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Real and financial sector interaction under liberalisation in an open developing economy

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Abstract

A short-run model incorporates instantaneous portfolio equilibrium with macroeconomic flows to clarify the structure of real-financial sector interactions. If equity and foreign exchange markets are introduced in structuralist theories of asset markets in developing countries, the key result that a fall in money supply raises the rate of inflation now holds only under special conditions on partial derivatives. But there is a tendency for interest rates to rise and for fluctuations in asset prices. Fuller integration of asset markets moderates these fluctuations. Outcomes are stable in spite of the generalized complementarity distinguishing equity markets from loan markets. Expectations play a major role. Implications for policy are to link domestic interest rates to foreign, remove artificial barriers to market integration, and stimulate demand as well as supply.

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1. Introduction

A well-known result[1] in the structuralist literature is that in an underdeveloped financially repressed economy, monetary contraction can cause inflation due to a rise in working capital costs. We show how this result is modified in a world in which the rate of inflation clears goods markets and equity markets are present with a market-clearing rate of return. Although the standard result holds only under special conditions, it is re-instated when equity markets become more active. From the eighties onwards, financial reform, opening out and inflows of foreign capital have characterized many developing countries. Adapting the structuralist model to incorporate these features is useful to clarify the structure of real-financial sector interactions. The analysis points to the importance of a monetary policy that prevents rise and fluctuations in interest rates.

Ours is a very short-run model that incorporates instantaneous portfolio equilibrium with macroeconomic flows. The focus is on daily variations in asset prices. Output and the price level are fixed at this horizon. But forward looking inflation expectations clear the goods market[2]. Since inflation affects returns to assets, and inflationary expectations can match the speed of asset price adjustment, the endogenous variables, at this time horizon, are the rate of inflation, the interest rate and equity returns. Over a longer time period, these prices would influence the evolution of output. Expectations lead to the jumps in asset prices that clear markets. As administrative controls are removed, expectations are more freely reflected in prices. In arbitrage across assets, the generic assumption made is that asset price elasticities exceed quantity elasticities, because price expectations act as jump variables.

Since both the demand and supply side of the goods market are modelled, the interest rate can affect inflation through cost-push. If the negative effect of the interest rate on goods market supply exceeds its negative effect on demand, a rise in inflation would be required to clear the goods market after a rise in interest rates. Profit rates rise with inflation and fall with interest rates and through these deeper determinants influence both goods market demand and equity returns.

Equity markets are distinguished from loan markets by generalized complementarity, in the sense that a rise in stock returns increases excess demand in all markets. A rise in the loan market price (interest rate) lowers excess demand in all markets. The reason equity is risky compared to debt is that a rise in its price does not reduce demand, so that a sustained rise or fall in equity prices is possible. Fundamentals, such as profit rates, influence equity returns, but speculative bubbles are possible, and these feed into excess demand in the goods market. In spite of this, it turns out that a rise in the diversity of assets available improves stability, provided monetary policy maintains stable interest rates.

We show that under monetary tightening during reform the rate of inflation may fall for a range of parameter values, but there can be large fluctuations in interest rates and equity returns. Over the medium-term this would harm output. Integration of financial markets moderates the fluctuations. If equity markets become more important, the structuralist result of inflation and interest rates rising together is re-established. Other results are that the stimulus to demand must exceed that to supply in order to lower inflation. Therefore the best policy combination is one that keeps market determined interest rates close to world rates, stimulates demand, supply, and integration of financial markets. Preliminary analysis of data from the Indian liberalisation supports the theoretical hypotheses.

The structure of the paper is as follows: in section 2 a financial balance sheet is presented and excess demands derived for the individual markets. Section 3 sets out the key assumptions and then examines the existence and stability of equilibria. Comparative static results are derived in section 4. Section 6 concludes. Algebraic analysis of shocks is in the Appendix.

2. The Model

We consider excess demand functions for six markets, one real and the other financial: the goods, loan, equity, bullion, foreign exchange and money markets. By Walras Law it is sufficient to analyze market clearing for five markets. The financial balance sheet of the economy represents the links between the six markets. This level of disaggregation captures relevant distinctions in the attributes of assets such as liquid (money), fixed income (debt), and risky (equity) assets. In addition, traditional assets (bullion) play a major role in developing countries, and foreign exchange is acquiring importance as an asset after liberalisation.

Maximisation over primitives such as technology, preferences delivers household portfolio demand functions in a general equilibrium framework. But it is not yet possible to derive similar qualitative restriction on signs of excess demand functions that include asset-demands from firms. There are fundamental problems in aggregating over debt and equity for a representative firm. Theory, such as principal-agent frameworks in incomplete capital markets and empirical evidence support our sign restrictions. But in order to side-step the deep problems of aggregation that affect atomistic optimising models, we use generalised demand and supply functions that can distinguish between supply and demand for assets from firms, households and government. A firm demands loans and supplies equity.

After a brief discussion of the balance sheet, agents and adding up conditions involved, we specify each of the market equilibrium conditions.

2.1 The Financial Balance Sheet: Agents and their activities

The balance sheet for the macroeconomy (table 1) reflects the financial structure of typical reforming developing economy. Households make a portfolio choice among bank deposits D_p; loans to firms L_p; equity of firms E_P; and bullion P_zZ. Bullion stock is Z, and its price is P_z. Bullion is a generic term for unproductive assets. Households cannot hold foreign currency or assets, or government securities G_b. After cancelling items appearing on both sides of the balance sheet, wealth (W) is sum of high-powered money, H, value of capital stock and bullion.

G_R are government securities held by the central bank. H, equals central bank liabilities such as currency, backed by central bank assets such as G_R and foreign reserves F. The central bank also performs the functions of a treasury, managing government debt. Banks are the financial intermediaries that, along with households, make finance available to firms and the government. Commercial banks hold assets in the form of reserves comprising deposits with the central bank, R, and government securities, G_b; loan to firms, L_b; and foreign assets, F_b. The assets are created, in order to maximise profits, out of liabilities that consist of deposits from households, D_p; firms, D_f; and non-resident nationals *(NRNs)*, D_N. Assets must equal liabilities for each entity, therefore for banks:

$$D_f + D_P + D_N = R + L_b + G_b + F_b \quad (1)$$

Commercial banks are required to hold a proportion of government securities *(G_b)* as statutory liquidity ratio *(SLR)* requirements, but they are free to hold excess. Similarly *R* can exceed the compulsory reserve ratio *(CRR)*, but cannot fall below that. The government deficit, *GD*, minus its monetization, ΔG_R, determines the supply of government securities, G_b, since:

$$GD = \Delta G_R + \Delta G_b \quad (2)$$

The treasury-bill rate, i_t, clears the market for these securities. Banks are allowed to hold foreign exchange assets *(F_b)*.

Table 1: Financial Balance Sheet

Assets	Liabilities
Central Bank	
Government Securities (G_R)	Reserves ($R + G_b$)
Foreign Exchange Reserves (F)	Currency
Commercial Banks	
Bank Reserve R, Statutory Liquidity Reserve G_b	Deposits from Firms (D_f)
Loans to Firms (L_b)	Deposits from Public (D_p)
Foreign Assets (F_b)	Deposits from NRIs (D_N)
Firms	
Physical Capital (PK)	Loans from Bank (L_b)
Loans for Working Capital (Deposits) to Firms (D_f)	Loans from Public (L_p)
	Loans from Abroad (L_f)
	Equity from Public (E_p)
Public	
Deposits with Banks (D_p)	Wealth ($W = G_R + F + PK + P_z Z$)
Equity in (E_p) and Loans to Firms (L_p)	
Bullion ($P_z Z$)	

Firms maximise profits and raise money to finance capital accumulation *(PK)* and working capital *(D_f)* by taking loans from banks, households or foreigners. They can also issue equity to households. The nominal rates of return are, interest rate on loans to firms, *i,* rate of return on equity, i_e, and on bullion: π_Z. The latter is the rate of bullion-price rise. Actual inflation, π equals inflationary expectations (π^e). Expectations are forward looking. Subtracting the inflation rate from the nominal rates of return gives the real rate of return of the assets. Since households do not hold foreign assets, they allocate wealth *(W)* in a portfolio of four assets, *viz.* loans to firms, equity, bullion and bank deposits.

$$L_P = f_1(\underset{+}{i}, \underset{-}{i_e}, \underset{-}{\pi_Z}, \underset{-}{i_d}, \underset{-}{\pi}, \underset{+}{y})\, W \tag{3}$$

$$E_p = f_2(\underset{-}{i}, \underset{+}{i_e}, \underset{-}{\pi_Z}, \underset{-}{i_d}, \underset{-}{\pi}, \underset{+}{y})\, W \tag{4}$$

$$Z = f_3(\underset{-}{i}, \underset{-}{i_e}, \underset{+}{\pi_Z}, \underset{-}{i_d}, \underset{-}{\pi}, \underset{+}{y})\, W \tag{5}$$

$$D_P = f_4(\underset{-}{i}, \underset{-}{i_e}, \underset{-}{\pi_Z}, \underset{+}{i_d}, \underset{-}{\pi}, \underset{+}{y})\, W \tag{6}$$

Standard assumptions are made: unit wealth elasticity, positive own interest rate elasticity i.e., $f_{11} > 0, f_{22} > 0, f_{33} > 0, f_{44} > 0,$ and gross substitutability between assets i.e. $f_{12} < 0, f_{13} < 0, f_{21} < 0, f_{23} < 0, f_{31} < 0, f_{32} < 0...$ By the adding up condition for wealth[3], the demand for bank deposits, which is also the demand for money can be derived from the other three. The public keeps a fraction, $f_4 = D_P / W$, of its wealth in the form of bank deposits. The interest rate i_d paid on bank deposits is administered; it does vary in response to market pressures, but is fixed in the short-run. Firms pay the same interest rates *i* to both banks and the public for their loans. Note that all these are simplifying assumptions. Public and bank loan rates for firms may follow each other closely, rather than being identical.

Households hold four assets, but markets have to clear for the five assets in our model, and the goods market. The portfolio decision gives the households' demand for these assets, but their supply also depends on profit maximising by firms and banks, arbitrage by foreign capital investors, and the government deficit. The market for bank loans clears by the adjustment in i, and equity market by i_e.

2.2 The markets

Structural features allow a simplified treatment of the bullion and foreign currency markets. The money market clears by Walras law once all other demands and supplies are satisfied. Given the household's portfolio decision, the demand for money balances is determined residually from the wealth identity, and is automatically equalled to supply. The loan market is examined in some detail and reduced form excess demand functions are derived. It is shown that under liberalisation there is a tendency for the loan rate of interest to rise. Excess demand functions are also derived for the equity and goods markets. The simultaneous interaction of the last three is then examined analytically in section 3.

The Bullion market:

After liberalisation π_z follows the international price of bullion, and becomes exogenous for a small country. In the short-run, bullion purchase is driven, not by portfolio considerations but by consumption demands or habit persistence. Therefore we can assume that the cross price elasticities of bullion demand are low and can be neglected. Bullion demand is a function of income, and that is exogenous in the time horizon of our model[4].

The External Market:

We assume a managed float. Therefore, in the short-run, the exchange rate is fixed. But banks and foreign investors can arbitrage in money markets, *NRN* deposits are freely convertible, and firms can raise money abroad. Therefore a discrepancy between domestic and foreign interest rates must be reflected in an expected depreciation or appreciation, which is the only source of risk in this simplified model. Uncovered interest parity holds as in equation 7, where i is the interest rate, i^* is the world interest rate and ε^e is the expected rate of depreciation of domestic currency.

$$i = i^* + \varepsilon^e \tag{7}$$

If there is a monetary shock so that i rises above i^*, the foreign inflow that results will be moderated by a rise in ε^e. Similarly, if there is a shock in the foreign exchange market such as a rise in the equilibrium exchange rate or in i^*, the equilibrating rise in i as arbitrage shrinks the supply of loans, may result in a further a rise in ε^e. Capital flows are mobile and respond to disequilibrium, but the elasticity of asset price adjustment exceeds that of quantity adjustment.

The loan market:

Firms have the option of borrowing abroad, therefore the demand for bank loans is:

$$L_b{}^d = l_b(\underset{-}{i}, \underset{+}{i_e}, \underset{+}{\pi}; \underset{+}{i^*}) \tag{8}$$

The demand for domestic loans falls with the interest rate, rises with world interest rate or cost of alternative sources of funds, and with the inflation rate. Even if a rise in i_e stimulates firms to issue more equity, there is a complementary demand for more loan finance.

To determine the supply of bank loans to firms (we assume households do not borrow from banks), we represent the banks' portfolio balance as follows:

$$D = rD + g_b D + l_b D + f_b D \quad and \quad r + g_b + l_b + f_b = 1 \tag{9}$$

Where r is the proportion of assets (deposits) held as reserve, g_b is the proportion of assets held as government securities, l_b is the proportion of assets held as loans to firms, and f_b is the proportion of assets held as foreign assets. The total deposits *(D)* are distributed over the assets the commercial banks hold (see table 1) in the proportion given above. The loan supply available to firms from banks will be $D_P + D_N - rD - g_b D - f_b D$. The portfolio decision of households decides D_p. Excess demand equilibrium for loans then is:

$$EL = l_b(\cdot) - \{ f_4(\cdot)W + D_N(\underset{-}{i}, \underset{-}{i_d}, \underset{-}{i^*};) - [R(\underset{-}{i}, \underset{+}{i_t}, \underset{-}{i^*};) + G_b(\underset{+}{i}, \underset{+}{i_t}, \underset{-}{i^*};) + f_b D(\underset{-}{i}, \underset{+}{i^*};)]\} - f_1(\cdot)W \tag{10}$$

Reforms and the interest rate: With liberalisation, the growth of money supply is unchanged under nominal money supply targeting. But as capital inflows rise and there is a persistent government deficit, it must be that $\Delta F = \Delta G_R$ such that R and H are constant[5]. G_R falls to keep high-powered money, H, constant as foreign inflows increase. The central bank sterilises capital inflows by swapping government debt for foreign assets. This is achieved as the central bank sells government treasury bills. The treasury bill rate *(i_t)* is no longer administered and adjusts to clear the market for government securities. Hence,

$$GD = \Delta G_R + \Delta G_b(i_t) \tag{11}$$

If GD is unchanged, and G_R falls, i_t must rise to induce a higher G_b. Indeed, the rising cost of borrowing for the government may necessitate a higher GD to finance the same real expenditure. The rise in G_b, through the excess demand for loans equation (10), will tend to raise i. As i rises above i^* firms will then access funds from abroad. But this fall in the demand for bank loans will not lessen the pressures making for a rise in i for two reasons.

First, as inflows from firm loans abroad are sterilised, the interest rate on treasury bills will rise again and maintain the pressures to raise i. Second, since better firms will be able to access credit from abroad, riskiness of domestic bank-loans will rise. Therefore banks will charge higher interest rates to the remaining firms.

Claim 1: If safe investors are raising funds abroad, banks will be less concerned about the adverse selection effects of a rise in i, and will raise i.

Proof: There are two types of projects, safe and risky, with returns $R^s{}_f$ and R^r respectively. $R^s{}_f$ can take different values across projects but R^r is the same. The probability that a project succeeds is P_f. The expected return R assumed to be the same across projects is then given by equation 12, for all projects, which we index by *f*.

$$R = P_f R_f^S + (1 - P_f) R^r \tag{12}$$

Each firm puts up *C* as collateral to invest in capital *K*. The firm borrows an amount $B = K - C$. Since the number of firms is *n*, we have $nB = L_b + L_f + L_P$. The cost of borrowing lies between the two returns, that is, $R^s{}_f > (1+i)B > R^r$. Therefore, the expected payoff to a firm, undertaking a project, assuming R^r to be zero, and that the loan is not repaid if the project fails, is:

$$E(\Pi_f) = P_f [R_f^S - (1+i)B] \tag{13}$$

Normally banks do not want to raise *i* since this increases the share of risky firms in the mix of borrowers. Substituting equation 12 into 13, demonstrates the latter:

$$E(\Pi_f) = R - R^r - P_f [(1+i)B] - R^r] \tag{14}$$

Since the returns to a firm investing in a project decrease as the probability of success P_f rises, high-risk investors will be willing to pay more for loans.

$$E(\Pi_b) = (1+i)B \int_O^P P_f \, g(P_f) dP_f + R^r \int_O^P (1 - P_f) g(P_f) dP_f \tag{15}$$

The distribution of P_f over firms undertaking projects follows the density function $g(P_f)$. Equation (15) then gives the expected payoff to the bank. P is the cut off probability at which customers come to the bank for loans. Equation 14 implies that $dP/di < 0$. This is clear from the first order condition (FOC) obtained by differentiating $E(\Pi_b)$ with respect to P_f :

$$(1+i)BPg(P) + R^r(1-P)g(P) = 0$$

If a larger proportion of safe firms is able to access funds from abroad, *P* falls and the profit maximising interest rate for banks, that equates the *FOC* to zero will rise.

Q.E.D.

The second factor making for a rise in *i* is the arbitrage equation for foreign currency assets, 7. If as *i* rises above *i**, the exchange rate is expected to rise to satisfy arbitrage, these expectations become difficult to reverse, and they prevent further inflows of D_N and f_b. Therefore if interest rates are allowed to rise during reform, it can cause shocks to the exchange rate, and a creeping rise in the government deficit. Claim 2 follows:

Claim 2: Interest rate targeting is superior to nominal money supply targeting, after liberalisation.

Proof: The pressures on the interest and exchange rate outlined above would be minimised. Proposition 4, Section 4 establishes that a cumulative rise in inflation will also not occur under such a policy.

The excess demand for loans, equation (10) can be written as the stylised reduced form Equation (16):

$$EL = L^d(\underset{-}{i}, \underset{-/+}{i_e}, \underset{+}{\pi}; \underset{+}{i^*}) - L^s(\underset{+}{i}, \underset{-}{i_e}, \underset{-}{\pi}; \underset{+}{m}) = EL(\underset{-}{i}, \underset{+}{\pi}, \underset{+}{i_e}; \underset{-}{m}, \underset{+}{i^*}) \qquad (16)$$

$L^d\left(i, i_e, \pi; i^*\right)$ is demand for loan from firms and $L^S\left(i, i_e, \pi; m\right)$ is supply of loans from households and banks. Loan-demand comes from firms and the loan-supply from a mixture of household portfolio decision, the monetary base, and banks' preferences between purchase of government securities, loans to firms and foreign arbitrage. The sign restrictions, derived earlier, can be summarised as follows: Loan demand decreases with an increase in cost of funds, i; falls if the cost of alternative source of fund declines (i_e increases) or may rise if debt and equity are complements; rises as inflation raises the profitability of companies; rises with the cost of external sources of funds, i*. Loan Supply rises with returns to loans, i; falls as creditors lose from inflation; falls with increase in returns to alternative source of investment (investment in equity). Under rising equity returns households will switch to equity markets and firms' demand for loans can also rise. An increase in money supply (m) will increase the supply of credit, an increase in i* decrease it. The net effects of i, i_e, and π on the excess demand for loans will be negative, positive and positive respectively.

The slope of the *EL* curve in π, *i* space is therefore:

$$\frac{d\pi}{di} = -\frac{\partial EL / \partial i}{\partial EL / \partial \pi} > 0$$

The Equity Market:

A stylized excess demand for the equity market, analogous to that for the loan market, is:

$$EE = E^d(\underset{-}{i}, \underset{+}{i_e}, \underset{+}{\pi};) - E^s(\underset{-}{i}, \underset{+/-}{i_e}, \underset{+}{\pi}; \underset{+}{i^*}) = EE(\underset{-}{i}, \underset{+}{i_e}, \underset{+}{\pi}; i^*) \quad (17)$$

$E^d\left(i, i_e, \pi;\right)$ is demand for equity from households and $E^S\left(i, i_e, \pi; i^*\right)$ is supply of equity from firms. The demand for equity decreases with an increase in return from alternative investments such as loans, *i*. It increases with own returns. It increases with inflation because equity provides a hedge against inflation as the latter increases the profitability of firms. Supply of equity increases with cost of funds from alternative sources (*i*), and if the cost of issuing equity declines (i_e increases). But at very high i_e supply may fall as firms fear to burst the bubble. Inflation will reduce the supply of loans and hence raise the supply of equity. The net effects of i, i_e, and π on the excess demand for equity will be negative, positive and positive respectively.

The slope of the EE curve in π, i space is therefore:

$$\frac{d\pi}{di} = -\frac{\partial EE / \partial i}{\partial EE / \partial \pi} > 0$$

2.4 The Goods Market

In the goods market we take output to be given exogenously (this could be at or below full capacity Y^*), and $\pi = \pi^e$. Then the excess demand for output:

$$EY = Y^d(\underset{-}{\pi}, \underset{-}{i}, \underset{+}{i_e}; \underset{+}{\theta}) - Y^s(\underset{-}{\pi}, \underset{-}{i}; \underset{+}{\psi}) = EY(\underset{+}{\pi}, \underset{-}{i}, \underset{+}{i_e}; \underset{+/-}{\lambda}) \tag{18}$$

$Y^d(\pi, i, i_e; \theta)$ is the demand for goods from households and $Y^s(\pi, i; \psi)$ is supply of goods from firms Where θ captures demand shocks due to change in fiscal policies, ψ supply shocks due to changes in productivity (change in technology, human capital and etc) of labour and capital, and λ is the net effect. If there are only demand (supply) shocks the net effect will be positive (negative). These shocks change output exogenously in our model. The sign restrictions on demand are standard: demand falls with inflation and with the interest rate as the cost of credit rises. The interest rate has a negative effect on supply for similar reasons, but the effect on demand may be expected to dominate. The negative sign of π on supply can be explained by the structuralist cost-push, if rise in working capital costs with the interest rate, lead to an upward shift in supply, resulting in a negative relation between supply and the rate of inflation. There are alternative explanations based on the microfoundations and industry structure. The spreading of overheads (Blanchard and Fischer 1989), or oligopolistic bargaining (Rotemberg and Saloner 1986), or risk aversion (Goyal[6] 1999) lead to counter-cyclical mark-ups, and downward sloping aggregate supply curves. The flat Keynesian supply curve arose from constant returns and fixed nominal wages. These New-Keynesian theories generate the flat or downward sloping Keynesian supply curve from rigorous profit maximisation. The almost flat supply curve implies that the effect of inflation on supply will dominate that on demand. Therefore excess demand will rise with inflation, as supply falls more than demand. The alternative interpretations imply that the analysis is not restricted to supply shocks; demand and supply interact in interesting ways.

From equation (18), applying the sign restrictions of excess demand for goods, the slope of *EY* in π, *i* space is:

$$\frac{d\pi}{di} = -\frac{\partial EY / \partial i}{\partial EY / \partial \pi} > 0$$

The excess demand functions can now be used to study the interaction between asset and goods markets.

3. Real and financial sector interlinkages

The discussion of the excess demand functions above, empirical observations and stability requirements allow us to formalize restrictions on the sign and relative sizes of the partial derivatives in two assumptions, on which comparative static results depend. After tracing the link between the signs of the partial derivatives and the nature of the equilibria, we derive comparative static results for the different equilibria. All these bring out the structure of market interactions. Partial derivatives of the excess demand functions are now indicated by subscript.

Assumption 1: There is short-term memory response in stock markets or $EE_{i_e} > 0$. This also implies that an increase in stock returns will raise excess demand in the goods market $\left(EY_{i_e} > 0\right)$ and loan market $\left(EL_{i_e} > 0\right)$. The justification for this assumption comes from the literature on noise trading[7]. In the short-run a rise in stock market returns leads to a complementary rise in excess demands for other assets and for output.

Assumption 2: $EY_{i_e} > EE_{i_e} > EL_{i_e}$: the size of the response of excess demands to a change in stock returns, follows a specific ordering with goods market excess demand showing the most response and loan markets the least.

These assumptions imply pairwise saddle-stability of the equity and goods market, and the equity and loan market, but ensure stability of the entire market system. If assumption 2 did not hold, so that the response of stock market excess demand to own returns exceeded that of all other markets the system could not be stable. An empirical feature that the assumptions ensure is reproduced is that a fall in money supply raises interest rates.

It will prove useful to distinguish between two further cases that have implications for the nature of the equilibria, and the relation between the slopes of the market clearing equations in π, i space. They help to relate the results to the structuralist literature.

Case a: stability of the goods and loan market equilibrium

$$|EY_i| > |EL_i| > |EE_i|$$
$$EY_\pi < EL_\pi < EE_\pi$$

Case b: saddle-stability of the goods and loan market equilibrium

$$|EE_i| > |EL_i| > |EY_i|$$

$$EY_\pi > EL_\pi > EE_\pi$$

If the interest rate response is large, the restrictions on the partial derivatives of the excess demand functions with respect to inflation are not required. Saddle-stability of the loan and goods market occurs if the interest rate response in the asset markets exceeds that in the goods market. Financial reforms enhance the role of asset markets and expectations. The present discounted value of future dividends, which varies inversely with interest rates is a major determinant of equity prices. The latter affect both credit demand and output – intensifying the normal channels by which interest rates affect goods and loan markets. As liberalisation removes administrative restraints on interest rates, case *b* is likely to occur in some periods.

Claim 3: *In case a,* $\left.\frac{d\pi}{di}\right|_{EE} > \left.\frac{d\pi}{di}\right|_{EL} > \left.\frac{d\pi}{di}\right|_{EY}$. *In case b,* $\left.\frac{d\pi}{di}\right|_{EY} > \left.\frac{d\pi}{di}\right|_{EL} > \left.\frac{d\pi}{di}\right|_{EE}$

In case a (b), in π*, i space, the slope of the equity (goods) market curve is greater than that of the loan market curve. The latter exceeds the slope of the goods (equity) market curve.*

Proof: Case *a* and *b* follow directly from the equations for the slopes. The ordering of the slopes can in turn be derived from case *a* and *b*.

3.1 Existence and stability of equilibria

The three endogenous variables in assets and goods market excess demand functions are i, i_e and π. We first examine the existence and stability of equilibrium for two markets together and then for all three markets.

3.1.1 Two markets

In doing so, we prove, for the two market case:

Proposition 1*: When only two markets interact, shocks can imply large equilibrating jumps in asset prices.*

Proof: The Jacobian of the partial derivatives with respect to π and i for goods and loan market:

Goods Market	$\underset{+}{\partial EY / \partial \pi}$	$\underset{-}{\partial EY / \partial i}$
Loans Market	$\underset{+}{\partial EL / \partial \pi}$	$\underset{-}{\partial EL / \partial i}$

The trace must be negative and the determinant positive, for stability. If the equilibrium is saddle-stable the trace can take any value and the determinant will be negative, implying that one root of the simultaneous equation system will be positive and the other negative. In this case the equilibrium can only be reached if the system jumps to the unique stable arm corresponding to the negative root. The trace will be negative if $|EL_i| > EY_\pi$. The determinant is negative under case *b* when $|EY_\pi EL_i| > |EY_i EL_\pi|$. So the equilibrium is saddle-stable. Since the speed of adjustment in asset market variables such as interest rates and equity prices exceed that of prices, these variables will be the jump variables. Therefore, large changes will occur in asset market variables in response to shocks. Moreover, from the arbitrage equation 7, a jump in *i* must imply a matching expected depreciation. If case *a* holds the inequality will be reversed and the equilibrium will be stable.

The Jacobian of the partial derivatives with respect to π and i_e for goods and equity market is:

Goods Market	$\underset{+}{\partial EY / \partial \pi}$	$\underset{+}{\partial EY / \partial i_e}$
Equity Market	$\underset{+}{\partial EE / \partial \pi}$	$\underset{+}{\partial EE / \partial i_e}$

The trace is positive. But the determinant is negative by assumptions 1 and 2 since $\left|EY_\pi EE_{i_e}\right| < \left|EY_{i_e} EE_\pi\right|$. Therefore, large equilibrating jumps in stock price are expected in response to shocks in goods market or monetary policy.

The Jacobian of the partial derivatives with respect to *i* and i_e for loans and equity market is:

Loans Market	$\underset{-}{\partial EL / \partial i}$	$\underset{+}{\partial EL / \partial i_e}$
Equity Market	$\underset{-}{\partial EE / \partial i}$	$\underset{+}{\partial EE / \partial i_e}$

The trace will be negative if $\left|EL_i\right| > EE_{i_e}$. The determinant will be negative since by assumptions 1 and 2, $\left|EL_i EE_{i_e}\right| > EL_{i_e} EE_i$. Hence, the loan and equity market equilibrium will be saddle-stable and large equilibrating jumps in equity prices are expected in response to shocks to money supply or news.

Q.E.D.

3.1.2 Three markets

Considering all three markets together, leads to:

Proposition 2: *When three markets interact, the system is stable, although pairwise the markets are saddle-stable. But the interest sensitivity of the goods and equity markets becomes high.*

Proof: The Jacobian now is:

$$\begin{array}{llll} \text{Goods Market} & \underset{+}{EY_\pi} & \underset{-}{EY_i} & \underset{+}{EY_{ie}} \\ \text{Loans Market} & \underset{+}{EL_\pi} & \underset{-}{EL_i} & \underset{+}{EL_{ie}} \\ \text{Equity Market} & \underset{+}{EE_\pi} & \underset{-}{EE_i} & \underset{+}{EE_{ie}} \end{array}$$

The trace will be negative if $|EL_i| > EY_\pi + EE_{ie}$.

The second condition for stability of a three-equation system is that the determinant of its Jacobian is negative. The Jacobian is the product of the three roots, while the trace is the sum. This condition implies that either the three roots are negative (stable), or two roots are positive (saddle-stability). The Jacobian of our system is negative (see appendix *A*.2). If the sum of the principal minors along the diagonal is negative, then the characteristic equation of the system has only one change of sign, so that by Descartes' rule of sign, there can be only one positive root. But this contradicts the negative Jacobian since it contradicts the condition for stability on the roots. Therefore it must be that the sum of the principal minors along the diagonal is positive:

$$\begin{vmatrix} \underset{+}{EY_\pi} & \underset{-}{EY_i} \\ \underset{+}{EL_\pi} & \underset{-}{EL_i} \end{vmatrix} + \begin{vmatrix} \underset{-}{EL_i} & \underset{+}{EL_{i_e}} \\ \underset{-}{EE_i} & \underset{+}{EE_{i_e}} \end{vmatrix} + \begin{vmatrix} \underset{+}{EE_{i_e}} & \underset{+}{EE_\pi} \\ \underset{+}{EY_{i_e}} & \underset{+}{EY_\pi} \end{vmatrix} > 0$$

Then it must be that EY_i, and EE_i are large or the equity and goods markets are highly interest sensitive.

Q.E.D.

4. Comparative Statics

The response of the endogenous variables to exogenous shocks can be derived by totally differentiating the excess demand functions. The shocks considered are monetary policy, news, demand (fiscal policy), and supply (organisational efficiency). The algebra is in the appendix, and figures demonstrate the results. In the figures numeral subscripts 1(2) indicates pre (post) -shock interest and inflation rates. Considering the goods and loan market together we get the structuralist result that a fall in money supply will raise inflation and interest rates (figure 1*a*). Under-saddle stability however, both will fall (figure 1*b* and appendix). Even so, a fall in money supply reduces inflation in the stable three-market system (figure 2*a* and Table 2).

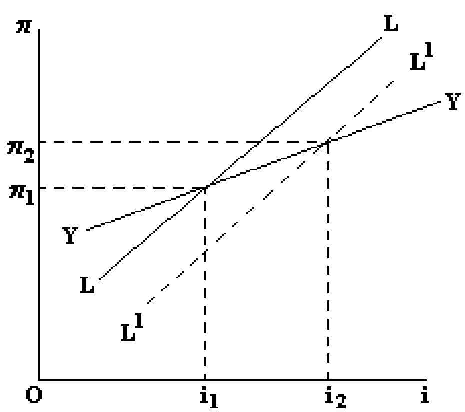

Figure 1 a : Stable Goods & Loan Market; π & i rise with a monetary contraction

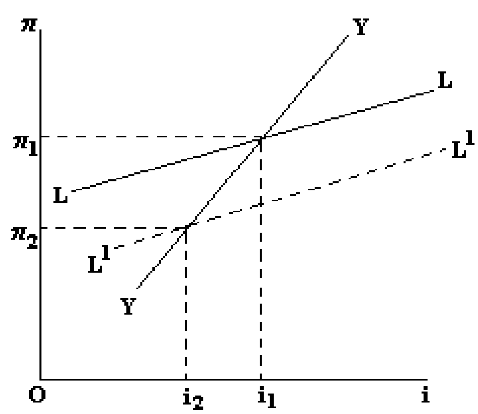

Figure 1 b : Saddle-Stable Goods & Loan Market; π & i fall with a monetary contraction

Table 2 presents comparative static results for a typical post-stabilisation pattern of shocks.

TABLE 2: The Effect of Shocks on Endogenous Variables

Endogenous Variables	Saddle–stable goods and loan market (case b)			Stable goods and loan market (case a)		
Shocks	π	i	i_e	π	i	i_e
M↓	↑	↗	↓	↓↑	↗	↑
i^*↓	↓	↙	↑	↑	↙	↑
y^s↑	↗	↗	↑	↗	↗	↓
y^d↓	↗	↗	↑	↗	↗	↓
η↓	↙	↙	↑	↙	↙	↓

Assumptions 1 and 2 and the stability conditions underlie the comparative static results. Except for *i**, the shocks listed in table 2 are typical of a standard reform package. In a period of structural change, as administrative curbs on asset prices are lifted, the parameters can change. Two markets interacting together can switch to saddle-stability and back. But full integration of financial markets will always make the system stable and reduce sharp fluctuations in asset prices. Only the effects on equity returns and the effect of money supply on inflation vary under case *a* and *b*; the others are invariant, as the italicised arrows of table 2 indicate. They imply that fluctuations will occur, but in the net equity indices will fall, interest rates rise, and if the monetary shocks are stronger than output shocks, inflation may fall under such a structure of shocks.

The new insights in our results are collected in the following propositions:

Proposition 3: *A contraction in money supply will raise interest rates but lower inflation, even in the presence of cost-push from working capital, once equity markets are active. A monetary contraction can raise interest rates and inflation if* $EY_{ie} - EE_{ie} > \left|EY_i - EE_i\right|$ and *under saddle-stability in the goods and loan markets.*

Proof: Result **R10** (Appendix A.2 (*A*.2.2)) gives $di/dm < 0$ as $\left|EY_\pi EE_{ie}\right| < \left|EY_{ie} EE_\pi\right|$ since $EY_{ie} > EE_{ie}$ from assumption 2. This establishes that a fall in

m will raise i. **R8** gives $d\pi / dm < 0$ if $EY_{i_e} - EE_{i_e} > |EY_i - EE_i|$. and **R9** gives $d\pi / dm < 0$ under saddle stability (case b).

Q.E.D.

The proposition is illustrated in table 2 and figure 2.

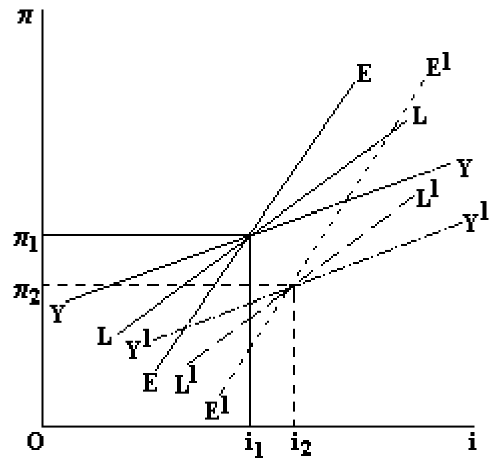

Figure 2 a : Stable Goods & Loan Market but π falls after a monetary contraction

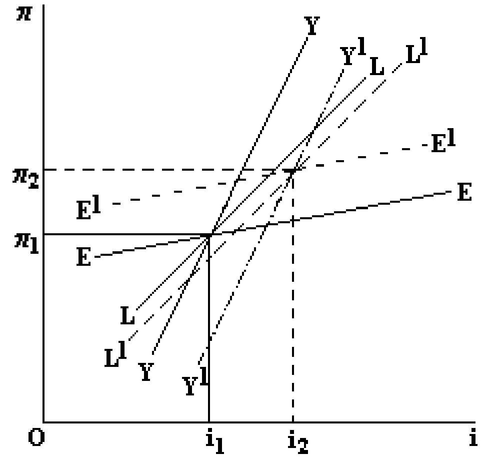

Figure 2 b : Saddle - Stable Goods & Loan Market but π & i rise after a monetary contraction

Proposition 4: *The affect of stock returns on the goods and stock market excess demands ensures that a rise (fall) in money supply cannot lead to accelerating (decelerating) inflation. It follows that a rise in money supply cannot lead to a cumulative rise in inflation and therefore interest rates.*

Proof: $EY_{i_e} > EE_{i_e}$ is assumption 2 which ensures $di / dm < 0$ or result **R10** (Appendix A.2 (*A*.2.2)) holds under both case a and b. In the saddle-stable case b a rise in money supply will cause inflation to fall (**R9**). But even in the stable case a, if $EY_{i_e} - EE_{i_e} > |EY_i - EE_i| \; d\pi / dm < 0$, so that inflation will fall with a rise in money supply (**R8**). This condition will be met if interest elasticities in the stock and goods market are high but similar, and the stock market returns have a greater impact on the goods market excess demands (assumption 2. As stock markets become more important in the economy EY_{ie} will rise. If a rise in money supply does not raise inflationary expectations it will not raise interest rates through the Fisher effect.

Q.E.D.

Proposition 5: *Where both positive demand and supply shocks occur, the demand shock must be stronger than the supply shock for inflation and interest rates to fall.*

Proof: Result **R2** (*A*.2.1 in Appendix *A*.2), shows that $di / d\theta < 0\ d\pi / d\theta < 0$, where θ is a positive demand shock. **R3** shows that $di / d\psi > 0\ d\pi / d\psi > 0$, where ψ is a positive supply shock. Therefore inflation and interest rates would fall if $\lambda = \theta - \psi$:or the net demand shock is positive.

Q.E.D.

Claim 4: *As financial markets deepen, a policy configuration that removes impediments to market integration; adjusts money supply to minimise variation in i; and raises demand and supply, will deliver the best case scenario of minimum asset price fluctuations with π and i constant and rising i_e.*

Proof: Table 2, drawing upon results in Appendix *A*2, shows that this class of shocks would lead to the best results. Propositions 1 and 2 demonstrate the tendency for asset price fluctuations and rising interest sensitivity. Therefore low and stable interest rates would minimise this volatility, and proposition 4 demonstrates that low *i* would not result in inflation.

As asset prices are freed from administrative controls, but other artificial restrictions on asset market integration continue, the saddle-stable case *b* is likely to occur. Without equity markets the structuralist result of a monetary tightening leading to a rise in inflation does not hold in the saddle-stable case. With equity markets the result holds in the saddle-stable case, but need not in the other. However, as financial markets deepen, and equity markets become active, even in this case *a*, the structuralist result would be re-established if the impact of stock returns on goods market excess demand is large. Therefore a monetary policy that is responsive to interest rates is required.

Preliminary tests with daily and monthly asset returns[8], interest rates, monetary aggregates and production and price indices, with Indian data covering the reform period, provide evidence for the sign restrictions imposed on the partial derivatives and for the mapping between shocks and endogenous variable response of table 2.

6. Conclusion

Widespread financial deepening, liberalisation and opening make it imperative that equity and foreign exchange markets are introduced in structuralist theories of asset markets in developing countries, while retaining features that reflect the structure of such markets. Another realistic feature of our model is the key role of expectations. Forward looking inflationary expectations clear the goods market and link it to asset markets. Assumptions are clearly laid out, and comparative static results derived for alternatives. The key result that a fall in money supply will raise the rate of inflation now does not hold under certain conditions, but is re-instated as equity markets become more important. Moreover, there is a tendency for interest rates to rise and for fluctuations in asset prices in the short-run. Fuller integration of asset markets moderates these fluctuations. More active equity markets moderate the impact of a rise on money supply on inflation. Therefore in transition, a conscious policy stance to keep domestic interest rates closely linked to foreign, remove artificial barriers to market integration, and stimulate demand as well as supply, will yield the best results. Although equity returns can deviate from fundamentals, outcomes can be stable implying that the cause of financial crises must lie more in high domestic interest rates.

The results are important because of the ambivalent experience many countries have had with financial reforms, and the fear of crises following the lifting of controls. But with change in technology controls are difficult to implement. Our results indicate that partial controls can create more problems, and until viable market institutions develop the onus is on the monetary authority to ensure liquidity.

The paper can be extended both in theoretical and empirical directions. The sign restrictions of the excess demand functions can be derived from an explicit maximization exercise, and the functions can themselves be estimated.

Appendix A

We derive the algebraic expressions for the effects of exogenous shocks on the endogenous variables, by taking total differentials of the excess demand functions.

The three excess demand functions are:

EE: Excess demand in equity markets
EL: Excess demand in the loan market
EY: Excess demand in the goods market

The three endogenous variables are:
i_e: the rate of return on equity
i: the loan rate of interest
π: the rate of inflation

The three exogenous shocks we consider are:
η: "news", a shock impinging on the stock market
m: a rise in the money supply
$\lambda = \theta - \psi$: demand shock minus supply shock, or the net demand shock

Two cases affecting the stability of the goods and loan market, for which we work out the results are:

Case *a*, stability: $|EY_i| > |EL_i| > |EE_i|$

$$EE_\pi > EL_\pi > EY\pi$$

Case *b*, saddle-stability: $|EE_i| > |EL_i| > |EY_i|$

$$EE_\pi > EL_\pi > EY\pi$$

A.1 The comparative statics of a monetary shock to the goods and loan market

$$\frac{\delta\pi}{\delta m} = \frac{\begin{vmatrix} 0 & -EY_i \\ -EL_m & -EL_i \end{vmatrix}}{|J_1|} = \frac{-EL_m EY_i}{|J_1|} \begin{matrix} >0 \; case\ b \\ <0 \; case\ a \end{matrix}$$

$$Since |J_1| = \begin{vmatrix} EY_\pi & -EY_i \\ EL_\pi & -EL_i \end{vmatrix} \begin{matrix} >0 \; case\ a \\ <0 \; case\ b \end{matrix} \qquad \textbf{R1}$$

$$\frac{\delta i}{\delta m} = \frac{\begin{vmatrix} EY_\pi & 0 \\ EL_\pi & -EL_m \end{vmatrix}}{|J_1|} = \frac{-EL_m EY_\pi}{|J_1|} \begin{matrix} >0 \; case\ b \\ <0 \; case\ a \end{matrix}$$

Results R1 show that, in case *a* which is the structuralist –*NKE* case fall in money supply will increase the interest rate and inflation.

A.2 Comparative statics: the three markets

Taking total differentials of the three excess demand curves, we get:

$$EY = EY(\underset{+}{\pi}, \underset{-}{i}, \underset{+}{i_e}; \underset{+/-}{\lambda}) \Rightarrow EY_\pi d\pi + EY_i di + EY_{ie} di_e + EY_\lambda d\lambda = 0$$
$$EL = EL(\underset{+}{\pi}, \underset{-}{i}, \underset{+}{i_e}; \underset{-}{m}) \Rightarrow EL_\pi d\pi + EL_i di + EL_{ie} di_e + EL_m dm = 0$$
$$EE = EE(\underset{+}{\pi}, \underset{-}{i}, \underset{+}{i_e}; \underset{-}{\eta}) \Rightarrow EE_\pi d\pi + EE_i di + EE_{ie} di_e + EE_\eta d\eta = 0$$

If all the partial derivatives are taken to be positive, so that the signs are reflected as pre-fixes:

$$\begin{aligned} EY_\pi d\pi - EY_i di + EY_{ie} di_e &= \pm EY_\lambda d\lambda \\ EL_\pi d\pi - EL_i di + EL_{ie} di_e &= -EL_m dm \\ EE_\pi d\pi - EE_i di + EE_{ie} di_e &= -EE_\eta d\eta \end{aligned}$$

Writing in matrix form

$$\Rightarrow \begin{bmatrix} EY_\pi & -EY_i & EY_{ie} \\ EL_\pi & -EL_i & EL_{ie} \\ EE_\pi & -EE_i & EE_{ie} \end{bmatrix} \begin{bmatrix} d\pi \\ di \\ di_e \end{bmatrix} = \begin{bmatrix} \pm EL_\lambda d\lambda \\ -EL_m dm \\ -EE_\eta d\eta \end{bmatrix} \qquad \text{(A1)}$$

The Jacobian of partial derivatives is

$$\begin{vmatrix} EY_\pi & -EY_i & EY_{i_e} \\ EL_\pi & -EL_i & EL_{i_e} \\ EE_\pi & -EE_i & EE_{i_e} \end{vmatrix}$$

The determinant of the Jacobian is:

$$|J| = EY_\pi \begin{vmatrix} -EL_i & EL_{i_e} \\ -EE_i & EE_{i_e} \end{vmatrix} + EY_i \begin{vmatrix} EL_\pi & EL_{i_e} \\ EE_\pi & EE_{i_e} \end{vmatrix} + EY_{i_e} \begin{vmatrix} -EL_\pi & -EL_i \\ -EE_\pi & -EE_i \end{vmatrix}$$

$|J| < 0$, if interest and stock return elasticities are high.

The effect of the exogenous on the endogenous variables can be obtained by applying Cramer's rule to equation $A1$.

A.2.1 Positive demand shock

$$\frac{d\pi}{d\lambda} = \frac{\begin{vmatrix} -EY_\lambda & -EY_i & EY_{i_e} \\ 0 & -EL_i & EL_{i_e} \\ 0 & -EE_i & EE_{i_e} \end{vmatrix}}{|J|} = \frac{-EY_\lambda[-EL_i EE_{i_e} + EE_i EL_{i_e}]}{|J|} < 0 \qquad \textbf{R2}$$

$$\frac{di}{d\lambda} = \frac{\begin{vmatrix} EY_\pi & -EY & EY_{i_e} \\ EL_\pi & 0 & EL_{i_e} \\ EE_\pi & 0 & EE_{i_e} \end{vmatrix}}{|J|} = \frac{+EY_\lambda[EL_\pi EE_{i_e} - EE_\pi EL_{i_e}]}{|J|} < 0 \qquad \textbf{R3}$$

$$\frac{di_e}{d\lambda} = \frac{\begin{vmatrix} EY_\pi & -EY_i & -EY_\lambda \\ EL_\pi & -EL_i & 0 \\ EE_\pi & -EE_i & 0 \end{vmatrix}}{|J|} = \frac{-EY_\lambda[-EL_\pi EE_i + EL_i EE_\pi]}{|J|} \qquad \textbf{R4}$$

The sign of $di_e / d\lambda$ which depends on the following conditions, gives us results 5 and 6:

R5: Case *a* (stability) $EL_i EE_\pi > EL_\pi EE_i$ $\left(|EL_i EE_\pi| > |EE_i EL_\pi|\right)$ the sign will be positive.

R6: Case *b* (saddle-stability) $EL_\pi EE_i > EL_i EE_\pi \left(|EE_i EL_\pi| > |EL_i EE_\pi|\right)$ the sign will be negative.

For a supply shock the signs are reversed since $EY_\lambda > 0$. Therefore:

R7: $d\pi / d\lambda > 0,$ $di / d\lambda > 0,$ and $di_e / d\lambda > 0$ under saddle-stability but < 0 under stability.

A.2.2 Shock to money supply

$$\frac{d_\pi}{d_m} = \frac{\begin{vmatrix} 0 & -EY_i & EY_{i_e} \\ -EL_m & -EL_i & EL_{i_e} \\ 0 & -EE_i & EE_{i_e} \end{vmatrix}}{J} = \frac{EY_m\left(-EY_i EE_{i_e} + EY_{i_e} EE_i\right)}{J}$$

R8: $d\pi / dm > 0$ under stability (case *a*) when $\left|EE_i EY_{i_e}\right| < \left|EY_i EE_{i_e}\right|$.
But it can be less than zero if $EY_{i_e} - EE_{i_e} > \left|EY_i - EE_i\right|$.

R9: $d\pi / dm < 0$ under saddle stability (case *b*).

$$\frac{di}{dm} = \frac{\begin{vmatrix} EY_\pi & 0 & EY_{ie} \\ EL_\pi & -EL_m & EL_{ie} \\ EE_\pi & 0 & EE_{ie} \end{vmatrix}}{|J|} = \frac{-EL_m[EY_\pi EE_{ie} - EY_{ie} EE_\pi]}{|J|}$$

R10: $di / dm < 0$ as $\left|EY_\pi EE_{i_e}\right| < \left|EY_{i_e} EE_\pi\right|$ since $EY_{i_e} > EE_{i_e}$ from assumption 2.

$$\frac{di_e}{dm} = \frac{\begin{vmatrix} EY_\pi & -EY_i & 0 \\ EL_\pi & -EL_i & -EL_m \\ EE_\pi & -EE_i & 0 \end{vmatrix}}{|J|} = \frac{EL_m[-EY_\pi EE_i + EY_i EE_\pi]}{|J|}$$

R11: $di_e / dm > 0 \; as \left|EE_\pi EY_i\right| < \left|EY_\pi EE_i\right|$--case *b*.

R12: $di_e / dm < 0 \; as \left|EE_\pi EY_i\right| > \left|EY_\pi EE_i\right|$--case *a*.

A.2.3 Shock in world interest rate

An increase in *i** will have the same effect as a decrease in *m*. Therefore the signs of section A.2.2 are reversed, leading to:

R13: $di / di^* > 0; \, but \; d\pi / di^* > 0, \, di_e / di^* < 0$ under case *b*,

R14: $d\pi / di^* < 0, di_e / di^* > 0$ in case a.

A.2.4 Favourable shock to "news" (a fall in international oil prices):

$$\frac{di}{d\eta} = \frac{\begin{vmatrix} EY_\pi & 0 & EY_{ie} \\ EL_\pi & 0 & EL_{ie} \\ EE_\pi & -EE_\eta & EE_{ie} \end{vmatrix}}{|J|} = \frac{EE_\eta \left(EL_{ie}EY_\pi - EE_\pi EY_{ie}\right)}{|J|} > 0$$

$$\frac{d\pi}{d\eta} = \frac{\begin{vmatrix} 0 & -EY_i & EY_{i_e} \\ 0 & -EL_i & EL_{i_e} \\ -EE_\eta & -EE_i & EE_{i_e} \end{vmatrix}}{|J|} = \frac{-EE_\eta \left(-EY_i EL_{i_e} + EL_i EY_{i_e}\right)}{|J|} > 0$$

$$\frac{di_e}{d\eta} = \frac{\begin{vmatrix} EY_\pi & -EY_i & 0 \\ EL_\pi & -EL_i & 0 \\ EE_\pi & -EE_i & -EE_\eta \end{vmatrix}}{|J|} = \frac{-EE_\eta[-EY_\pi EL_i + EY_i EL_\pi]}{|J|}$$

R15:

$di_e / d\eta > 0$ under case a

$di_e / d\eta < 0$ under case b

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Endnotes

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[1] There is much commentary in the literature on this result, but the seminal papers were Taylor 1983, Wijnbergen Van 1983*a*, *b*.

[2] The microfoundations for this comes from a paper of Barro (1972). Monopolistic firms want to maintain their relative prices. This leads to variation in aggregate inflation even if the price level is fixed. Fischer (1972) obtains a similar conclusion by allowing the Walrasian auctioneer to hold inflationary expectations. Otherwise in neoclassical economics the price level or inflation rate is independent of the price-setting process. Inflation can be sparked off by expected cost-push due to a rise in interest rates. In our model inflation is determined by the interaction of demand and supply in the goods market.

[3] Walras law imposes the consistency of meeting the budget constraint on schedules of supply and demand. For the household portfolio decision, for example, this will imply that the partial derivatives with respect to any interest rate must add up to the partial derivative of wealth demand, with respect to the same variable. Gross substitutability is a stronger assumption and implies that a rise in any interest rate raises the demand for the asset whose yield has increased, without spillover into the other assets. The demand for any asset is positive with respect to own yield but non-positive with respect to other yields. Portfolio theory does not require such a strong assumption (see Tobin 1982). Assets with a strong covariance of yields could be complements. Moreover income effects following the rise in expected yield of any asset can dominate substitution effects. Our assumption 1 imposes Walras law but not gross substitutability of aggregate excess demands.

[4] The assumption is validated by the experience of the nineties in India where π_z-π was negative, but gold demand increased steeply inspite of the fall in prices.

[5] India in the nineties provides an interesting illustration of this. While the growth in Reserve Bank *(RBI)* credit to the government was 20.58 in 1990-91 it varied between only 0.86 and 5.82 over 1991-1995. These were the years when foreign exchange reserves were built up. *RBI* credit to the government fell steadily from about 15-16 per cent of the *GDP* over 1988-1992 to 10 per cent in 1996-97. The influx of foreign capital started in 1993.

[6] Stable dynamic adjustment in spite of high induced demand response to exogenous shocks is made possible by pricing rules that maximize profits for risk averse firms. Switches between high and low growth equilibria result that are used to understand developing economy macroeconomic outcomes in Goyal 1999. Other relevant articles are Goyal 1994, 1995, 1997. The first applies the analysis to examine agriculture-industry interactions, the second derives aggregate demand and supply curves from it and the third brings out the implications for closure rules in a general equilibrium model.

[7] Noise traders are defined to work with a less than infinite time horizon and to be risk-averse. It has been proved (Shleifer and Summers 1990), that for such traders strategies like "jumping on a bandwagon" or "following a trend" or "stop loss" make profits on average. They would then buy assets when their prices are high, and increase price volatility rather than decrease it. The received wisdom earlier had been that those who buy when high must loose money on average, and would therefore be eliminated. In other words, speculation would help in the revelation of fundamental values. These theories have been validated by much empirical work, starting with Shiller (1981), who showed that volatility in stock prices exceeds that justified by movements in fundamentals.

[8] We first compute simple correlation coefficients between daily asset returns. The data was for call money, stock, foreign exchange, gold and silver markets, over the period March 31, 1993 to June 30, 1996. Next we estimate the impact of innovations and changes in volatility. Finally we test for a structural break in the role of asset markets in

transmitting the changes in monetary policy post-liberalisation. Results available with the authors.