	-12856.13	8509.70	0.662	-11.62	-7080.90	22.83	13582.88	13768.51	1.014
HCS	17.85	2588.82	30.89	4526.36	3074.46	0.679	19.87	2881.53	-37.90	-5718.08	5712.88	0.999
HLA (-)	-7.59	-3135.57	-17.46	-7173.24	3653.58	0.509	-9.16	-3786.01	14.56	5892.90	8053.29	1.367
GER	8.00	335.34	39.98	1704.32	150.27	0.088	2.41	101.05	46.68	1972.07	364.13	0.185
DEP	-1.20	-1076.45	1.65	1486.87	984.19	0.662	-1.31	-1180.58	-1.97	-1776.23	1816.63	1.023
GGD/GSY%	-1.86	-1461.31	-3.65	-2860.88	1730.45	0.605		0.63		-0.81	2.08	2.568
LR %		-0.48		1.35	2.06	1.524		-0.06		3.98	1.23	0.308
RS %		-85.00		-118.15	156.71	1.326		-91.45		118.75	254.88	2.146
GSY(S1)	S1: Deterministic		S1: Stochastic		Standard Error		S2: Deterministic		S2: Stochastic		Standard Error	
OMO(S2)	% change	Actual	% change	Actual	Absolute	Relative	% change	Actual	% change	Actual	Absolute	Relative
BER	6.79	284.39	2.90	123.78	48.71	0.394	7.25	303.75	2.77	116.88	107.84	0.923
BGD	-10.29	-2118.91	-6.87	-1426.57	372.52	0.261	-8.28	-1704.65	-1.34	-281.09	814.16	2.897
BCS	16.46	1376.50	7.83	645.33	709.30	1.099	11.36	950.29	-5.15	-408.66	1016.08	2.486
BLA	1.04	458.00	1.50	657.61	365.85	0.556	1.02	450.59	1.30	572.94	319.52	0.558
OFIGD	-13.30	-3613.18	-9.84	-2690.06	1687.40	0.627	-10.64	-2890.67	2.00	564.77	2835.60	5.021
OFICS (-)	73.78	2602.10	71.41	2344.02	1190.91	0.508	50.83	1792.86	-12.64	-341.60	2043.06	5.981
OFILA	28.88	6215.30	23.87	5034.09	2875.30	0.571	21.77	4683.54	-4.61	-906.39	4874.87	5.378
PCBCS (-)	-72.92	-3400.66	-60.57	-2988.11	1419.13	0.475	-48.43	-2258.56	11.42	644.72	2562.51	3.975
PCBLA (-)	9.85	3489.32	8.50	2988.11	1419.13	0.475	6.68	2365.23	-1.87	-644.72	2562.51	3.975
PCBDEP	2.22	88.67	0.00	0.00	0.00	0.000	2.67	106.67	0.00	0.00	0.00	0.000
HCUR	5.62	1266.59	13.70	3083.93	257.01	0.083	6.23	1405.06	8.62	1925.27	437.80	0.227
HDEP	0.51	348.25	-0.58	-395.32	299.36	0.757	1.77	1198.09	1.43	970.50	484.01	0.499
HGD	6.14	3744.20	2.16	1304.36	2588.40	1.984	4.97	3025.27	-3.11	-1852.72	3648.79	1.969
HCS	-15.00	-2175.06	-8.80	-1289.42	935.80	0.726	-9.76	-1416.00	4.72	711.77	1529.03	2.148
HLA (-)	7.70	3183.98	6.58	2703.59	1102.45	0.408	6.70	2768.91	0.77	311.28	2065.50	6.636
GER	6.79	284.39	2.90	123.78	48.71	0.394	7.25	303.75	2.77	116.88	107.84	0.923
DEP	0.49	436.92	-0.44	-395.32	299.36	0.757	1.45	1304.76	1.08	970.50	484.01	0.499
GGD/GSY%	-2.53	-1987.90	-3.59	-2812.27	529.49	0.188		-1.33		-0.61	0.39	0.633
LR %		-1.05		-1.90	0.60	0.317		-0.54		-1.10	0.14	0.131
RS %		49.76		28.57	45.31	1.586		28.58		-45.58	43.42	0.953

% and actual change: mean values of the proportionate and actual changes respectively by simulated policy changes over the period of 1969-93. Since the deterministic simulation consists of a single run, the deterministic mean is a straight mean, whereas the stochastic mean is a mean of 500 runs. Standard Error: SE = SD / $\sqrt{500}$ and SD = Standard Deviation of the stochastic change, Relative Standard Error = SE / Stochastic change. OMO 2% purchases increase the mean value of HW by around 1444 Rs. crores during the period of 1969-93.
Deterministic simulation is the reproduction of Table 9.6 in Chapter 9. Rs. crores = 10 million rupees.

Appendix 11.1c Simulated Expansionary Policy Effects: Deterministic and Stochastic (500) means for the period 69-93 (Rs. Crores for Actual changes)

Deposit	S1: Deterministic		S1: Stochastic		Standard Error		S2: Deterministic		S2: Stochastic		Standard Error	
	% change	Actual	% change	Actual	Absolute	Relative	% change	Actual	% change	Actual	Absolute	Relative
BER	-7.13	-298.87	-19.21	-818.79	81.04	0.099	-0.40	-16.63	-22.46	-948.85	184.71	0.195
BGD	-6.16	-1269.39	-5.34	-1107.44	640.97	0.579	-4.67	-961.33	5.72	1200.67	1588.29	1.323
BCS	16.23	1357.11	14.40	1186.05	1218.96	1.028	10.71	895.75	-31.65	-2511.94	2034.99	0.810
BLA	0.48	211.13	1.69	740.16	624.89	0.844	0.19	82.20	5.14	2260.08	555.05	0.246
OFIGD	-11.52	-3128.54	-14.01	-3832.39	2898.20	0.756	-8.95	-2430.05	19.12	5388.33	5468.71	1.015
OFICS (-)	74.98	2644.52	130.22	4274.58	2052.14	0.480	50.81	1792.09	-89.37	-2415.79	4255.85	1.762
OFILA	26.83	5773.09	38.44	8107.01	4945.41	0.610	19.62	4222.16	-39.66	-7804.16	9708.66	1.244
PCBCS (-)	-73.69	-3436.33	-108.92	-5373.69	2443.85	0.455	-50.09	-2336.05	46.79	2642.52	5154.16	1.950
PCBLA (-)	10.16	3596.78	15.18	5334.00	2443.85	0.458	7.23	2558.46	-7.79	-2682.21	5154.16	1.922
PCBDEP	4.02	160.46	-0.99	-39.69	0.00	0.000	5.57	222.42	-0.99	-39.69	0.00	0.000
HCUR	-15.76	-3552.87	-5.95	-1338.69	437.85	0.327	-9.61	-2167.35	-5.91	-1320.23	923.54	0.700
HDEP	3.08	2092.90	1.04	708.29	514.32	0.726	2.89	1962.58	3.39	2308.81	931.35	0.403
HGD	9.84	5996.30	10.62	6428.63	4447.04	0.692	5.56	3390.36	-11.07	-6589.00	7054.30	1.071
HCS	-14.82	-2148.91	-15.60	-2285.16	1607.51	0.703	-9.93	-1439.71	18.15	2738.68	2931.00	1.070
HLA (-)	5.78	2387.44	8.55	3513.18	1897.57	0.540	4.22	1745.89	-7.07	-2861.87	4102.88	1.434
GER	-7.13	-298.87	-19.21	-818.79	81.04	0.099	-0.40	-16.63	-22.46	-948.85	184.71	0.195
DEP	2.50	2253.37	0.74	668.60	514.32	0.769	2.43	2185.00	2.52	2269.11	931.35	0.410
GGD/GSY%	2.04	1598.37	1.90	1488.80	909.50	0.611		-0.48		0.33	1.01	3.064
LR %		0.53		-0.60	1.04	1.729		0.13		-1.91	0.60	0.314
RS %		60.57		53.95	78.71	1.459		55.60		-54.18	123.57	2.281
Devaluation	**S1: Deterministic**		**S1: Stochastic**		**Standard Error**		**S2: Deterministic**		**S2: Stochastic**		**Standard Error**	
	% change	Actual	% change	Actual	Absolute	Relative	% change	Actual	% change	Actual	Absolute	Relative
BER	-8.10	-339.35	-21.63	-922.28	91.32	0.099	-6.62	-277.37	-26.09	-1101.95	161.34	0.146
BGD	-5.72	-1177.02	-4.52	-938.90	699.24	0.745	-3.51	-723.07	7.80	1638.09	1352.11	0.825
BCS	18.76	1568.28	16.13	1328.76	1333.13	1.003	13.88	1160.98	-27.28	-2164.72	1741.86	0.805
BLA	-0.12	-51.93	1.21	532.40	690.24	1.296	-0.36	-160.57	3.70	1628.48	499.18	0.307
OFIGD	-10.43	-2833.23	-13.00	-3555.27	3159.15	0.889	-7.30	-1982.47	19.80	5578.94	4673.92	0.838
OFICS (-)	86.31	3044.04	147.02	4826.29	2227.19	0.461	64.89	2288.58	-70.92	-1916.97	3601.53	1.879
OFILA	27.31	5877.30	39.75	8381.60	5380.92	0.642	19.85	4271.07	-38.09	-7495.95	8262.36	1.102
PCBCS (-)	-61.44	-2865.31	-100.86	-4975.80	2650.11	0.533	-40.49	-1888.07	56.27	3177.94	4367.37	1.374
PCBLA (-)	8.74	3093.14	14.16	4975.80	2650.11	0.533	6.02	2131.69	-9.23	-3177.94	4367.37	1.374
PCBDEP	5.70	227.84	0.00	0.00	0.00	0.000	6.10	243.63	0.00	0.00	0.00	0.000
HCUR	-0.08	-18.71	10.78	2426.53	481.53	0.198	1.69	380.16	5.52	1232.06	774.27	0.628
HDEP	-0.32	-218.25	-2.48	-1685.88	560.59	0.333	-0.51	-345.40	-0.19	-130.13	795.32	6.112
HGD	7.15	4358.72	7.73	4675.71	4847.08	1.037	4.44	2704.53	-12.13	-7217.03	6023.79	0.835
HCS	-9.58	-1389.54	-10.09	-1478.27	1752.45	1.185	-5.24	-760.47	22.70	3425.68	2504.09	0.731
HLA (-)	6.61	2732.23	9.59	3938.19	2063.67	0.524	4.79	1978.81	-6.65	-2689.53	3487.28	1.297
GER	-8.10	-339.35	-21.63	-922.28	91.32	0.099	-6.62	-277.37	-26.09	-1101.95	161.34	0.146
DEP	0.01	9.60	-1.87	-1685.88	560.59	0.333	-0.11	-101.76	-0.14	-130.13	795.32	6.112
GGD/GSY%	0.44	348.47	0.23	181.55	990.47	5.456		0.35		1.08	0.81	0.755
LR %		0.07		-1.12	1.15	1.027		0.19		-1.59	0.48	0.299
RS %		66.13		68.23	86.02	1.261		51.25		-43.52	99.28	2.281

% and actual change: mean values of the proportionate and actual changes respectively by simulated policy changes over the period of 1969-93. Since the deterministic simulation consists of a single run, the deterministic mean is a straight mean, whereas the stochastic mean is a mean of 500 runs.

Standard Error: SE = SD / $\sqrt{500}$ and SD = Standard Deviation of the stochastic change, Relative Standard Error = SE / Stochastic change.

Deterministic simulation is the reproduction of Table 9.6 in Chapter 9. Rs. crores = 10 million rupees.

Appendix 11.2a Simulated Multiple Expansionary Policy Effects: Deterministic and Stochastic (500) means for the period 69-93 (Rs. Crores for Actual changes)

CRR/Bank	S1: Deterministic		S1: Stochastic		Standard Error		S2: Deterministic		S2: Stochastic		Standard Error	
	% change	Actual	% change	Actual	Absolute	Relative	% change	Actual	% change	Actual	Absolute	Relative
BER	-48.47	-2031.52	-49.60	-2114.45	42.54	0.020	-28.73	-1204.21	-52.79	-2229.82	123.19	0.055
BGD	2.57	528.87	5.94	1233.49	491.20	0.398	1.39	286.96	3.07	645.74	877.21	1.358
BCS	19.15	1601.52	14.41	1187.39	897.05	0.755	13.70	1145.91	0.41	32.52	1140.47	35.072
BLA	3.52	1550.26	3.06	1343.19	420.09	0.313	3.23	1420.47	7.28	3201.34	333.85	0.104
OFIGD	-6.90	-1873.57	-5.45	-1490.07	2120.46	1.423	-7.05	-1915.70	-0.54	-151.92	2888.60	19.014
OFICS (-)	75.05	2646.98	83.83	2751.79	1522.27	0.553	52.26	1843.15	97.60	2638.14	2277.47	0.863
OFILA	21.01	4520.57	20.12	4241.89	3641.24	0.858	17.47	3758.86	14.18	2790.06	5154.01	1.847
PCBCS (-)	-67.46	-3146.21	-60.32	-2975.95	1820.68	0.612	-45.92	-2141.58	-55.23	-3119.15	2699.37	0.865
PCBLA (-)	9.11	3225.25	8.47	2975.95	1820.68	0.612	6.76	2394.31	9.06	3119.15	2699.37	0.865
PCBDEP	1.98	79.05	0.00	0.00	0.00	0.000	6.32	252.74	0.00	0.00	0.00	0.000
HCUR	-6.68	-1506.08	1.84	415.19	309.50	0.745	9.83	2216.90	18.14	4052.04	496.83	0.123
HDEP	0.69	469.10	-0.69	-471.52	380.95	0.808	0.57	384.74	-0.25	-172.46	496.12	2.877
HGD	9.82	5983.30	6.74	4076.94	3293.84	0.808	2.67	1627.73	-0.83	-493.82	3764.29	7.623
HCS	-14.48	-2100.75	-9.63	-1411.55	1189.75	0.843	-9.96	-1444.34	-3.40	-513.53	1560.39	3.039
HLA (-)	6.88	2845.58	6.35	2609.13	1417.21	0.543	6.74	2785.02	7.10	2872.25	2193.96	0.764
GER	-48.47	-2031.52	-49.60	-2114.45	42.54	0.020	-28.73	-1204.21	-52.79	-2229.82	123.19	0.055
DEP	0.61	548.15	-0.52	-471.52	380.95	0.808	0.71	637.48	-0.19	-172.46	496.12	2.877
GGD/GSY%	5.91	4638.60	4.87	3820.36	683.15	0.179		-2.09		-1.43	0.58	0.409
LR %		-0.47		-1.03	0.53	0.518		-1.91		-4.29	0.34	0.078
RS %		45.04		58.75	48.03	0.818		56.69		-30.67	72.87	2.376
CRR/SLR	S1: Deterministic		S1: Stochastic		Standard Error		S2: Deterministic		S2: Stochastic		Standard Error	
	% change	Actual	% change	Actual	Absolute	Relative	% change	Actual	% change	Actual	Absolute	Relative
BER	-19.42	-813.86	9.81	418.38	118.76	0.284	-14.83	-621.49	-6.70	-283.21	524.03	1.850
BGD	13.76	2834.35	21.39	4439.98	1672.33	0.377	11.66	2401.93	14.04	2949.14	4951.41	1.679
BCS	-21.76	-1819.36	-50.31	-4144.65	2982.47	0.720	-19.65	-1642.92	-39.24	-3114.29	6583.69	2.114
BLA	3.29	1448.03	2.13	935.82	1318.08	1.408	3.44	1511.64	4.77	2097.89	2198.07	1.048
OFIGD	15.75	4278.24	38.34	10484.63	7249.11	0.691	13.34	3622.25	18.46	5200.87	16639.35	3.199
OFICS (-)	-80.36	-2834.20	-304.92	-10009.55	5238.31	0.523	-70.52	-2487.26	-201.21	-5438.73	12861.73	2.365
OFILA	-33.05	-7112.47	-97.19	-20494.29	12484.83	0.609	-28.39	-6109.54	-54.07	-10639.66	29492.76	2.772
PCBCS (-)	67.46	3145.83	233.46	11517.75	6345.95	0.551	57.99	2704.13	87.04	4915.93	15283.98	3.109
PCBLA (-)	-9.90	-3506.85	-32.78	-11517.75	6345.95	0.551	-8.52	-3017.48	-14.28	-4915.93	15283.98	3.109
PCBDEP	-9.03	-361.01	0.00	0.00	0.00	0.000	-7.84	-313.34	0.00	0.00	0.00	0.000
HCUR	9.36	2110.19	1.59	357.66	1038.66	2.904	13.37	3014.25	4.82	1076.73	2708.63	2.516
HDEP	-0.68	-464.45	2.71	1837.59	1304.68	0.710	-0.63	-429.24	1.26	856.07	2840.09	3.318
HGD	-9.74	-5934.30	-26.26	-15888.57	11280.85	0.710	-9.89	-6025.19	-13.70	-8150.01	21588.32	2.649
HCS	14.69	2131.00	38.58	5652.84	4073.40	0.721	12.82	1859.78	17.17	2591.49	8933.76	3.447
HLA (-)	-5.22	-2157.60	-19.58	-8040.72	4870.60	0.606	-3.82	-1580.42	-8.96	-3625.83	12482.84	3.443
GER	-19.42	-813.86	9.81	418.38	118.76	0.284	-14.83	-621.49	-6.70	-283.21	524.03	1.850
DEP	-0.92	-825.46	2.04	1837.59	1304.68	0.710	-0.83	-742.58	0.95	856.07	2840.09	3.318
GGD/GSY%	1.50	1178.28	-1.23	-963.95	2361.70	2.450		-0.90		5.43	8.90	1.639
LR %		-1.21		-0.03	1.67	63.632		-1.81		-4.19	2.71	0.646
RS %		-68.23		-212.65	159.06	0.748		-57.90		-829.03	1066.48	1.286

% and actual change: mean values of the proportionate and actual changes respectively by simulated policy changes over the period of 1969-93. Since the deterministic simulation consists of a single run, the deterministic mean is a straight mean, whereas the stochastic mean is a mean of 500 runs. Standard Error: SE = SD / $\sqrt{500}$ and SD = Standard Deviation of the stochastic change, Relative Standard Error = SE / Stochastic change. CRR 2% reduction increases the mean value of BW by around 1649 Rs. crores during the period of 1969-93. Rs. crores = 10 million rupees.

Appendix 11.2b Simulated Multiple Expansionary Policy Effects: Deterministic and Stochastic (500) means for the period 69-93 (Rs. Crores for Actual changes)

CRR/Deposit	S1: Deterministic		S1: Stochastic		Standard Error		S2: Deterministic		S2: Stochastic		Standard Error	
	% change	Actual	% change	Actual	Absolute	Relative	% change	Actual	% change	Actual	Absolute	Relative
BER	-32.14	-1347.20	-57.37	-2445.89	117.26	0.048	-16.00	-670.63	-65.34	-2759.98	232.90	0.084
BGD	1.01	207.03	-4.88	-1013.03	1522.00	1.502	0.23	48.01	-2.32	-487.13	1707.11	3.504
BCS	18.13	1515.67	41.92	3453.96	2736.07	0.792	13.49	1128.26	-1.06	-84.09	2206.39	26.238
BLA	2.89	1273.62	3.77	1654.39	1234.87	0.746	2.60	1143.49	11.32	4980.82	628.31	0.126
OFIGD	-7.92	-2151.50	-26.93	-7363.08	6591.65	0.895	-8.45	-2295.92	-2.89	-813.62	5626.42	6.915
OFICS (-)	74.06	2612.14	270.15	8868.15	4750.04	0.536	56.79	2002.97	195.90	5295.08	4439.97	0.839
OFILA	22.14	4763.67	76.97	16231.32	11338.47	0.699	19.98	4298.91	31.04	6108.71	10044.06	1.644
PCBCS (-)	-66.50	-3101.01	-207.64	-10243.93	5732.42	0.560	-51.06	-2381.35	-114.39	-6460.92	5277.54	0.817
PCBLA (-)	9.60	3398.30	29.04	10204.24	5732.42	0.562	7.95	2814.61	18.65	6421.23	5277.54	0.822
PCBDEP	7.44	297.29	-0.99	-39.69	0.00	0.000	10.84	433.27	-0.99	-39.69	0.00	0.000
HCUR	-14.29	-3220.47	-4.62	-1039.21	951.89	0.916	-1.29	-290.67	15.10	3371.57	973.28	0.289
HDEP	3.22	2185.29	-0.19	-130.44	1185.60	9.090	3.21	2178.20	1.58	1077.68	966.55	0.897
HGD	9.32	5678.70	22.61	13680.64	10251.20	0.749	3.69	2246.90	2.19	1300.75	7330.94	5.636
HCS	-13.82	-2004.54	-32.96	-4829.73	3702.11	0.767	-10.39	-1506.64	-7.17	-1081.75	3039.86	2.810
HLA (-)	6.38	2638.99	18.70	7681.47	4419.46	0.575	6.36	2627.79	11.53	4668.30	4278.31	0.916
GER	-32.14	-1347.20	-57.37	-2445.89	117.26	0.048	-16.00	-670.63	-65.34	-2759.98	232.90	0.084
DEP	2.76	2482.58	-0.19	-170.13	1185.60	6.969	2.90	2611.46	1.15	1037.99	966.55	0.931
GGD/GSY%	4.76	3734.23	6.77	5304.53	2139.89	0.403		-1.85		-0.93	1.14	1.236
LR %		-0.12		-1.47	1.58	1.076		-1.51		-6.13	0.69	0.113
RS %		83.57		189.46	148.64	0.785		73.86		-59.62	142.08	2.383
CRR/GSY(S1)	S1: Deterministic		S1: Stochastic		Standard Error		S2: Deterministic		S2: Stochastic		Standard Error	
CRR/OMO(S2)	% change	Actual	% change	Actual	Absolute	Relative	% change	Actual	% change	Actual	Absolute	Relative
BER	-18.01	-754.88	-49.64	-2116.28	42.54	0.020	-8.76	-367.34	41.95	1771.86	3053.30	1.723
BGD	-3.36	-692.73	5.95	1235.22	491.20	0.398	-3.64	-749.04	-80.21	-16846.56	16419.33	0.975
BCS	19.02	1590.41	14.41	1187.53	897.09	0.755	14.54	1215.60	324.27	25733.90	25173.71	0.978
BLA	3.42	1506.33	3.06	1343.15	420.13	0.313	3.52	1549.92	-20.48	-9009.05	11813.99	1.311
OFIGD	-10.15	-2756.71	-5.45	-1490.31	2120.47	1.423	-9.80	-2661.22	-206.17	-58090.11	57447.66	0.989
OFICS (-)	75.59	2665.88	83.83	2752.01	1522.27	0.553	56.82	2003.95	1613.50	43612.81	40882.52	0.937
OFILA	25.20	5422.61	20.12	4242.34	3641.25	0.858	21.68	4665.19	516.84	101703.46	98329.78	0.967
PCBCS (-)	-68.39	-3189.39	-60.33	-2976.17	1820.64	0.612	-48.15	-2245.24	-861.86	-48677.94	46136.32	0.948
PCBLA (-)	9.63	3410.13	8.47	2976.17	1820.64	0.612	7.25	2567.52	141.41	48677.94	46136.31	0.948
PCBDEP	5.52	220.74	0.00	0.00	0.00	0.000	8.07	322.30	0.00	0.00	0.00	0.000
HCUR	6.63	1494.93	1.84	415.18	309.49	0.745	15.01	3382.96	53.36	11915.88	6603.76	0.554
HDEP	0.70	477.56	-0.69	-471.56	380.95	0.808	1.95	1324.80	-13.26	-9025.80	9639.30	1.068
HGD	6.01	3660.24	6.74	4077.34	3293.84	0.808	3.02	1840.22	123.30	73367.64	73866.90	1.007
HCS	-14.58	-2113.92	-9.64	-1411.69	1189.75	0.843	-10.05	-1456.88	-204.11	-30799.03	30419.32	0.988
HLA (-)	8.51	3518.82	6.35	2609.32	1417.21	0.543	8.83	3647.59	108.75	44016.46	40407.99	0.918
GER	-18.01	-754.88	-49.64	-2116.28	42.54	0.020	-8.76	-367.34	41.95	1771.86	3053.30	1.723
DEP	0.78	698.31	-0.52	-471.56	380.95	0.808	1.83	1647.10	-10.01	-9025.80	9639.30	1.068
GGD/GSY%	0.27	210.79	4.88	3822.25	683.14	0.179		-2.86		-7.02	4.57	0.651
LR %		-1.74		-1.03	0.53	0.518		-2.20		-0.40	3.64	9.011
RS %		68.44		58.75	48.04	0.818		67.21		616.05	594.95	0.966

% and actual change: mean values of the proportionate and actual changes respectively by simulated policy changes over the period of 1969-93. Since the deterministic simulation consists of a single run, the deterministic mean is a straight mean, whereas the stochastic mean is a mean of 500 runs. Standard Error: SE = SD / $\sqrt{500}$ and SD = Standard Deviation of the stochastic change, Relative Standard Error = SE / Stochastic change. CRR 2% reduction increases the mean value of BW by around 1649 Rs. crores during the period of 1969-93. OMO 2% purchases increase the mean value of HW by around 1444 Rs. crores during the period of 1969-93. Rs. crores = 10 million rupees.

Appendix 11.2c Simulated Multiple Expansionary Policy Effects: Deterministic and Stochastic (500) means for the period 69-93 (Rs. Crores for Actual changes)

Deposit/Bank	S1: Deterministic		S1: Stochastic		Standard Error		S2: Deterministic		S2: Stochastic		Standard Error	
	% change	Actual	% change	Actual	Absolute	Relative	% change	Actual	% change	Actual	Absolute	Absolute
BER	-21.11	-884.71	-32.99	-1406.53	82.03	0.058	-11.86	-497.02	-36.19	-1528.60	202.81	0.133
BGD	-3.35	-689.69	-2.53	-524.30	648.13	1.236	-2.46	-506.82	8.54	1792.61	1735.48	0.968
BCS	16.29	1361.93	14.33	1180.51	1232.98	1.044	10.89	910.57	-35.10	-2785.59	2225.53	0.799
BLA	0.48	212.45	1.71	750.45	632.49	0.843	0.21	93.26	5.73	2521.72	606.80	0.241
OFIGD	-11.51	-3126.18	-13.93	-3810.14	2931.15	0.769	-9.54	-2592.41	20.97	5909.80	5969.63	1.010
OFICS (-)	75.04	2646.45	130.02	4268.15	2075.01	0.486	51.35	1811.03	-100.97	-2729.35	4654.08	1.705
OFILA	26.83	5772.66	38.31	8078.33	5001.18	0.619	20.46	4403.46	-43.90	-8639.19	10606.04	1.228
PCBCS (-)	-73.61	-3432.71	-108.71	-5363.25	2470.96	0.461	-50.90	-2373.48	52.95	2990.53	5630.37	1.883
PCBLA (-)	10.15	3594.81	15.15	5323.56	2470.96	0.464	7.40	2619.60	-8.80	-3030.22	5630.37	1.858
PCBDEP	4.06	162.11	-0.99	-39.69	0.00	0.000	6.16	246.12	-0.99	-39.69	0.00	0.000
HCUR	-15.73	-3546.54	-5.92	-1333.36	442.99	0.332	-7.79	-1755.88	-3.77	-840.84	1010.38	1.202
HDEP	3.08	2090.27	1.05	711.28	520.14	0.731	2.96	2007.79	3.54	2409.34	1016.75	0.422
HGD	9.84	5994.74	10.58	6402.81	4497.40	0.702	5.08	3098.22	-12.94	-7702.40	7702.12	1.000
HCS	-14.81	-2148.19	-15.53	-2275.61	1625.73	0.714	-10.16	-1473.02	20.19	3046.77	3199.46	1.050
HLA (-)	5.78	2390.29	8.53	3505.22	1918.84	0.547	4.54	1877.12	-7.63	-3087.26	4482.39	1.452
GER	-21.11	-884.71	-32.99	-1406.53	82.03	0.058	-11.86	-497.02	-36.19	-1528.60	202.81	0.133
DEP	2.50	2252.38	0.75	671.59	520.14	0.775	2.51	2253.92	2.63	2369.65	1016.75	0.429
GGD/GSY%	2.78	2178.86	2.64	2068.38	919.79	0.445		-0.83		0.07	1.11	16.812
LR %		0.53		-0.61	1.05	1.726		-0.10		-2.34	0.65	0.280
RS %		60.79		53.45	79.58	1.489		59.01		-62.75	135.28	2.156
Deposit/SLR	S1: Deterministic		S1: Stochastic		Standard Error		S2: Deterministic		S2: Stochastic		Standard Error	
	% change	Actual	% change	Actual	Absolute	Relative	% change	Actual	% change	Actual	Absolute	Relative
BER	5.15	216.04	20.77	885.53	76.13	0.086	1.92	80.47	24.22	1023.22	185.32	0.181
BGD	5.94	1222.98	7.06	1466.08	623.52	0.425	7.51	1545.49	-4.68	-982.59	1559.27	1.587
BCS	-19.75	-1651.64	-20.99	-1729.34	1197.15	0.692	-21.38	-1788.05	26.70	2118.63	2005.03	0.946
BLA	0.48	212.63	-1.42	-622.25	613.97	0.987	0.37	162.10	-4.91	-2159.21	528.12	0.245
OFIGD	8.72	2369.32	13.13	3589.34	2795.84	0.779	10.58	2872.36	-21.33	-6011.29	5302.40	0.882
OFICS (-)	-61.97	-2185.67	-133.78	-4391.68	2009.94	0.458	-69.61	-2455.10	96.67	2612.86	4214.29	1.613
OFILA	-21.17	-4555.01	-37.85	-7981.06	4801.28	0.602	-24.76	-5327.49	43.83	8624.20	9499.34	1.101
PCBCS (-)	44.85	2091.68	99.39	4903.55	2364.29	0.482	52.38	2442.55	-61.50	-3473.64	5053.52	1.455
PCBLA (-)	-6.68	-2365.01	-14.07	-4943.24	2364.29	0.478	-7.76	-2747.19	9.98	3433.95	5053.52	1.472
PCBDEP	-6.84	-273.33	-0.99	-39.69	0.00	0.000	-7.62	-304.63	-0.99	-39.69	0.00	0.000
HCUR	-1.49	-336.55	-7.42	-1668.85	407.29	0.244	-4.37	-984.49	-6.79	-1516.13	922.72	0.609
HDEP	1.83	1243.49	3.23	2195.16	495.70	0.226	1.78	1209.68	0.78	532.57	904.50	1.698
HGD	-7.29	-4441.93	-10.62	-6427.49	4286.07	0.667	-7.25	-4418.87	11.75	6993.88	6858.81	0.981
HCS	10.74	1557.65	15.30	2241.21	1548.20	0.691	12.24	1775.50	-19.75	-2979.41	2843.43	0.954
HLA (-)	-4.78	-1977.36	-8.91	-3660.07	1844.51	0.504	-5.85	-2418.19	7.49	3031.03	4020.99	1.327
GER	5.15	216.04	20.77	885.53	76.13	0.086	1.92	80.47	24.22	1023.22	185.32	0.181
DEP	1.08	970.17	2.39	2155.47	495.70	0.230	1.01	905.05	0.55	492.88	904.50	1.835
GGD/GSY%	-1.08	-849.64	-1.75	-1372.08	868.37	0.633		0.35		-0.48	1.05	2.186
LR %		-0.22		0.75	1.05	1.410		0.01		2.07	0.61	0.295
RS %		-50.72		-64.20	80.26	1.250		-55.16		64.57	129.00	1.998

% and actual change: mean values of the proportionate and actual changes respectively by simulated policy changes over the period of 1969-93. Since the deterministic simulation consists of a single run, the deterministic mean is a straight mean, whereas the stochastic mean is a mean of 500 runs. Standard Error: SE = SD / $\sqrt{500}$ and SD = Standard Deviation of the stochastic change, Relative Standard Error = SE / Stochastic change. CRR 2% reduction increases the mean value of BW by around 1649 Rs. crores during the period of 1969-93. Rs. crores = 10 million rupees.

Appendix 11.2d Simulated Multiple Expansionary Policy Effects: Deterministic and Stochastic (500) means for the period 69-93 (Rs. Crores for Actual changes)

Deposit/GSY(S1)	S1: Deterministic		S1: Stochastic		Standard Error		S2: Deterministic		S2: Stochastic		Standard Error	
" /OMO(S2)	% change	Actual	% change	Actual	Absolute	Relative	% change	Actual	% change	Actual	Absolute	Relative
BER	9.06	379.90	-16.30	-695.01	122.66	0.176	8.10	339.58	-12.90	-545.10	293.21	0.538
BGD	-8.89	-1831.59	-12.21	-2534.01	983.15	0.388	-7.49	-1543.15	3.15	660.64	2479.24	3.753
BCS	15.28	1277.40	22.23	1831.38	1871.17	1.022	11.78	985.35	-25.25	-2004.16	3059.70	1.527
BLA	0.40	174.27	3.18	1397.77	957.25	0.685	0.50	218.21	4.29	1888.68	897.83	0.475
OFIGD	-14.28	-3877.35	-23.85	-6522.45	4439.47	0.681	-12.37	-3358.50	16.54	4660.68	8577.19	1.840
OFICS (-)	71.98	2538.60	201.62	6618.60	3153.01	0.476	55.85	1969.68	-73.26	-1980.19	6241.61	3.152
OFILA	29.82	6415.97	62.32	13141.11	7585.01	0.577	24.76	5328.21	-33.75	-6640.91	14809.16	2.230
PCBCS (-)	-71.45	-3332.14	-169.49	-8361.80	3748.59	0.448	-53.34	-2487.49	50.14	2831.93	7831.73	2.766
PCBLA (-)	10.28	3638.47	23.68	8322.11	3748.59	0.450	7.92	2804.63	-8.34	-2871.62	7831.73	2.727
PCBDEP	7.67	306.33	-0.99	-39.69	0.00	0.000	7.94	317.14	-0.99	-39.69	0.00	0.000
HCUR	-2.23	-502.25	7.75	1745.24	666.07	0.382	-2.82	-636.50	2.19	489.36	1356.51	2.772
HDEP	3.10	2106.61	0.46	312.97	787.78	2.517	4.41	2993.35	4.57	3108.11	1466.75	0.472
HGD	5.61	3418.35	12.78	7732.99	6811.52	0.881	5.47	3331.61	-11.58	-6890.35	11053.86	1.604
HCS	-14.28	-2070.94	-24.40	-3574.58	2461.87	0.689	-10.36	-1503.16	18.93	2855.90	4631.42	1.622
HLA (-)	7.14	2951.78	15.14	6216.76	2911.32	0.468	6.63	2741.79	-4.65	-1880.61	6291.55	3.345
GER	9.06	379.90	-16.30	-695.01	122.66	0.176	8.10	339.58	-12.90	-545.10	293.21	0.538
DEP	2.68	2412.94	0.30	273.28	787.78	2.883	3.68	3310.49	3.40	3068.42	1466.75	0.478
GGD/GSY%	-2.92	-2290.59	-1.69	-1323.47	1391.37	1.051		-1.65		1.19	2.03	1.702
LR %		-0.72		-2.50	1.61	0.642		-0.39		-3.01	0.58	0.192
RS %		84.44		82.51	121.76	1.476		71.15		-247.39	225.98	0.913
CRR/Deposit/	S1: Deterministic		S1: Stochastic		Standard Error		S2: Deterministic		S2: Stochastic		Standard Error	
SLR	% change	Actual	% change	Actual	Absolute	Relative	% change	Actual	% change	Actual	Absolute	Relative
BER	-22.93	-961.09	-12.00	-511.46	42.52	0.083	-15.72	-658.69	-13.64	-576.18	93.35	0.162
BGD	10.80	2223.67	13.41	2783.17	624.73	0.224	6.16	1269.26	6.52	1368.44	846.71	0.619
BCS	-12.55	-1049.43	-22.74	-1873.72	1113.04	0.594	-6.60	-551.63	-9.20	-729.87	1128.20	1.546
BLA	3.26	1436.00	2.85	1251.51	489.69	0.391	3.61	1590.20	3.61	1587.19	384.30	0.242
OFIGD	8.60	2335.94	16.88	4616.91	2706.72	0.586	2.99	812.24	3.07	864.51	2844.85	3.291
OFICS (-)	-35.95	-1268.09	-118.36	-3885.33	1959.41	0.504	-9.14	-322.51	-26.64	-720.13	2195.12	3.048
OFILA	-16.75	-3604.05	-40.32	-8502.29	4665.35	0.549	-5.27	-1134.76	-8.05	-1584.65	5038.40	3.180
PCBCS (-)	25.04	1167.74	86.08	4246.72	2373.64	0.559	-0.69	-32.13	4.20	237.08	2607.48	10.998
PCBLA (-)	-3.80	-1343.99	-12.20	-4286.41	2373.64	0.554	-0.19	-67.57	-0.80	-276.77	2607.48	9.421
PCBDEP	-4.41	-176.25	-0.99	-39.69	0.00	0.000	-2.49	-99.70	-0.99	-39.69	0.00	0.000
HCUR	-2.44	-549.13	-4.86	-1092.80	385.78	0.353	3.96	892.94	3.20	714.42	461.54	0.646
HDEP	2.09	1420.38	3.21	2178.72	487.21	0.224	2.23	1515.61	2.28	1551.04	485.53	0.313
HGD	-4.34	-2644.36	-10.39	-6285.29	4212.60	0.670	-3.42	-2082.51	-3.75	-2232.94	3691.03	1.653
HCS	6.54	949.07	15.26	2235.11	1520.99	0.681	1.36	196.99	1.64	246.81	1527.38	6.188
HLA (-)	-1.99	-824.06	-7.22	-2964.36	1820.63	0.614	1.27	523.01	0.69	279.31	2132.23	7.634
GER	-22.93	-961.09	-12.00	-511.46	42.52	0.083	-15.72	-658.69	-13.64	-576.18	93.35	0.162
DEP	1.38	1244.13	2.38	2139.02	487.21	0.228	1.57	1415.91	1.68	1511.34	485.53	0.321
GGD/GSY%	2.44	1915.23	1.42	1114.79	882.05	0.791		-1.34		-0.39	1.40	3.571
LR %		-0.91		-0.48	0.61	1.274		-1.74		-2.21	0.57	0.258
RS %		-29.61		-82.44	57.32	0.695		-7.24		-117.84	168.15	1.427

% and actual change: mean values of the proportionate and actual changes respectively by simulated policy changes over the period of 1969-93. Since the deterministic simulation consists of a single run, the deterministic mean is a straight mean, whereas the stochastic mean is a mean of 500 runs. Standard Error: SE = SD / $\sqrt{500}$ and SD = Standard Deviation of the stochastic change, Relative Standard Error = SE / Stochastic change. CRR 2% reduction increases the mean value of BW by around 1649 Rs. crores during the period of 1969-93. OMO 2% purchases increase the mean value of HW by around 1444 Rs. crores during the period of 1969-93. Rs. crores = 10 million rupees.

Chapter 12 Conclusion

The current study sheds important light on a range of issues in the financial sector in India: the way in which different sectors of the economy choose their portfolios; how credit rationing and financial liberalization in the financial sector affect the country's financial performance; how interest rates are determined and affect different sectors of the economy and how credit is distributed to the most in need of the economic development.

The content in this thesis is a first step towards a fuller analysis directed at the ways in which policy instruments affect an economy as a whole, as well as for future development of this kind of study for developing economies.

In Section 12.1 a summary and the key findings and in Section 12.2 the key policy implications drawn from the empirical analysis are spelled out. The limitations in conducting this project are explained by outlining further promising research ideas in section 12.3.

12.1 Summary and the Key Findings

In the general equilibrium system in the financial sector for India, Banks, OFIs, PCB and Household sectors are modelled with the financial instruments of currency, deposits, government debt (including provident funds), company securities, loans and excess reserves.

The survey in Chapter 2 shows the difficulty in obtaining statistically significant and correctly-signed interest rate coefficients (or price coefficients in the case of the AIDS model). Table 12.1 shows the overall econometric performance for each single sector.

Table 12.1 The Performance of the demands for financial assets and liabilities with the AIDS model in India

Sector (Number of share equations)	Proportion of the significant own price coefficients at a 5% level	Proportion of the correctly-signed own-price coefficients *	Static S & H joint test (SSLR test) **	Proportion of cointegration existing in share equations at the 5% level	
				Engle-Granger	Johansen
Banking: Model 2 (4)	2/3 (3/3 at 10%) (–0.38 imposed on PER in ER)	4/4	Rejected (S given H, not rejected)	2/4	4/4
PCB: Model 1 (3)	2/3	2/3	Not applicable	3/3	3/3
OFI: Net (3)	3/3	2/3	Accepted	0/3	3/3
Household: Model 2 (5)	5/5	4/5	Accepted	5/5	5/5

PER=Price of excess reserves, ER=Excess reserves equation
S = Symmetry, H = Homogeneity, SSLR = Small sample-adjusted likelihood ratio test,
* 'on a priori ground'
** Specific model taken as a null of restricted model

With respect to price coefficients, the result is comparable with that of Barr and Cuthbertson in Table 2.2 (in Chapter 2), and outperforms the pitfalls type model in Table 2.1 (in Chapter 2). Further, though not shown in the table, 73 out of the 110 parameters in the demand equations used for simulation have *t*-ratio being greater than 2.0, and all but 12 parameters have *t*-ratio being greater than unity. This is itself a considerable achievement, but also, cointegration analysis reveals that a long-run equilibrium relationship appears to exist in the share equations.

In general the estimated long-run model provided coherent price parameters, and also economically plausible parameters of policy variables. It shows that the AIDS model is capable of explaining portfolio behaviour in the context of the financial sector in India.

Having achieved sensible results in estimation, we then conducted the policy analysis by simulation, in a system-wide model incorporating all the behavioural equations and the market clearing identities. Simulation analysis is implemented with a view to the removal of rigidities in the flow of funds in the government sector and the delivery of adequate funds to the private sectors. The simulation policy experiments provided us with plausible unbiased policy effects in the financial sector. The general impression produced by the experiments is that the policy effects in a single-shot experiment reconcile the developing economy-specific features: a weak effect is found in the indirect monetary policies of the Bank rate and OMO, whereas a relatively strong effect is found in the direct policies of CRR, SLR, deposit rate and government securities' yields.

As a whole in this project, the key finding is the significant role of interest rates in the financial sector. Interest rates play an important role in portfolio selection in the disaggregated economic sectors. This is also clear from system-wide simulation experiments: there is a relatively strong impact from exogenous and endogenous interest rates on the flow of funds for India (though the impact of the bank rate turns out to be relatively limited). These results demonstrate that interest rates matter in the operation of financial markets. The other key finding is that the nationalization of the banking sector in 1969 and the financial liberalisation in the early 1990s have exerted an enormous effect on the whole financial sector in India. It is evidenced from the significant dummy variable effects, in particular on loans by dummy 69 and on company securities by dummy 90, in estimation, and the influences on the level of endogenous interest rates in simulation.

12.2 Policy Implications

Over the past two or three decades, financial liberalization has been set in train in many developing economies. However, it was not always the case that financial liberalisation improved the mobilization and allocation of scarce domestic resources in the financial sector. Our simulation experiments reveal that this is also the case for India. The following are the key policy implications drawn from this research.

i) Market-determined government securities' yields versus controlled government securities' yields:

It is not clear as to whether controlled or market-determined yields contribute most in delivering extra funds to private economic activities. Government securities' yields were suppressed before the financial reforms, so that government could borrow cheaply from the market. On the other hand, it had an advantageous effect in that investors invested in other financial assets, which generated a better rate of return. If these funds were made available to non-financial private sectors, they would bring benefits in generating extra funds for private economic activities. After the financial reforms were begun, government securities yields became market-determined, and this increased the yields. However, this had a detrimental effect. Investors (in particular in the banking sector) are attracted to risk-free government securities, and therefore funds tend to stagnate in the government sector. Yet, controlled government securities yields are intuitively disadvantageous to the economy from the point of view of the banking sector. Commercial banks were obliged to invest the government securities under SLR, though the yields were pushed lower than market-determined yields. This reduced their profitability, so that banks had to either increase their lending rate or lower the deposit rate, or both, in order to improve their profitability. Further, banks may have been forced to curtail credit rationing towards priority sectors, since credit rationing was delivered at subsidised rates. These situations represent financial repression. In this respect, the introduction of market-determined government securities yields in the post-reform era may well be better than the controlled yields in the long run.

ii) The effect of SLR:

Empirical experiments reveal a relatively clear picture of the policy effect for the main policy instruments. However, the effect of the SLR on the economy is ambiguous, as to whether it is detrimental or advantageous in terms of delivering the funds to the non-financial private sectors. Further the allocation of SLR, between *government securities* issued by the government sector and *government approved securities* issued by the OFIs sector, is not clear. With respect to the government securities, it is widely believed that lowering SLR will increase the flow of loans to the private sector and that it may cause a problem for government finances, since the captive market diminishes. However, the empirical experiments demonstrated an unexpected outcome: Government securities are attractive risk-free assets, therefore, where there is a fall in the rate of return in other financial assets, the banking sector *voluntarily* invests in government securities, irrespective of the level of the SLR. This is particularly so in the post-reform period because; first, government securities' yields were de-controlled, raising the nominal yields (as mentioned above); second, liberalization may reduce lending rates, if firms can more easily raise funds on the stock market, the demand for loans, hence lending rates may fall (Green, Murinde and

Moore, 2002); and third, there is the increasing perception of risk. Our empirical study suggests that commercial banks' subscription to government approved securities under this regulation contributes to delivering funds into the private sector. It seems that the allocation of SLR between the government securities and government approved company securities is a key to whether this is detrimental or favourable. When the share of the *government approved company securities* is high enough to ensure credit to the industrial sector, then an increase in SLR may be a desirable policy strategy.

iii) Fiscal disciplinary efforts:

The econometric estimation results and the simulation experiments repeatedly directed us to the issue of fiscal stance. The attractiveness of government securities are frequently found especially in the banking and household sectors. This is the implication of 'crowding-out' effect. Literally, the effect emerges through the interest rate channel as a result of an increase in government expenditure. In the system-wide model, the real sector is treated as exogenous, hence 'crowding-out' effect is observed through the flow of funds from other financial assets to the government securities This suggests the need for fiscal disciplinary efforts by reducing government deficit, hence, government debt in the government sector in order to increase the funds for the private sectors.

iv) Deposit rates:

Our experiments demonstrate that as the ceiling on the deposit rate is removed, financial saving increases in the household sector and these funds are made available for private economic activities with a relatively small increase in the lending rate. This not only supports the view of the McKinnon and Shaw school, but also is consistent with the aim of financial liberalization in India, and may well be one of the main channels through which the flow of funds into investment projects can increase (Green *et al.*, 2002). Yet, abolishing entirely the control of interest rates is unlikely to achieve the optimum results. Our study suggests that, faced with expansionary policies, market-determined deposit rates fall in line with the lending rates, and this may discourage deposit savings in the household sector resulting in a detrimental effect on the flow of loanable funds. Continued government intervention in the determination of the institutional interest rates may be the best interim policy until competition within the financial sector is adequate and interest rates achieve the efficient allocation of resources. In particular this is the case where there is a tendency towards a cartelised banking industry as seen in many developing economies (Fry, 1995).

v) Robustness of complete interest rate liberalisation:

Possible perverse outcomes from a completely liberalised interest rate regime are also highlighted in the stochastic simulations, with respect to government securities' yields. There is evidence that the policies are sensitive to the uncertainty in the regime of S2 , where the government securities' yields are liberalised, whereas this is less so in S1, where the government securities' yields are controlled and the supply of securities is endogenous. This highlights the exposure to vulnerability in policy effects on the financial markets in the face of liberalised interest rates. We have seen that the financial sector in developing economies tends to suffer from government intervention in allocating resources. However, if the detrimental effects of the complete liberalisation of interest rate structure proves to be a general characteristic of liberalized financial markets in a developing country, it emphasises the need for gradualism in implementing policies with the view to giving a greater role to the market in determining interest rates (Green *et al.*, 2002). It may be worth noting that 'indiscriminate attempts at financial decontrol have sometimes come to grief' (McKinnon, 1988)[1].

vi) Optimal policy:

Deterministic and stochastic simulation experiments conclude that lowering CRR and removing the deposit rate ceiling are the most robust policy instruments in achieving the target of increasing loanable funds to non-financial private sectors. This finding is in line with the argument of McKinnon (1988). Indeed, he comments on the applicability of a policy package for developing economies; lowering the cash reserve ratio potentially improves profitability in the banking sector, and this would allow

[1] For example, in the last decade, the financial liberalisation in Thailand led to a massive inflow of foreign capital and these funds fuelled exuberant and speculative spending and lending. This in turn aggravated the current account deficits and inflation to such an extent that the IMF-led rescue packages became inevitables. The crisis can be largely attributed to the undertaking of the financial decontrol when the financial system and institutions were not yet ready (Vajragupta and Vichyanond, 2000).

them to raise deposit rates, whilst containing loan rates. In this respect, the policy may be widely considered not only in India, but also in other developing economies.

12.3 Limitations and PRIs

A number of limitations in this study and a future research area are as follows.

i) The AIDS prices:

With respect to prices in the ADIS model, there are two points to be noted. The first point is inflation illusion. The estimation of the AIDS model was based on real prices, hence real interest rates. This implies that nominal expected returns and expected goods price inflation have an equal impact on long run asset shares (Barr and Cuthbertson, 1991b). Then, the comparative study by using nominal interest rates may reveal whether agents suffer from inflation illusion[2], as it is possible that the effect will be reflected in the magnitude of parameter estimates. The second point is the price of company securities. The major limitation in modelling the flow of funds is that, in order to derive the price of company securities in the AIDS model, we relied on *the rate of growth in share prices* (since dividend yields were not available over the sample period). Moreover, since share prices exhibited relatively volatile behaviour, it proved difficult to solve the complete model without creating 'excess volatility' for the price of company securities.

ii) Dynamic model and real sector:

Given an annual data, concentration is on the LR model in this thesis. Some of the estimated models suffer from serial correlation. If we assume that agents use an adjustment mechanism to attain an optimal portfolio, a logical extension would be to estimate a dynamic version of the models. Moreover, we have confined the estimation to the financial sector for India. It can be extended to endogenise variables in the real sector, then the main channels through which the financial sector affects the real economy can be identified. Further, this depicts the full cycle of the economy since this is equivalent to endogenising the Net Acquisition of Financial Assets (NAFAs): changes in real variables directly affect the NAFAs which then feed back

[2] It is hinted in the simulation of the rise in GDP in Chapter 10 (PDEP Endogenous Model) that the houshold secotr is responsive to the nominal deposit rates.

into the financial sector. There are however caveats in a dynamic and extended model: first, as indicated here, its estimation is dependent upon data constraints, and second, everything becomes dependent on everything and the system-wide model has a tendency to become too large.

iii) Co-operative banks and credit societies:

In this study the co-operative banks and credit societies are treated as exogenous due to the fact that their financial transactions are negligible as compared with other sectors. Yet, it is still essential to examine the portfolio behaviour of these financial institutions, as the main objective of these institutions is to ensure loans to the rural areas where commercial banks do not reach. A study of their portfolio behaviour by itself may be appropriate rather than including it in a system-wide simulation model, and this would be a potentially important contribution to the study of microfinance in India.

iv) Non-linear AIDS:

The AIDS share equation is transformed from non-linear to linear form, by assuming the quadratic price index to a Stone index of a form. It can be compared to the results derived from the true non-linear model. This is worthwhile, in particular, if there is a gain in using a more accurate AIDS model in terms of not only econometrics estimation but also of solving endogenous variables in simulation.

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