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Money, the Stock Market and the Macroeconomy: A Theoretical Analysis

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The finance-growth nexus has become a significant issue in recent macroeconomic modelling and the centre of attention of policy makers. Over the past few decades equity markets have experienced phenomenal growth which has proved to be a major determinant of capital flow to emerging market economies. Naturally, one wants to know how development of equity markets influences the real sector and produces macroeconomic outcomes. In this paper we construct an open economy, structuralist model to examine the short-run and long- run effects of both policy-induced and exogenous shocks on output, the dynamics of stock market valuation and adjustment in monetary base. The model shows that devaluation or capital inflow will boost the economy, while fiscal expansion has deleterious consequences for stock market valuation and investment.

JEL Classifications: G01, G12, F32, F36
Keywords: Tobin's q, Effective Demand, Devaluation

1. INTRODUCTION

When one approaches the analysis of current economic conditions prevailing in "emerging market economies", one has to address at least two connected issues. The first issue relates to the nature of financial structure of emerging markets (EMEs), and the second addresses the possible connection between the real and financial sectors. This paper aims at studying the interdependence of the two sectors while focusing on an important constituent of the financial system, namely, the stock market.

Developing countries have been working towards reforming and deepening financial systems through the expansion of capital markets in order to improve their ability to mobilise resources and efficiently allocate them to the most productive sectors of the economy. The increasing penchant of the policy makers for stock market development in emerging market economies has led to the phenomenal expansion of such markets in terms of both size and liquidity.[1]

Theoretically, there have been two alternative approaches to the study of the impact of the financial sector on economic growth. One is the bank-based approach and

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[1]Market size is important because the level of savings mobilisation and risk diversification depend on this indicator for the development of the market. On the other hand, liquidity ensures low cost fund mobilisation and easy movement of funds from one investor to another.

the other is the market-based approach. In this paper, the market-based approach is chosen for the theoretical exposition of the interaction between the real and the financial sector. A large body of empirical studies clearly shows that the development of stock markets is strongly and positively correlated with the level of economic development and capital accumulation.[2] Empirical observations also validate the interconnectedness between the real sector and the capital market. In particular, one can mention works of King and Levine (1993a, 1993b), Atje and Jovanovic (1993), Levine and Zervos (1998), Mohtadi and Agarwal (2007), Caporale, *et al.* (2004) and Deb and Mukherjee (2008). Moreover, works by Levine (1991), Bencivenga, *et al.* (1996), Greenwood and Smith (1997), Grossman and Stiglitz (1980), Kyle (1984), Allen (1993) and Holmstrom and Tirole (1993) shed light on the role of stock markets in supporting resource allocation and initiating growth. By improving risk diversification through internationally integrated stock markets and increasing the array of possible investments, stock markets can augment the rate of saving and the rate of investment [Saint-Paul (1992); Devereux and Smith (1994); Obstfeld (1994)]. These works motivate us to carry out a theoretical analysis of complexities of the relationship between the real sector and the stock market in the presence of unemployment.

In its orientation this paper draws on Blanchard (1981). We have extended Blanchard's closed economy model to account for increasing openness of an emerging market economy in terms of both trade in goods and financial assets. Our model is closer to Buffie (1986) with some basic differences. Though Buffie incorporated Tobin's q, the dynamics of this asset price has not been addressed. Moreover, Buffie assumed perfect sterilisation of the balance of payment surplus. We drop this assumption and permit the specie flow mechanism to operate which changes the stock of nominal money supply. Another difference between Buffie and our work is that unemployment in Buffie's paper arises due to fixed real wage whereas, in our paper, unemployment is caused by demand deficiency. We consider different speeds of adjustment in macroeconomic variables. The asset price, particularly Tobin's q is a jump variable, which adjusts instantaneously while real money supply evolves continuously and given perfect foresight, the model has the standard properties of saddle path stability. The model shows that a devaluation or capital inflow will boost the economy while fiscal expansion depresses the stock market.

The paper is organised as follows. Section II elaborates the structure and working of the model. In Section III, we undertake certain comparative static exercises. Section IV concludes the paper.

2. THE MODEL

The following symbols will be used in the formal representation of the model:

Y : Domestic output
C : Consumption
I : Investment
X : Export

[2]Atje and Jovanovich (1993); Demirgüç-Kunt and Levine (1996); Demirguc-Kunt and Maksimovic (1996); Korajczyk (1996); Levine and Zervos (1998) have confirmed that as economies develop, equity markets tend to expand both in terms of the number of listed companies and in terms of market capitalisation.

q	:	Tobin's q
e	:	Nominal exchange rate[3]
P	:	Domestic price which is fixed
P^*	:	Foreign price level
m	:	Real money supply
M	:	Currency
Q	:	Consumer's Price Index
R	:	The rate of return on capital equity required by stock holders
F	:	Net capital inflows
γ	:	Proportion of investment expenditure on domestic capital
$1-\gamma$	:	Share of investment expenditure on imported capital
α	:	Share of consumption expenditure on domestically produced goods
$1-\alpha$	:	Share of consumption expenditure on imported goods
π	:	Profit earned by the firms
$\dot{a}$	:	$\frac{da}{dt}$, change in any variable, say, a over time

2.1. Structure of the Model

2.1.1. *The Capital Market*

There are three assets in the economy, viz. money, equity and government bond. Bond and equity are considered to be perfect substitutes.[4] However, equity is a very special asset. The reason is that its market fundamental depends on its future prices. Hence, expectation plays an important role in determining the dynamics of the stock price. We assume that all economic agents have perfect foresight concerning the relevant variables of an economic system other than unanticipated shocks.[5]

The demand for money depends on real income, and the interest rate. An important point to note is that the real money balance is deflated by consumer's price index, which is a weighted average of both domestic price level and import price: $Q = Q(\underset{+}{eP^*}, \underset{+}{P})$

$$\frac{M}{Q(eP^*, P)} = L(r, Y) \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

$$r = \left[\frac{\pi(Y)}{q}\right] + \frac{\dot{q}}{q} \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

Equations (1) and (2) describe the mechanisms of asset valuation in the capital market. Equation (1) is the money market equilibrium. Equation (2) is the arbitrage condition on the assumption that bonds and stocks are perfect substitutes and hence, their returns are equalised. We also note that Equation (2) represents an inter-temporal

[3]In this paper, commodity price level is assumed to be fixed, Since we ignore inflation, the nominal interest rate is same as the real interest rate.

[4]We assume perfect substitutability between equity and bonds. See Blanchard (1981), Gavin (1989).

[5]The perfect foresight assumption is a special case of rational expectation in a non-stochastic framework and hence, the expected rate of change of Tobin's q is same as the actual rate of change.

condition of capital market equilibrium, since it is entailed by the correct expectation of $\dot{q}$ and r at all future dates. The return on equity is obtained from both capital gains[6] as well as from dividends. We assume that the entire profit is distributed as dividend.

2.1.2. *The Goods Market*

The demand for domestic output is composed of domestic demand and foreign demand. Aggregate demand comprises consumption, investment, government expenditure and exports. While consumption is a stable and rising function of disposable income, investment is determined by Tobin's q. Equation (3) gives the commodity market equilibrium.

$$Y = \alpha C(Y-T) + \gamma I(q) + G + X(\frac{e}{P}) \quad \ldots \quad (3)$$

2.2. Dynamic Adjustment and Steady State

The dynamics of the system and the overshooting of stock market valuation are analysed from the perspective of the different speeds of adjustment in the asset markets. The dynamics of the system can be described by the behaviour of the state variables q and h.

$$\dot{q} = rq - \beta\pi(Y) \quad \ldots \quad (4)$$

$$\dot{H} = PX(\frac{e}{P}) + eF - e\left[(1-\alpha)C(Y-T) + (1-\gamma)I(q)\right] \quad \ldots \quad (5)$$

$$h = \frac{H}{P} \quad \ldots \quad (6)$$

Since the price level is assumed to be fixed, we have

$$\frac{\dot{h}}{h} = \frac{\dot{H}}{H}$$

Thus, we get

$$\dot{h} = \frac{\dot{H}}{H}\frac{H}{P} = \frac{\dot{H}}{P}$$

$$= X(\frac{e}{P}) + \frac{e}{P}F - \frac{e}{P}\left[(1-\alpha)C(Y-T) + (1-\gamma)I(q)\right] \quad \ldots \quad (7)$$

Equation (5) represents an inter-temporal condition of the capital market equilibrium, since it is entailed by correct expectations of $\dot{q}$ and r at all future dates. Under the fixed exchange rate, the change in the supply of money is determined by a

[6] i.e. $\frac{\dot{q}}{q}$. In a non-stochastic framework, rational expectation boils down to perfect foresight.

change in the net foreign asset holding by the central bank. Equations (5) to (7) explain the change in the real monetary base of the economy denoted by h.[7] The model includes import of both capital goods and consumer goods. In particular, import = $(1-\alpha)\, C\,(Y-T) + (1-\gamma)\, I(q)$. Exports vary directly with the real exchange rate. The flow of financial capital to the home country is assumed to be exogenous.

The dynamics of the system can be described by the behaviour of the state variables q and h which is represented by adjusting Equations (5) and (7).

In this model, h is a slow moving variable and it evolves continuously while q is a jump variable, which adjusts instantaneously.

Equations (5) and (7) can be represented in the matrix form:

$$\begin{bmatrix} \dot{q} \\ \dot{h} \end{bmatrix} = \begin{bmatrix} f_1 & f_2 \\ g_1 & g_2 \end{bmatrix} \begin{bmatrix} q - \bar{q}_2 \\ h - \bar{h}_2 \end{bmatrix}$$

where

$$f_1 = \frac{d\dot{q}}{dq} > 0$$

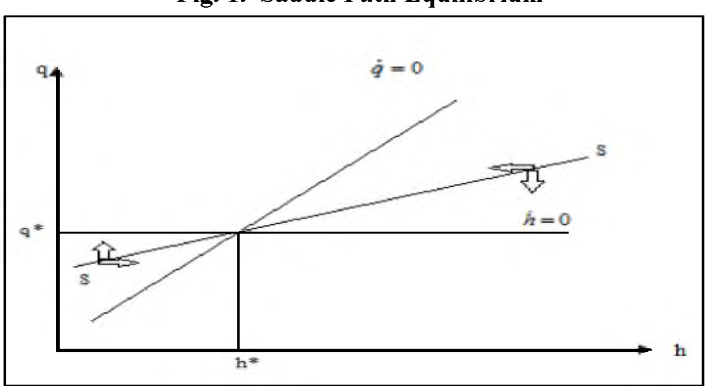
$$f_2 = \frac{d\dot{q}}{dh} < 0$$

$$g_1 = \frac{d\dot{h}}{dq} < 0$$

$$g_2 = \frac{d\dot{h}}{dh} = 0$$

In the steady state we have $\dot{h} = 0$ and $\dot{q} = 0$. Given perfect foresight, the model has the standard properties of saddle path stability where h is a slow moving variable and q is a jump variable, which adjusts instantaneously. In implicit forms, the dynamics of money supply and Tobin's q can be expressed as $\dot{h} = g(q, h) = 0$ and $\dot{q} = f(q, h) = 0$ respectively. This is shown in Figure 1.

Fig. 1. Saddle Path Equilibrium



[7]Money supply here is high powered money multiplied by the money multiplier.

In order to depict equilibrium, we draw $\dot{h} = 0$ and $\dot{q} = 0$ on the (h, q) plane. The arrows indicate adjustment of the two variables, h and q in different quadrants. First, the locus $\dot{q} = 0$ gives the combination of Tobin's q and money supply that maintains $\dot{q} = 0$ in the (h, q) plane. From the system of equations, this has the slope $(\frac{dq}{dh})_{\dot{q}=0} = -\frac{f_2}{f_1} > 0$. The intuitive explanation for the slope of $\dot{q} = 0$ is this. An increase in the stock value has two effects. First, as q rises, to maintain money market equilibrium, given Y, r has to rise. So, we get $\dot{q} > 0$. Secondly, with a rise in q, investment increases, thus causing output to expand. However, with a rise in Y, profit level increases, thus, making $\dot{q} < 0$. For simplicity, we assume that $\dot{q} > 0$, following a rise in q.

Again as money supply increases, the rate of interest declines and hence, we get $\dot{q} < 0$. So with a rise in q, money supply has to increase to maintain the steady state. Hence, the $\dot{q} = 0$ locus is upward sloping.

Likewise, $\dot{h} = 0$ is the locus of combination of money supply and Tobin's q consistent with money market conditions. The slope of $\dot{m} = 0$ is given by $(\frac{dq}{dh})_{\dot{h}=0} = -\frac{g_2}{g_1}$. Intuitively, a rise in Tobin's q increases import of capital goods and thus makes< 0. However, a rise in h has no effect on $\dot{h}$. Hence, $\dot{h}$= 0 locus is horizontal.

The stable saddle path, SS is given by the equation

$$(q - \bar{q}_2) = (\frac{f_2}{\lambda_1 - f_1})(h - \bar{h}_2)$$

Or equivalently as

$$(q - \bar{q}_2) = (\frac{\lambda_1 - g_1}{g_2})(h - \bar{h}_2)$$

The slope of the saddle path (SS) is given by:

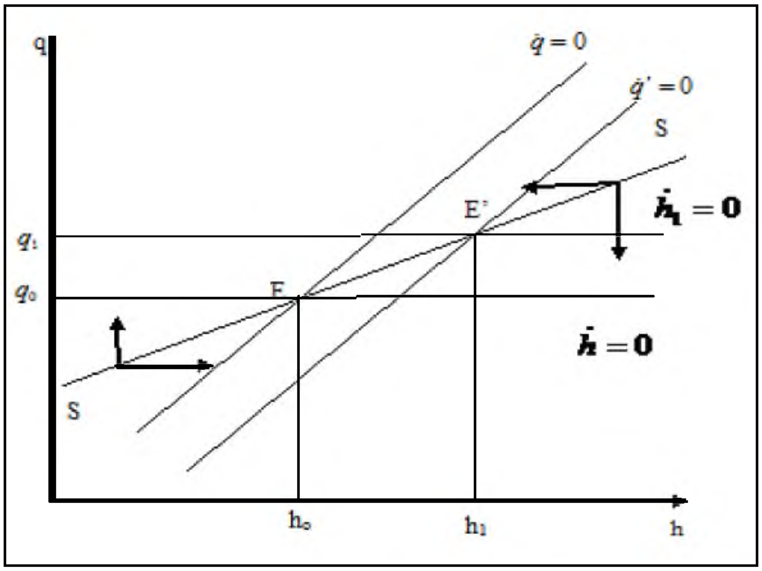
$$\frac{dq}{dh} = \frac{f_2}{\lambda_1 - f_1} = \frac{\lambda_1 - g_1}{g_2}$$

3. COMPARATIVE STATIC EXERCISES

3.1. Effects of Devaluation

Starting from an initial steady state E, devaluation will bring about rise in export and hence, output will rise leading to a rise in demand for real balance. Again, there will be a fall in real money supply since it is deflated by the consumer price index. On both counts there is a rise in interest rate. So $\dot{q} > 0$. Thus, the $\dot{q} > 0$. locus will shift downward. Again with BOP surplus, $\dot{h} > 0$. So money supply will increase and the $\dot{h} = 0$ locus will shift upward. In the long run, output, q and money stock will rise. However, the effect on r is ambiguous. The rise in h tends to offset the initial increase in interest rate. This is shown in the following Figure 2.

Fig. 2. Effects of Devaluation



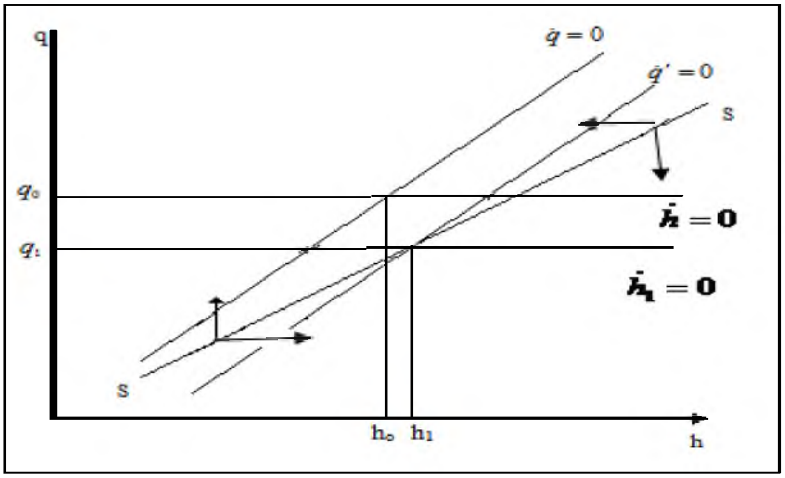
3.1.2. *Effects of Rise in Capital Inflow*

Following foreign capital inflow, there will be a favourable impact on the economy. The intuitive explanation is this. With rise in capital flow, there will be BOP surplus and hence, money supply will increase. This will cause the interest rate to fall and q to rise, thus, allowing investment to increase. The rest of the analysis of effects of capital flow is the same as that of the effects of devaluation.

3.1.3. *Effects of Fiscal Expansion*

With an increase in government expenditure, output will rise. This will cause imports to rise and hence, there will be BOP deficit. So the $\dot{h}=0$ locus will shift downward. Again, to maintain the money market equilibrium following the rise in Y, r has to increase. Assuming that the rise in r is more than the rise in profit per unit of capital, we get $\dot{q}>0$. So the $\dot{q}>0$ locus will shift downward. In the long run, q will decrease unambiguously but the effect on h will be ambiguous. Since Tobin's q falls, investment declines. However, the output level will increase. The intuition is this. At the steady state, $X(\frac{e}{P})+\frac{e}{P}F-\frac{e}{P}\left[(1-\alpha)C(Y-T)+(1-\gamma)I(q)\right]=0.$ Since investment declines, import of capital goods falls. To maintain the balance of payment equilibrium, there has to be an increase in imports of consumption goods which requires rise in output. The steady state effects of fiscal expansion are shown in Figure 3.

Fig. 3. Effects of Fiscal Expansion



4. CONCLUSION

The issue of relationship between the financial sector and macroeconomic performance has long been debated. The channel of transmission has been identified as many and varied depending on the financial system in a particular economy. In this paper an attempt has been made to develop a demand side model of interconnectedness between the financial sector and the real sector with specific focus on macroeconomic implications of movement in stock market valuation under the fixed exchange rate regime. The paper shows that capital flow and devaluation contribute to the development of stock market as Tobin's q increases in both the cases. However, fiscal expansion has perverse effect on the stock market value. The model can be extended in several directions. The model is based on the assumption that the economy is in Keynesian unemployment. A detailed treatment of aggregate supply and the long run dimension of capital accumulation can be addressed. Moreover, the paper can be extended to include exchange rate dynamics with its attendant macroeconomic implications.

APPENDIX I

DERIVATION OF SADDLE PATH

First we derive the condition for existence of unique saddle path. The differential equations are:

$$\dot{q} = f(q,h), \dot{h} = g(q,h).$$

Using the Taylor series approximation of these two equations around the initial steady state values $(\bar{q}, \bar{h})$, we get,

$$\begin{bmatrix} \dot{q} \\ \dot{h} \end{bmatrix} = \begin{bmatrix} f_1 & f_2 \\ g_1 & g_2 \end{bmatrix} \begin{bmatrix} q - \bar{q}_1 \\ h - \bar{h}_1 \end{bmatrix} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

Now suppose that at time 0, it is announced that the parameters are to be increased at time T $\geq$ 0. Therefore, the new steady state after the shifts have occurred is specified by

$$\begin{bmatrix} \dot{q} \\ \dot{h} \end{bmatrix} = \begin{bmatrix} f_1 & f_2 \\ g_1 & g_2 \end{bmatrix} \begin{bmatrix} q - \bar{q}_2 \\ h - \bar{h}_2 \end{bmatrix} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

As long as the shifts are additive, the co-efficient a_{ij} remains unchanged between the two regimes, the Eigen values λ_1, λ_2, say of Equations (1) and (2) are identical.

For simplicity and without loss of generality, we shall assume they are real. The fact that the dynamics are described by a saddle path, means that the product $\lambda_1\lambda_2 = f_1 g_2 - f_2 g_1 < 0$. We assume that $\lambda_1 < 0, \lambda_2 > 0$, such that $f_1 g_2 - f_2 g_1 < 0$.

Over the period $0 \leq t \leq T$, before the shifts in the parameters occur, the solutions for $q(t)$ and $K(t)$ are:

$$q(t) = \bar{q}_1 + A_1 e^{\lambda_1 t} + A_2 e^{\lambda_2 t} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

$$h(t) = \bar{h}_1 + (\frac{\lambda_1 - f_1}{f_2}) A_1 e^{\lambda_1 t} + (\frac{\lambda_2 - f_1}{f_2}) A_2 e^{\lambda_2 t} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

Since λ_i s are Eigen values, $\frac{\lambda_i - f_1}{f_2} = \frac{g_1}{\lambda_i - g_2}$

For i = 1,2. , in which case (4) can be rewritten as

$$h(t) = \bar{h}_1 + (\frac{g_1}{\lambda_1 - g_2}) A_1 e^{\lambda_1 t} + (\frac{g_1}{\lambda_2 - g_2}) A_2 e^{\lambda_2 t}$$

Likewise, for the period $t \geq T$, after the shifts have occurred, the solutions for $q(t)$ and $h(t)$ are

$$q(t) = \bar{q}_2 + A_1' e^{\lambda_1 t} + A_2' e^{\lambda_2 t} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

$$h(t) = \bar{h}_2 + (\frac{\lambda_1 - f_1}{f_2}) A_1' e^{\lambda_1 t} + (\frac{\lambda_2 - f_1}{f_2}) A_2' e^{\lambda_2 t} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

It is noted that $q(t)$ and h(t) do not diverge as $t \to \infty$. It is clear that $A_2' = 0$ and hence

$$q(t) = \bar{q}_2 + A_1' e^{\lambda_1 t} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

$$h(t) = \bar{h}_2 + (\frac{\lambda_1 - f_1}{f_2}) A_1' e^{\lambda_1 t} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (8)$$

That is, after time T, $q(t)$ and $h(t)$ must follow the stable paths described by (7) and (8).

The remaining constants A_1, A_2, A_1' are obtained by solving the equations

$A_1 + A_2 = 0$

$(A_1 - A_1')e^{\lambda_1 t} + A_1 e^{\lambda_2 t} = d\bar{q}$

$$\left(\frac{\lambda_1 - f_1}{f_2}\right)(A_1 - A_1')e^{\lambda_1 t} + \left(\frac{\lambda_1 - f_1}{f_2}\right)A_2 e^{\lambda_2 t} = d\overline{h}$$

$d\overline{h}$ and $d\overline{q}$ are shifts of steady state in h and q respectively.

Eliminating $A_1'e^{\lambda_1 t}$ from Equations (7) and (8), we get the equation of the stable saddle path equation as

$$(q - \overline{q}_2) = \left(\frac{f_2}{\lambda_1 - f_1}\right)(h - \overline{h}_2)$$

Or equivalently as

$$(q - \overline{q}_2) = \left(\frac{\lambda_1 - g_1}{g_2}\right)(h - \overline{h}_2)$$

The slope of the saddle path (SS) is given by:

$$\frac{dq}{dh} = \frac{f_2}{\lambda_1 - f_1} = \frac{\lambda_1 - g_1}{g_2}$$

This locus between q and h defines the stable arm of the saddle point passing through the steady state $(\overline{q}, \overline{h})$. Since $f_1>0$, $\lambda_1<0$ and $f_2<0$, hence, the locus is positively sloped.

APPENDIX II

EFFECTS OF DEVALUATION

$$\dot{q} = f(q,h,e), f_1 > 0, f_2 < 0, f_3 > 0$$
$$\dot{h} = g(q,h,e), g_1 < 0, g_2 = 0, g_3 > 0$$

Differentiating with respect to e, we get,

$$\begin{bmatrix} f_1 & f_2 \\ g_1 & g_2 \end{bmatrix} \begin{bmatrix} \dfrac{\partial q}{\partial e} \\ \dfrac{\partial h}{\partial e} \end{bmatrix} = \begin{bmatrix} -f_3 \\ -g_3 \end{bmatrix}$$

Using Cramer's Rule we get,

$$\frac{\partial q}{\partial e} = \frac{\begin{bmatrix} -f_3 & f_2 \\ -g_3 & g_2 \end{bmatrix}}{\Delta} = \frac{-f_3 g_2 + f_2 g_3}{\Delta} > 0$$

$$\frac{\partial h}{\partial e} = \frac{\begin{bmatrix} f_1 & -f_3 \\ g_1 & -g_3 \end{bmatrix}}{\Delta} = \frac{-f_1 g_3 + f_3 g_1}{\Delta} > 0$$

Where $\Delta = f_1 g_2 - f_2 g_1 < 0$

APPENDIX III

EFFECTS OF FISCAL EXPANSION

$\dot{q} = f(q,h,G), f_1 > 0, f_2 < 0, f_4 > 0$

$\dot{h} = g(q,h,G), g_1 < 0, g_2 = 0, g_4 < 0$

Differentiating with respect to G, we get,

$$\begin{bmatrix} f_1 & f_2 \\ g_1 & g_2 \end{bmatrix} \begin{bmatrix} \frac{\partial q}{\partial G} \\ \frac{\partial h}{\partial G} \end{bmatrix} = \begin{bmatrix} -f_4 \\ -g_4 \end{bmatrix}$$

Using Cramer's Rule we get,

$$\frac{\partial q}{\partial G} = \frac{\begin{bmatrix} -f_4 & f_2 \\ -g_4 & g_2 \end{bmatrix}}{\Delta} = \frac{-f_4 g_2 + f_2 g_4}{\Delta} < 0$$

$$\frac{\partial h}{\partial G} = \frac{\begin{bmatrix} f_1 & -f_4 \\ g_1 & -g_4 \end{bmatrix}}{\Delta} = \frac{-f_1 g_4 + f_4 g_1}{\Delta}$$

Where $\Delta = f_1 g_2 - f_2 g_1 < 0$. This result can be either positive or negative.

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