Financial Fragility in Developing Economies

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Abstract

The paper develops a mathematical representation of Hyman Minsky's (1975, 1982) regimes of hedge, speculative, and Ponzi finance. The Minskian model of Lance Taylor and Stephen O'Connell (1985), which analyzes the dynamics of a closed Kaleckian economy where growth has a positive feedback on investment through a rise in exuberance and monetary policy is directed at stabilizing the growth rate, is modified to allow for finance of investment through capital inflows, which allows the economy to reach the speculative regime. When interest rate policy stabilizes the growth rate a positive growth rate shock can set off a dynamical path that brings the economy into the Ponzi regime of financial fragility.

Keywords: financial fragility, Minsky, open economy macroeconomics

JEL Classification: E1, F4

1 Introduction

The epidemic of financial crises in developing and newly industrializing countries that accompanied the liberalization of domestic and international capital markets in the 1990s has underlined the relevance of Hyman Minsky's (1975, 1982) conception of financial fragility to the contemporary world economy. Minsky's own work focused on financial fragility in fully industrialized capitalist economies with highly developed financial institutions and markets. Minsky saw a tendency for financial positions to become increasingly indebted in periods of prosperity, and hence increasingly vulnerable to debt-deflation crisis, as both borrowers and lenders become tolerant of higher ratios of debt to equity finance. In Minsky's view a financially fragile economy posed a difficult problem for a central bank; in attempting to control financial fragility by tightening monetary policy and raising interest rates the central bank could trigger the financial crisis it sought to avert.

The drama of financial crisis in the international economy in the 1990s played out in a rather different context. Industrializing economies with high structural profit rates and good opportunities for profitable investment but relatively undeveloped financial institutions faced large inflows of short-term debt capital in the context of the "Washington consensus"-inspired liberalization of international capital flows. Positive shocks to investment and profitability in these economies triggered unstable capital inflows which led in turn to external and internal financial crisis as the resulting current account deficits became unmanageable. In this repeated pattern of events, however, we can see the outlines of Minskian crisis based on increasing financial fragility.

The purpose of this paper is to modify the model of Minskian crisis put forward by Lance Taylor and Stephen O'Connell (1985) to analyze the crises of the 1990s. Taylor and O'Connell study a Kaleckian economy in which capacity utilization and the profit rate vary to bring about a short-run equilibrium of aggregate demand and supply. They introduce an investment demand function into this economy which has a variable "exuberance" factor to represent a potentially destabilizing tendency for firms to increase their investment plans during booms. One curious aspect of the Taylor-O'Connell model is that it maintains the closed economy Kaleckian relation between the growth rate and the savings out of profits, $g = sr$, which, assuming $s < 1$, imposes a regime of Minskian hedge finance in which $r > g$.

Opening the economy to capital inflows from abroad is a natural way to allow domestic growth rates to exceed domestic profit rates, and thereby to allow the economy to reach Minsky's speculative regime where $g > r$. The modified model, however, remains true to the basic insight of Taylor-O'Connell that the growth rate and profit rate are highly positively correlated in a Kaleckian economy, which may make it very difficult to reduce financial fragility by lowering the growth rate. Indeed, the modified model exhibits paths, even around stable equilibria, which force the economy into the financially fragile regime of Ponzi finance as growth rates and profit rates fall in the course of a stabilizing correction.

While there are undoubtedly relevant "supply-side" factors constraining growth in industrializing economies, particularly the challenge of improving infrastructure to complement capital accumulation and the stress of rapid growth on entrepreneurial capabilities, the modified model suggests that higher target growth rates are likely to be more robust financially. Central bankers and their advisers from international agencies would do well to ponder the interaction of Kaleckian aggregate demand dynamics and Minskian financial constraints in the short-run dynamics of structural adjustment in industrializing economies.

2 The analytics of financial fragility

Financial fragility arises from the widespread practice of firms using debt contracts to finance production. In a debt contract the borrowing firm receives finance from a lender in exchange for promising a contractually fixed stream of interest and principal payments (*debt service*) over the duration of the loan. The failure of the borrowing firm to make one of these contractual payments triggers its *bankruptcy*, which interrupts the firm's normal operation, and puts its other creditors at risk of not receiving the payment of their contracted debt service. An economy is financially fragile, in Minsky's terms, if the bankruptcy of one firm can set off a chain reaction of bankruptcies of other firms.

Minsky analyzes financial fragility in terms of a firm's cash flow accounting categories. In a highly aggegated form, the cash flow identity equates the firm's sources of funds from net operating revenues, R, and new borrowing, D, to its uses of funds for investment, I, and debt service, V. (For simplicity I abstract from the payment of dividends.)

$$R + D \equiv I + V \tag{1}$$

This organization of the cash flow identity in terms of sources and uses of funds is somewhat arbitrary, since it is possible for R to be negative, if the firm is operating at a loss, for D to be negative if the firm is repaying debt, for I to be negative if the firm is selling assets, or for V to be negative if the firm is a net creditor.

The net worth of the firm, W, is equal to the difference between the value of its assets, A, and the value of its debts, B. Net worth is increased by investment, which is the change in assets, $\dot{A} = I$, and reduced by borrowing, which is the change in debt, $\dot{B} = D$.

$$W = A - B \tag{2}$$

$$\dot{W} = \dot{A} - \dot{B} = I - D \tag{3}$$

If a bankrupt firm turns out to be insolvent, $W \leq 0$, then its creditors will be unable to recover the principal value of their loans.

Minsky identifies three possible firm financial states.

A *hedged* firm has $R \geq V + I$, so that $D \leq 0$. The firm's net revenues cover its debt service and investment, so that it is in a position to reduce its net indebtedness. A hedged firm may still get into financial trouble, of course, if its net revenues decline (as might happen in a business downturn) or its debt service rises (as might happen in a credit crunch). Hedged firms are financially relatively secure, but this may be due to their lack of attractive investment opportunities. The net worth of a hedged firm is increasing, and as long as it stays hedged it will never become bankrupt.

A *speculative* firm has $R \geq V$, but $R < V + I$, so that $D \geq 0$, but $D < I$. The speculative firm can cover its current debt service out of its net revenues, but it is borrowing in order to finance some part of its investment. The speculative firm's creditworthiness depends on the prospective profitability of its investments. In the event of a rise in its debt service costs it has some margin of financial security in restricting investment, as long as its net revenues remain strong. Almost all successful capitalist firms go through a speculative phase in their development, since successful firms generate investment opportunities that exceed their capacity for self-finance. The net worth of a speculative firm is increasing. As long as its investments remain profitable, it will not go bankrupt.

A *Ponzi* firm has $R < V$, so that $D > I$. The Ponzi firm is borrowing to pay part of its debt service. The Ponzi firm's creditworthiness depends on its ability to convince potential lenders that its net revenues will rise in the near future, since it has no margin of financial security. A rise in debt service makes it harder for a Ponzi firm to find willing borrowers. Many successful capitalist firms have gone through Ponzi phases as the result of unanticipated but short-lived shocks to their net revenues or debt service. But a Ponzi firm is living on borrowed time, since it will become insolvent in a finite time on its current financial path. If its creditors lose faith in the firm's revenue prospects, they will refuse new loans to pay its debt service, and bankrupt the firm immediately.

3 The dynamics of firm finance

The path of firm finance is easiest to work out in terms of rates of change and return on assets and debt. Let $g = I/A$ be the growth rate of the firm's assets, $r = R/A$ be its profit rate, and $i = V/B$ be its interest rate (the ratio of debt service to the stock of debt). Then the cash flow identity can be written:

$$\dot{B} = D = I + V - R = (g - r)A + iB \tag{4}$$

If we look at paths on which g is constant, so that $A(t) = A_0 e^{gt}$, this differential equation has the general solution:

$$B(t) = (B_0 - \frac{g-r}{g-i}A_0)e^{it} + \frac{g-r}{g-i}A_0 e^{gt} \tag{5}$$

It is more convenient to write this solution in terms of the ratio of debt to assets, $\phi = B/A$. The firm is solvent as long as $\phi < 1$. The path of ϕ is, writing $\phi^* = (g-r)/(g-i)$:

$$\phi(t) = \phi^* + (\phi_0 - \phi^*)e^{(i-g)t} \tag{6}$$

If $g > i$, the second term vanishes asymptotically, and $\lim_{t\to\infty}\phi(t) = \phi^*$. If $i > g$, then the second term dominates and $\lim_{t\to\infty}\phi(t) = \pm\infty$ as $\phi_0 >< \phi^*$. There are thus two types of paths on which the firm becomes bankrupt in finite time: those on which $g > i$ and $\phi^* > 1$, and those on which $i > g$ and $\phi_0 > \phi^*$.

On paths where $r > i$, the firm will not go bankrupt. When $r > g > i$, $\phi(t) \to \phi^* < 0$ and the firm is an asymptotic creditor. When $r > i > g$, $\phi^* > 1 > \phi_0$, $\phi(t) \to -\infty$ and the firm is an asymptotically unbounded creditor. On both these paths the firm is always hedged.

But a firm for which $r > i$ has a strong incentive to increase its investment by raising g. If $g > r > i$, $\phi(t) \to \phi^* < 1$. This is the case of speculative finance. The firm is never hedged, since it is always borrowing to carry out its investment, but its debt grows asymptotically at the same rate as its assets.

If the firm expects $i > r$ indefinitely, it is better off putting its net worth into financial assets and becoming a bank. The policy that achieves this is to lower g, making it negative if necessary.

On paths where $g > i > r$, $\phi(t) \rightarrow \phi^* > 1$, and the firm must go bankrupt in finite time. This is the classic case of Ponzi finance. While it is unlikely that a reputable firm would choose a Ponzi path voluntarily, a firm might be trapped into a Ponzi posture at least temporarily by events beyond its control. A rise in the interest rate, as a result of policy or market developments beyond the firm's control, for example, will transform a speculative financial strategy into a Ponzi strategy. In this situation the firm either has to hope that the interest rate falls below its profit rate before it becomes insolvent, and that its lenders are willing to see it through the crisis, or it has to try to save itself by lowering g.

How successfully can a Ponzi firm manage to stabilize itself financially by restricting investment? With $g < i$, $\phi(t) \rightarrow (\phi_0 - \phi^*)\infty$, so the firm must aim for $\phi^* = (r - g)/(i - g) > \phi_0$, or $g < (r - \phi_0 i)/(1 - \phi_0)$. The lower is r, the higher i, and the higher ϕ_0, the more must the firm lower g to reach safety. If a large number of firms try to stabilize themselves by cutting back investment expenditures, they may reduce aggregate demand and wind up reducing their profit rates as well, setting off a decline in output and national income, and making it that much harder to reach stability.

4 Financial fragility of national economies

The equations describing the financial dynamics of a firm apply equally well to a national economy, viewed as a collection of firms. In reality, the ensemble of firms making up a national economy will be distributed statistically among different financial states — some proportion of the firms at any moment will be hedged, some proportion speculative, and some proportion Ponzi. But, following Lance Taylor and Stephen O'Connell (1985), we can get some insight into the economy-wide dynamics by studying a model where the firms of a nation are averaged into one representative firm.

Consider a small, open Kaleckian economy in which real output X is distributed as wages, $W = (1 - \pi)X$, all of which are spent immediately, and profits, $P = \pi X$, a fraction s of which are saved, so that consumption $C = W + (1 - s)P = (1 - s\pi)X$. We take the profit share, π, as an unvarying exogenous parameter. All quantities are measured in real terms (or equivalently at world prices.) For simplicity we will abstract from government taxation and spending. Investment is I. D, the current account deficit, or, equivalently, capital account surplus, is the difference between expenditure and output, $D = C + I - X = I - s\pi X$. This D for the whole economy is analogous to the D defined above for an individual firm, since it represents net new borrowing. Writing $d = D/K$, $g = I/K$, and $r = \pi X/K$ where K is the capital stock, we have:

$$d = g - sr \tag{7}$$

Given d and g, the actual output-capital ration, X/K, must adjust to determine a realized profit rate r that satisfies equation (7). Taylor and O'Connell's closed economy has $d = 0$, which implies that $g < r$, on the assumption that $s < 1$. As a result, their economy cannot actually get into the speculative regime where $g > r > i$. The open economy of the present model, however, can import capital to finance investment, so that it can reach the speculative regime.

Assume that the capital account surplus, d, depends on the real interest rate i, controlled by the monetary authority,[1] and the profit rate r:

$$d = d_0 + \eta i - \psi r \tag{8}$$

[1]The exact mechanisms through which the monetary authority controls the real interest rate will depend on institutional details such as the foreign exchange regime (floating or fixed), and the structure of the domestic financial markets, but do not need to be specified to carry out the analysis of financial fragility. The ways in which a crisis of financial fragility manifest themselves will also depend on these institutional details, but the underlying cause will be the long run unviability of the country's financial path.

The parameters η and ψ are positive, on the assumptions that a rise in the real interest rate will increase capital inflows, and that capitalists use some proportion of their saved profits to buy foreign assets.

Following Taylor and O'Connell, assume that the growth rate of capital depends on the profit rate r, the real interest rate, i, and a confidence factor ρ, representing the exuberance of the investing capitalists:

$$g = g_0 + h(r + \rho - i) \tag{9}$$

The parameter h is positive. We see that:

$$r = \frac{g - d}{s} = \frac{g_0 - d_0 + (h + \psi)r + h\rho - (h + \eta)i}{s}$$

Solving for r:

$$r = \frac{g_0 - d_0 + h\rho - (h + \eta)i}{s(1 - \psi) - h} \tag{10}$$

A rise in the interest rate leads to an increase in capital inflows and imports, and a fall in domestic investment, both reducing domestic output, the output-capital ratio, and the profit rate. An increase in exuberance raises domestic investment, the output-capital ratio, and the profit rate.

In the same fashion we can solve for g:

$$g = \frac{s(1 - \psi)g_0 - hd_0 + hs(1 - \psi)\rho - h(s(1 - \psi) + \eta)i}{s(1 - \psi) - h} \tag{11}$$

Thus we can view the equations (7), (8), and (9) as determining r, g, and d, given ρ, i, and the structural parameters. In this way of approaching the model, ρ and i are the state variables. Since g and ρ are related monotonically, we can alternatively take g and i as state variables, understanding that ρ is being determined implicitly. This approach to the dynamics has the advantage of allowing us to visualize the dynamics of the economy in (g, i) space, where the relationships defining financial fragility are more transparent. In this way of approaching the model, we can write r (and the current account deficit, d) in terms of g and i:

$$r = \frac{g - d_0 - \eta i}{s(1 - \psi)} \tag{12}$$

$$d = \frac{g\psi \quad - d_0 - \eta i}{s(1 - \psi)} \tag{13}$$

Figure 1 shows the regions in (g, i) space corresponding to the different regimes of finance. The dashed 45-degree line on which $i = g$ is the boundary between the $g > i$ regime below and the $i > g$ regime above. Each combination of g and i determines a particular profit rate r in short-run equilibrium through equation (12). The bold line in Figure 1 is the locus of (g, i) pairs on which $r = i$. Above this line $i > r$, which, as we have seen signals the unsustainable state of Ponzi finance. An economy which crosses this boundary is vulnerable to a financial crisis. The undashed line is the locus of (g, i) pairs on which $r = g$, and marks the boundary (where $i \leq r$) between the regime of hedged and speculative finance. Figure 1 emphasizes the linkage between the growth rate and the profit rate in the open Kaleckian economy. In this economy a *rise* in the growth rate *diminishes* financial fragility because it raises the profit rate.

[Figure 1 about here.]

5 Minskian dynamics

In order to study the dynamic paths of the model, we need to specify laws of motion for the state variables, ρ and i. We suppose that exuberance, ρ, increases as the growth rate rises above its equilibrium level, $\bar{g}$, and falls as the interest rate rises above its equilibrium level, $\bar{i}$:

$$\dot{\rho} = \beta(g - \bar{g}) - \delta(i - \bar{i}) \tag{14}$$

While Taylor and O'Connell analyze monetary policy in the context of a full asset equilibrium model, we can follow the simpler route of taking the real interest rate as the monetary policy instrument. The target is equally simple: the authorities raise the interest rate as the growth rate rises above its equilibrium level:

$$\dot{i} = \gamma(g - \bar{g}) \tag{15}$$

Differentiating equation (11) with respect to time we see that:

$$\dot{g} = h(\frac{s+h}{s})\dot{\rho} - h(\frac{s+h+\eta}{s})\dot{i}$$

or

$$\dot{g} = (\frac{h}{s(1-\psi)-h})(\beta(s(1-\psi)) - \gamma(s(1-\psi)+\eta))(g-\bar{g})$$
$$-(\frac{h}{s-h-\psi})\delta(s(1-\psi))(i-\bar{i}) \tag{16}$$

Equations (16) and (15) define the dynamical system representing the economy. The monetary authority determines the equilibrium by choosing its target $\bar{g}$. At equilibrium $\rho = 0$ and $i = \bar{i}$, where, from equations (7–9) we have:

$$\bar{i} = \frac{s(1-\psi)g_0 - (s(1-\psi)-h)\bar{g} + hd_0}{h(s(1-\psi)+\eta)} \tag{17}$$

The Jacobian of the system is:

$$\begin{bmatrix} (\frac{h}{s(1-\psi)-h})(\beta(s(1-\psi)) - \gamma(s(1-\psi)+\eta)) & -(\frac{h}{s-h-\psi})\delta(s(1-\psi)) \\ \gamma & 0 \end{bmatrix} \tag{18}$$

We have $\text{tr}J = (\frac{h}{s(1-\psi)-h})(\beta(s(1-\psi)) - \gamma(s(1-\psi)+\eta))$ and $\det J = \gamma(\frac{h}{s-h-\psi})\delta(s(1-\psi)) > 0$. The system has either two real roots of the same sign or a pair of complex roots. In either case the stability depends on the trace. We will assume that the monetary authority is sufficiently vigorous, that is, chooses a high enough γ to stabilize the economy, so that the trace is negative.

But an interest rate policy that stabilizes the economy may also expose it to financial crisis. A central bank attempting to cool off an economy by raising the interest rate may transform a large number of speculative firms into Ponzi firms, and force a drastic nonlinear contraction of investment plans.

[Figure 2 about here.]

Figure 2 shows the phase diagram of the system for a stable equilibrium in the speculative regime, $\bar{g} > \bar{r} > \bar{i}$, where a small, open economy with good investment prospects seems likely to find itself. The $\dot{i} = 0$ locus is the vertical dashed line at $\bar{g}$. At higher growth rates, $g > \bar{g}$, the monetary authorities raise the interest rate. At a stable equilibrium the $\dot{g} = 0$ locus is downward-sloping. To the right of this locus the growth rate is decreasing, and to the left it is increasing. The phase arrows show the general motion of the system in the four regions. It is clear that, whether there are two negative real roots or a pair of complex roots with negative real parts, a positive shock to the growth rate sets off a dynamic path on which the growth rate falls and the interest rate rises, such as the one drawn. For reference the $r = i$ locus which is the boundary of the Ponzi financial region is drawn as well. But this is precisely the sequence of events that forces the economy from speculative into Ponzi finance and makes it vulnerable to a financial crisis. The positive shock to the growth rate increases exuberance, which is more than offset by the rising interest rate, but sets the stage for overshooting the equilibrium. On its way back to equilibrium the economy crosses the line into the Ponzi region as the interest rate overtakes the profit rate, and becomes financially fragile.

In more conventional political economic terms, the positive shock to the growth rate leads the central bank to raise the real interest rate in one way or another in order to bring growth back to its target level by reducing the rate of investment. The lower rate of investment, however, depresses aggregate demand and the profit rate and lowers the economy's capacity utilization. This decline in capacity utilization will often be accompanied by a rise in unemployment, the familiar side-effects of a policy of monetary austerity. But as the interest rate rises and the profit rate falls, the economy, which started at a speculative equilibrium, slides into the Ponzi regime. Everyone understands that this is a "temporary" situation resulting from the attempt to adjust to the positive shock in the growth rate, but this does not alter the fact that the economy has to pay its debt service with new borrowing during this period. If the country can convince private or public lenders to tide it over, it can pass through this phase without a financial crisis. As the trajectory of the Figure indicates, eventually growth falls below the target rate and the real interest rate will be allowed to decline, easing the financial pressure on the economy. Growth and profit rates continue to fall, however, until a turning point is reached where growth starts to rise again. Sometime after this the growth rate and profit rate will rise and the interest rate fall sufficiently to get the economy back into the speculative regime.

But during the Ponzi-finance period the economy remains vulnerable to a financial crisis precipitated by the unavailability of new borrowing in sufficient magnitude. Such a crisis may interrupt the smooth adjustment back to equilibrium sketched in Figure 2, driving real interest rates sharply higher, and growth and profit rates sharply lower, forcing many firms or financial intermediaries into bankruptcy.

6 Conclusions

The small, open, Kaleckian economy has two important lessons for policy makers. Both stem from the fact that in the short run the growth rate and profit rate of this type of economy are strongly positively correlated. The small, open, Kaleckian economy becomes financially fragile when its growth rate falls and drags down the profit rate. This insight is in sharp contrast to the conventional wisdom that the way to avoid financial crisis is to reduce the growth rate through austerity policies based on restrictive monetary policy.

The first lesson is that the central bank should not target too low a growth rate as its equilibrium. At low growth rates, profit rates are low, and the economy is closer to the Ponzi regime. The economy may face other constraints that limit its growth rate, such as the provision of complementary infrastructure and the supply of competent entrepreneurship, but within these constraints it is more likely to avoid financial crisis at higher rather than lower targeted growth rates.

The second lesson is that in trying to stabilize the economy against a positive shock by raising interest rates, the central bank should take into account the impact of the relation of interest rates and profit rates on the financial viability of firm balance sheets. An overly vigorous interest rate policy may inadvertently trigger financial fragility and financial crisis.

In a small, open, developing economy it is likely that the state will come under pressure to absorb the debts of firms in periods of financial fragility in one way or another. Thus the financial fragility of the private sector is converted into financial vulnerability of the public sector, and the financial crisis that occurs can appear in the form of a crisis of public finance and foreign exchange reserves.

7 References

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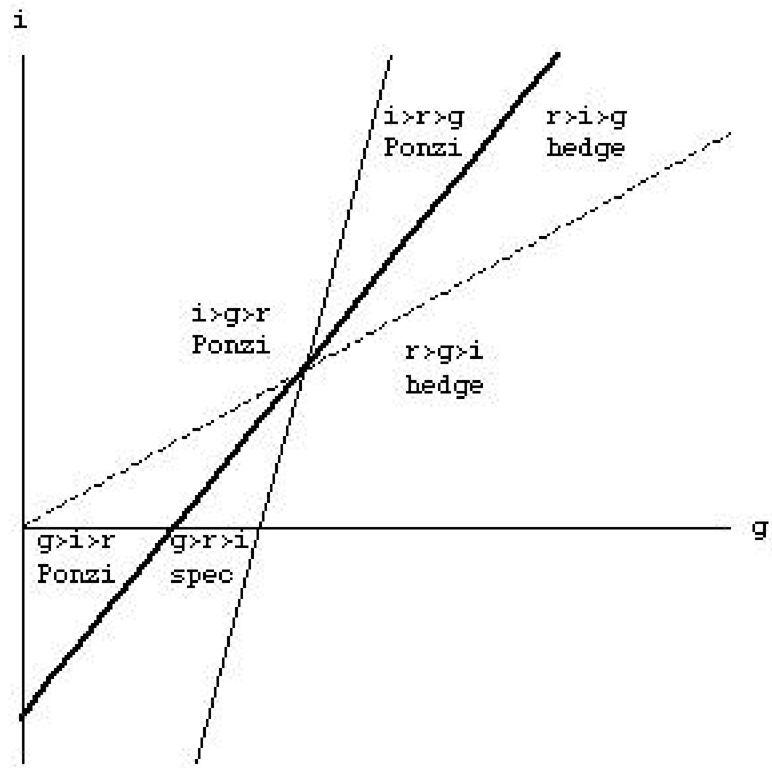

Figure 1: On the dashed 45-degree line $i = g$. The bold line is the locus of points on which $r = i$, and is the lower boundary of the Ponzi region. The undashed line is the locus of points on which $r = g$ and is the upper boundary of the hedge finance region.

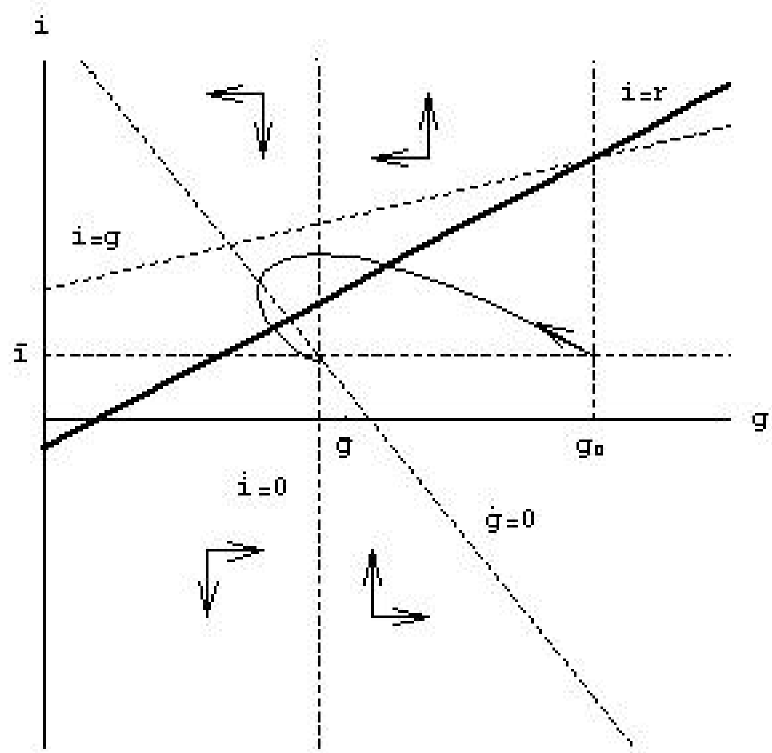

Figure 2: An economy at a stable equilibrium in the speculative finance regime may respond to a positive shock to the growth rate by following a path that crosses into the Ponzi finance regime.