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ANIMAL SPIRITS, CAPITAL REPATRIATION AND INVESTMENT

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ANIMAL SPIRITS, CAPITAL REPATRIATION AND INVESTMENT

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Abstract In the aftermath of the debt crisis, developing countries are endeavoring to repatriate flight capital and to resume domestic private investment. Yet investment and the associated capital inflows continue to be disappointing and highly uneven over time in many cases. This paper provides a model of investment and capital movements in and out of such countries. Central to the paper is the introduction of fiscal increasing returns to domestic capital into a standard dynamic optimizing model. The resulting system may display multiple steady states and surprising dynamic behavior. A limit cycle may occur around one of the welfare-inferior equilibria. Along that cycle, capital stocks and relative prices display endogenous fluctuations. Moreover, initial conditions and expectations both matter in selecting the equilibrium on which the economy converges. For some initial conditions, "animal spirits" can determine the course of investment and capital flows.

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I. Introduction

In the aftermath of the debt crisis, developing countries are endeavoring to repatriate flight capital and to resume domestic private investment. Yet investment performance and the associated capital inflows have been disappointing in many cases. In fact, gross capital formation in developing countries declined from an average of 26.5% of GDP in 1981 to 23.5% during 1985-88.[1]

This lackluster investment performance is often attributed to macroeconomic disarray in the countries in question. Clearly, inflation, high domestic real interest rates and the debt overhang must have deterred investment.[2] Yet undertaking structural reforms and setting the macroeconomy in order are necessary but not sufficient conditions for the resumption of investment. Bolivia undertook a most drastic adjustment program, and yet capital has remained outside the country and investment continues to stagnate. The Israeli economy, coming out of the successful stabilization program applied in the mid-1980s, was stuck in a low-investment slump for over two years. Dornbusch (1991b) has claimed that the resumption of investment and growth may be more difficult to achieve than stabilization itself.

That is not to say that capital has always chosen to stay away. It is just that investment performance and capital movements have been uneven over time, and seemingly very sensitive to expectations and the state of business confidence. As Mexico and Chile stabilized and opened up their economies, investment was very slow in responding, remaining below pre-crisis levels for over a

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[1]International Monetary Fund (1989). See also World Bank (1989).

[2]For empirical evidence on investment performance in LDCs and some possible macroeconomic explanations, see Green and Villanueva (1991) and Serven and Solimano (1990).

decade in the case of Chile. In the late 1980s, there was a sudden shift in both countries; investment picked up sharply and a massive wave of capital repatriation took place. This has led some economists to assert that decisions on investment and capital movements may have been driven by rumors and arbitrary changes in expectations.[3]

This paper presents a model in which domestic investment and international capital movements can be determined by "animal spirits," moving the economy between several possible steady state equilibria. Key to the model is the notion that there is an externality associated with the amount of capital an investor holds in an LDC economy: the larger the number of agents who invest in a given economy, the larger the **ex-post** rate of return will be for each of them.

There are many ways of formalizing this externality. Dornbusch (1991a) and Laban (1991) stress the connection between capital inflows and investment, one the one hand, and the viability of a stabilization experiment, on the other. A larger (smaller) stock of capital at home increases (decreases) the real wage in the transition, making it less (more) likely that the program will be aborted by political pressures. If stabilization succeeds investment turns out to be profitable, and vice versa. Hence, expectations can become self-fulfilling, leading the economy to success based on high investment or to a capital-flight driven failure.[4]

By contrast, this paper focuses on a fiscal externality. There is a difference in the tax status of capital domestic residents

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[3]On this point see especially Tornell (1990).

[4]For related models, which also focus on the roles of uncertainty and credibility, see Van Wijnbergen (1985) and Rodrik (1990).

hold at home and abroad. The latter cannot be taxed (in practice taxation is unenforceable), while the former can. Suppose the tax rate on capital held domestically is set by the fiscal authorities to ensure that a constant amount of spending is financed[5] --hence, the equilibrium tax rate is inversely related to the size of the tax base. In this setup, domestic capital can enjoy what Blanchard and Summers (1987) label "fiscal increasing returns."[6]

By embedding such fiscal returns in a standard optimizing model --with adjustment costs in the installation of domestic capital-- we obtain two main results. First, there may be multiple steady state equilibria, with different associated values for the stock of domestic capital. This suggests an explanation of why apparently similar economies display very different investment performances. Moreover, the equilibria can be Pareto-ranked, with steady states displaying higher domestic capital stocks also involving higher welfare.

Second, the dynamics generated by the model leave ample room for expectations to determine outcomes --a result congruent with the perceived volatility in the behavior of capital movements. For a range of initial capital stocks, "animal spirits" may lead the economy to jump across different equilibrium trajectories, possibly leading to different steady state equilibria. In addition, a limit cycle may occur around one of the low-domestic-capital steady states. As a result, the stocks of domestic and foreign capital held by local residents and the shadow price of domestic capital in terms of the consumption good (Tobin's q) may display endogenous fluctuations.

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[5]Assume also that taxes on domestic capital are the only source of revenue for the government. Adding other taxes changes nothing as long as part of the exogenous spending must be still financed through the tax on domestic capital or its output.

[6]In their view, these are "for macroeconomics, the most important type of increasing returns."

The paper is organized as follows. Section II describes the static conditions necessary for the existence of multiple equilibria. Section III develops the associated dynamics, while Section IV studies the effects of changes in expectations as well as the possibility of cycles. Finally, Section V provides some conclusions and policy implications.

II. The Role of Fiscal Increasing Returns

Consider an economy with two assets: foreign capital (b) and domestic capital (k). Domestic residents hold both kinds of capital. The foreign asset has the fixed rate of return r, which can be interpreted as the world interest rate. On the domestic side, total domestic output is the sum of two components: an exogenous flow y and a variable flow produced according to the function f(k), with $f'(k)>0$ and $f''(k)<0$. We also impose the Inada conditions.[7]

A crucial feature of the model is that domestic output is taxed at the rate τ, while the return from foreign capital is always beyond the reach of the taxman. The tax rate τ is endogenous but is regarded as given by the individual. It should also be interpreted broadly to include the inflation tax or any other means by which the government obtains revenue at the expense of capital held domestically.

The equilibrium level of taxes is determined in the following way. Assume that the government must finance an exogenous level of spending g by using only taxes on domestic output. The constant g should be interpreted as any type of government spending that is independent of the level of economic activity --for instance,

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[7]These conditions are contained in the following expressions:

$$f(0) = 0, \quad \lim_{t\to 0} f'(k_t) = \infty, \quad \lim_{t\to\infty} f'(k_t) = 0.$$

payments on foreign debt. Then, the government budget constraint is

$$\tau_t[y+f(k_t)] = g \qquad (1)$$

where we assume that y≥g. This last assumption simply ensures that domestic output is larger than government spending (and that therefore $\tau \leq 1$), even as the domestic capital stock becomes small.

The after-tax marginal return on domestic capital is f'(k)(1-τ). Solving (1) for τ and substituting into this last expression we have

$$f'(k_t)\,[1-\frac{g}{y+f(k_t)}] \qquad (2)$$

Equation (2) appears in Figure 1, plotted as a function of k. There are three possible configurations. In Figure 1A we see the borderline case in which y=g. The function goes through the origin, because when k=0, τ=1 and the after-tax return to domestic capital is zero as well. Up to the point where the function reaches a maximum, domestic capital enjoys increasing fiscal returns --in that the after-tax return to this asset is increasing in k-- even if f(k) is a constant-returns-to-scale production function. To the right of the maximum, the after-tax marginal return on k is decreasing in k, as usual. Given the Inada conditions, the marginal return to k goes to zero as k becomes very large.

As y becomes larger than g, the function is generally as it appears in Figure 1B. Since τ<1 and since f'(k) goes to infinity as k goes to zero (also because of the Inada conditions), all of expression (2) also goes to infinity as k goes to zero. For larger values of k, the function behaves as in the previous case.

Finally, the configuration in Figure 1C is also possible. It will occur, among other things, when y is very large relative to g.

In this case, there are decreasing (after-tax) marginal returns to domestic capital for all the relevant range of k. This is the conventional situation.

If the two assets are perfect substitutes, arbitrage will ensure that in any steady state equilibrium the following relationship must hold:

$$r = f'(k_t)\,[1-\frac{g}{y+f(k_t)}] \tag{3}$$

The after-tax return on domestic capital must equal the world interest rate. The different versions of Figure 1 show that there may be as many as three equilibria --in the case of Figure 1B, either at a low level of domestic capital (labeled k_L), at an intermediate point (labeled k_M) or at a high level (labeled k_H).

Since, in the presence of distortionary taxes, the equilibrium level of domestic capital is always too low, the lower the tax rate (and the higher the associated domestic capital stock) the higher the resulting level of welfare. Thus, the equilibria can be Pareto ranked unambiguously. Because an individual domestic investor does not internalize the effect that his portfolio decision has on the tax rate, a coordination failure of the sort discussed by Cooper and John (1988) may occur. In that case, the economy may by stuck in a particularly inefficient equilibrium. The intuition for this result is simple: when the tax base is large (there is a large amount of capital at home), the tax rate is low; thus the after-tax return on domestic capital is high, and it pays off for agents to keep their capital at home. Exactly the opposite happens when there is little capital at home.[8]

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[8]This mechanism is similar to that explored by Eaton (1987). That paper, however, contains no dynamics.

III. Dynamics

The presence of multiple equilibria raises a number of questions. First, which equilibria are either locally or globally stable? In particular, will the economy ever converge to k_L or k_M? Many multiple equilibria models involve welfare-inferior equilibria that are unstable and hence probably unobservable in reality.[9] If that were so, the existence of possible equilibria at k_L or k_M need not be a source of concern to the policymaker.

One must also ask what forces place the economy on an equilibrium trajectory leading to a given steady state. If initial conditions alone determine which path is feasible, then, in Krugman's (1991) terminology, "history" determines the outcome. In such a case, economies which start out with little capital at home may be unable to converge to k_H, finding themselves in an "underinvestment trap". By contrast, if more than one path is feasible from given initial conditions, then "expectations" become a factor in determining the outcome. In this case, the appropriate coordination of expectations may lead the economy to a high-domestic-capital, high-welfare steady state.

To answer such questions it is necessary to add dynamics to the model, being more explicit about the underlying structure of the economy. Suppose there is one consumption good, produced by the two technologies (assets) described above. In what follows, we focus on the problem of domestic residents who face a standard consumption-savings decision plus the portfolio decision of allocating wealth between assets b and k.

Domestic capital is subject to installation costs, as is usual

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[9]This point is discussed exhaustively by Howitt and McAffee (1988), who also provide conditions under which inferior equilibria can be stable in a model of trading externalities.

in much of the optimal investment literature. Therefore, its total stock is predetermined at each moment in time --as we shall prove below-- and its relative price in terms of the consumption good (Tobin's q) adjusts in the short run to ensure that all installed capital is willingly held.

If c denotes consumption, the optimization problem of the representative agent in the domestic economy is[10]

$$\max_{c,\dot{k}} \; U_0 = \int_0^\infty u(c_t)\, \exp(-rt)\, dt \tag{4}$$

subject to the budget constraint

$$\dot{b}_t + \dot{k}_t = rb_t + [y+f(k_t)](1-\tau_t) - \dot{k}_t i\left(\frac{\dot{k}_t}{K_t}\right) - c_t \tag{5}$$

written using the consumption good as the numeraire. The function $i(\dot{k}/K)$, where K is the aggregate domestic capital stock, captures the cost associated with the installation of domestic capital. We assume $i(0)=0$, $i'(.)>0$ and $2i'(.)+i(\dot{k}/K)i''(.)>0$. That is to say, the cost is an increasing and convex function of the size of the amount of investment undertaken relative to the existing aggregate stock of domestic capital.[11]

As usual, we also require the no-Ponzi game condition

$$\lim_{t\to\infty} b_t \exp(-rt) = 0 \tag{6}$$

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[10]Notice that we have implicitly assumed that the rate of discount is equal to the world interest rate.

[11]This formulation is the standard one for adjustment costs in investment. See, for instance, Blanchard and Fischer (1989).

Agents maximize

$$H_t = u(c_t) + \lambda_t[rb_t+[y+f(k_t)](1-\tau_t)-\dot{k}_t[1+i(\frac{\dot{k}_t}{K_t})]-c_t] + q_t\lambda_t\dot{k}_t \quad (7)$$

where λ and $q\lambda$ are the costate variables associated with b and k, respectively. Notice that maximization by the individual treats τ and K as given. If we normalize the number of agents in the economy to one, in equilibrium k=K.

Necessary and sufficient conditions for a maximum are

$$u'(c_t) = \lambda_t \qquad (from\ \frac{\partial H_t}{\partial c_t}=0) \quad (8a)$$

$$q_t-1 = \frac{\dot{k}_t}{k_t}i'(\frac{\dot{k}_t}{k_t})+i(\frac{\dot{k}_t}{k_t}) \qquad (from\frac{\partial H_t}{\partial \dot{k}_t}=0) \quad (8b)$$

$$\frac{\dot{\lambda}_t}{\lambda_t} = r-r = 0 \qquad (from\ \dot{\lambda}=r\lambda-\frac{\partial H_t}{\partial b_t}) \quad (8c)$$

$$\frac{\dot{\lambda}_t}{\lambda_t}+\frac{\dot{q}_t}{q_t} = r-\frac{f'(k_t)(1-\tau_t)}{q_t} \qquad (from\ q_t\dot{\lambda}_t+\dot{q}_t\lambda_t=rq_t\lambda_t-\frac{\partial H_t}{\partial k_t}) \quad (8d)$$

plus the usual transversality conditions on b and k.[12]

Equations (8a) and (8c) reveal that c is a constant. Its value can be obtained by integrating (5) subject to (6):
Therefore, the constant consumption flow simply equals a portion r

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[12]As is usual in this kind of problem, these conditions are

$$\lim_{t\to\infty}[k_t q_t \lambda_t \exp(-rt)] = 0 \quad and \quad \lim_{t\to\infty}[b_t\lambda_t \exp(-rt)] = 0$$

$$\int_0^\infty \bar{c}\exp(-rt)\,dt-\frac{\bar{c}}{r}-\int_0^\infty [[y+f(k_t)](1-\tau_t)-\dot{k}_t i(\frac{\dot{k}_t}{k_t})]\exp(-rt)\,dt+b_0=w_0 \qquad (9)$$

of the initial stock of wealth w_0, defined as the present value of after-tax domestic income, net of costs associated with expected investment, plus initial holdings of the foreign asset.[13] There is no aggregate asset accumulation over time, but simply a possible portfolio redistribution between the two available assets.

By combining (8b) and (8c) we obtain[14]

$$\frac{f'(k)\,[1-\frac{g}{y+f(k)}]}{q}+\frac{\dot{q}}{q}=r \qquad (10)$$

where we have also substituted for the value of τ from (1). Equation (10) has an obvious interpretation: arbitrage ensures that the return on domestic capital --defined as the after-tax marginal return plus the capital gain-- must equal the international rate of interest.

Finally, equation (8b), plus our assumptions on i(.), define a relationship

$$\frac{\dot{k}}{k}=\phi(q),\quad \phi'(.)>0,\quad \phi(1)=0,\quad \phi(q>1)>0,\quad \phi(0<q<1)<0. \qquad (11)$$

Hence, the stock of domestic capital will be changing as long as its price is different from one, as is usual in this kind of model.

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[13] Of course, a given w_0 is contingent on a given expected perfect foresight path. Notice also that wealth is written using the consumption good as the numeraire.

[14] Time subscripts are omitted from now on.

Equations (10) and (11) represent a system of two differential equations in two variables --the price of domestic capital and the domestic stock of capital-- which can be solved independently of other variables.[15] Steady state conditions are clearly q=1 (the shadow price of domestic capital equals its replacement cost) and $f'(k)(1-\tau)=r$. Hence, the long run equilibria of the dynamic model correspond to the static equilibria discussed above. To solve for the equilibrium stock of foreign capital, it is sufficient to take the solution to (9), (10) and (11) and substitute it into (5).

The phase diagrams of the system in (10) and (11), for each of the three cases of Figure 1, appear in Figure 2. Henceforth I focus only on the case illustrated in Figure 1B and 2B--that is to say, the configuration with three steady states.[16] Of the other two cases, that in 1C is well understood[17] and that in 1A is simply a borderline fluke.

A little more notation will help clarify the dynamics around the possible steady states. Define

$$h(k) \equiv f'(k)\,[1-\frac{g}{y+f(k)}], \qquad where \;\; h'(k) \gtrless 0 \qquad \textbf{(12)}$$

Notice that if $h'(k)>0$ there exist fiscal increasing returns to domestic capital, and viceversa.

Appendix 1 establishes that, evaluated in the neighborhood of a steady state where $h'(k)<0$, the system (10)-(11) has one positive

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[15]Notice that the relative price is a "jump" variable, while the capital stock is a state (sluggish) variable.

[16]The configuration with two steady states is studied in an earlier version of this paper (Velasco, 1991).

[17]See, for instance, Blanchard and Fischer (1989).

root and one negative root. This fact is reflected in Figure 2B, where we observe that the steady states at k_L and k_H are saddle path stable. Since at those equilibria the eigenvalues are of opposite sign, convergence to the corresponding steady state occurs along a saddle path governed by the negative eigenvalue. Appendix 1 also establishes that, in the neighborhood of k_M (where $h'(k)>0$) both eigenvalues are positive (and real) or at least have positive real parts. Hence, the system is locally unstable.

IV. History, Animal Spirits and Cycles

We can now tackle the question of "history versus expectations." For this purpose we must again distinguish among three possible dynamic configurations that can occur when the system has three steady states. These cases appear in Figure 3.[18]

Unstable dynamics out of the steady state at k_M give rise to the two saddle paths that converge to the outer steady states.[19] In case 3A the paths give rise to an S-curve configuration. The dynamic behavior of the system is quite clear. If initial conditions are at k_M, the system is immediately locked in to the corresponding steady state. If the initial capital stock is greater than k_M, then there is a unique value of q that places the system on the saddle path leading to k_H. Finally, if initial capital is below k_M, a jump to the corresponding saddle path ensures convergence to k_L.

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[18]In a related paper, Krugman (1991) analyzes two of the possible three cases below. His model with multiple equilibria can generate S-curves and spirals, of which he provides an illuminating discussion. Since his model is linear, however, it cannot give rise to limit cycles. For related results see also Matsuyama (1991).

[19]In what follows we focus only on diverging trajectories that converge either on a steady state or a limit cycle. Explosive trajectories (in which k and q go to either zero or infinity) eventually violate transversality conditions.

In case 3A history determines everything. An economy that starts with much domestic capital can only converge to the equilibrium at k_H. On the other hand, an economy that starts out with little capital is trapped there (although notice that an economy that starts out to the left of k_K and begins to travel along the corresponding saddle path will be accumulating capital.) Put differently, if you are rich you stay rich and viceversa.[20]

In the case of Figure 3B the saddle paths arising out of k_H are spirals. The system diverges from the center as in the previous case, but the path followed by the capital stock is not monotonic. The key fact about this case is that there is a range of capital stocks for which the saddle paths leading to k_L and k_H overlap. For initial conditions within this range, the behavior of the system is indeterminate, for it could jump onto either saddle path and end up with high or low domestic capital. Animal spirits determine the outcome. If expectations are coordinated on an "optimistic" outcome, the system will jump onto the saddle path leading to k_H and converge there. The opposite will happen if expectations are somehow coordinated on a "pessimistic" outcome.

Also within the overlap region, shocks to expectations can change the course of the system. Imagine, for instance, the economy is travelling along the saddle path leading to k_H. An unanticipated and "negative" shock to expectations could lead the system to jump to the other saddle path and converge to k_L. If animal spirits are volatile, so will the relative price and the stock of domestic capital.[21] This feature of the model is reminiscent of the country experiences discussed at the start.

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[20]Rich in terms only of domestic assets, of course. Some economies in Latin America are poor by this definition but rich in their holdings of foreign assets.

[21]These shocks to expectations would have to be fully unanticipated, however. Otherwise, anticipations of a future change would affect the current behavior of the system.

Notice that while these shocks to expectations may be arbitrary, there is nothing irrational about them. Expectations of future returns are always governed by fundamentals, for these expectations become self-fulfilling. In this sense, the indeterminacy observed here is very different from that present in bubbles.

Finally, Figure 3B depicts what happens if the overlap covers the whole range of capital stocks from k_L to k_H. In this case, if it starts within this range the economy will converge to at least one limit cycle around the steady state at k_M. Along that cycle, the stock of domestic capital and its price will display endogenous and permanent fluctuations.

Consider in Figure 3C the shaded region enclosed by (but not including) the two saddle paths and the vertical lines at k_L and k_H. Any path starting in that region must remain within it, for all the arrows of motion point "inward." But the path cannot converge to the steady state at k_M, which has been shown to be unstable. The only solution is for the economy to cycle around that steady state following the laws of motion of the system. Hence, there must be at least one limit cycle within the shaded region. The proof of these statements, which resorts to the Poincare-Bendixon Theorem, is sketched out in Appendix 2.[22]

Finally, notice in case 3B that if initial conditions are to the right of k_H the outcome is also indeterminate. Depending on expectations, the system could be placed on the saddle-path leading to k_H or on that leading to k_L. Hence, if expectations are pessimistic, even an economy that starts out with a great deal of

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[22]For statements of the theorem see Hirsch and Smale (1974, pp 248-250), Guckenheimer and Holmes (1983, pp. 44-45), and Gabisch and Lorenz (1989, pp. 129-143). Proving uniqueness of the limit cycle, on the other hand, is a much more difficult task which we do not undertake here.

domestic capital could end up at the low-capital steady state. Exactly the reverse situation could occur if initial conditions are to the left of k_L.

This completes the description of the three types of dynamics that can occur under the multiple steady state configuration. Under which conditions or parameter values will each materialize? That is not a question for which an answer can be provided without assuming specific functional forms and (probably) retreating into a piece-wise linear model.[23] One can only speculate on a couple of polar cases that shed some light on the more general situation.

The extent to which investment is costly plays a key role. Consider first the limiting case in which costs are so high as to be prohibitive, so that domestic capital can be neither accumulated nor deccumulated. In that case, the system would stay forever at whatever point on the $\dot{q}=0$ schedule corresponds to the initial domestic capital stock.[24] In that case, history determines everything, and there can be no saddle path overlap. Consider now the other polar case, in which investment costs go to zero. Then, initial conditions cease to matter, for the system can jump to any steady state around which expectations get coordinated. By continuity, one can therefore argue that the case in Figure 3A is more likely when the function $i(\dot{k}/K)$ is such that investment costs are very high, and that an overlap (such as those in Figures 3B or

[23]Matsuyama characterizes the global dynamics of a similar model by analyzing first the case in which the rate of discount (r in our model) goes to zero, an assumption under which the system turns Hamiltonian and its global dynamics can be analyzed by graphical methods. He then proceeds to analyze to case of a small rate of discount by studying perturbations of the Hamiltonian system. That technique is not available for the model in this paper, for assuming $r=0$ implies that the only equilibrium is at $k=\infty$. See also Krugman (1991) for a discussion of the factors affecting the existence of a saddle-path overlap.

[24]Of course, only by a fluke would at that point $q=1$.

3C) is more likely when such costs are low.

Intuition suggests the interest (and discount) rate r should also play a crucial role in determining the existence and width of a saddle-path overlap. Because investment is costly, resources move in response to not only current return differentials, but also future differentials. It pays off to invest at home if individuals expect that others will invest at home in the future, thus increasing the return associated with domestic capital --and since the decisions of other depend on their expectations of future returns, the kind of self-fulfilling prophecy we have discussed can occur. However, if r is large, so that individuals discount the future a great deal, the impact of the anticipated actions of others is lessened, and the potential for self-fulfilling expectations should decrease as well.[25]

[25]This intuition would seem to be confirmed by the result (to be found in Appendix 1) that both eigenvalues of the system are real in the neighborhood of the k_M steady state if $r^2>\phi'(1)h'(k_M)k_M$. In fact, in Krugman's (1991) linear model the existence of real roots is enough to rule out the existence of an overlap. That result does not carry over, however, to piecewise linear models (as Matsuyama (1991) shows) or to non-linear models such as this one. One also wants to be careful in discussing the dynamic effects of changes in r, for such changes can also alter the number of feasible steady sates. In fact, as r becomes very large a unique steady state with very low domestic capital comes into being; if r becomes very small, a unique steady state with high domestic capital arises. Hence, our discussion in the text should be understood as referring only to "small" changes in r --small enough to ensure that the initial number of steady states is not changed.

IV. Summary and Policy Implications

The notion that the return from investing in a given country is a function of how many other agents are investing there as well is part of the folk wisdom of foreign investment decisions -- typically, foreign investment flows go largely to countries that are already enjoying substantial flows. This logic --which implicitly assumes an externality associated with capital flows-- applies not only to foreign investors, but to any agent planning to acquire capital in a given economy. This paper formalizes one mechanism --a fiscal externality that can give rise to increasing returns to domestic capital-- and links it to the decision faced by domestic residents choosing whether to hold capital at home or abroad. The model shows that the existence of this externality has important implications for the dynamic behavior of investment, asset prices and capital flows.

The system may have as many as three steady states, which can be Pareto-ranked. Since, in the presence of distortionary taxes, the equilibrium level of domestic capital is always too low, the lower the tax rate (and the higher the resulting domestic capital stock) the higher the resulting level of welfare.

This economy may be dynamically indeterminate, in the sense that more than one steady state may be reachable from some initial conditions. In those cases, "animal" spirits determine the outcome, with optimistic expectations leading the economy to a Pareto-preferred steady state, and viceversa.

And perhaps most strikingly, business-cycle-like endogenous oscillations may occur around the middle steady state. Along that cycle, the domestic and foreign capital stocks and the shadow price of the domestic capital display regular fluctuations.

The resulting multiplicity of equilibria and associated inefficiencies pose serious questions for the conduct of policy. What should government do in this situation? First, policy may be able to restore uniqueness to the economy and place it on a Pareto-preferred steady state by manipulating some exogenous variables. Reducing government spending g or increasing the exogenously fixed tax base y will generally achieve this aim.[26]

Second, government can attempt to expand the range of initial conditions from which the system can converge to the optimistic equilibrium. This may be achievable, for instance, if policy may lower the costs associated with the installation of domestic capital.

Third, in those cases in which self-fulfilling prophecies are possible, the simplest role for government is to coordinate expectations around the preferred outcome. Precisely because expectations are self-fulfilling, an announcement should be enough. A credible government ought to be able to influence expectations so as to ensure all agents move to the better equilibrium.

But when government announcements lack credibility or when agents base their behavior on other sorts of information, actions can speak louder than words. For instance, if agents base their beliefs on "extrinsic" factors (as in a sun-spot equilibrium), government may be able to identify these factors and act upon them. Whatever their intrinsic economic merits, highly visible and symbolic moves --such as large-scale privatization or the proposed U.S.-Mexico-Canada Free Trade Agreement-- may help consolidate optimistic expectations and thereby enhance welfare.

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[26]Of course, the statement that reducing g will increase welfare relies on the assumption that in this model government spending does not enter individual's utility functions. If it did, welfare consequences would depend on the initial ratio of private to public consumption.

Appendix 1

Recall the definition of h(k) from equation (12) in the text. With this we can write the Jacobian of the linear approximation to system (10)-(11) around a steady state as:

$$A = \begin{bmatrix} r & -h'(k) \\ \phi'(q) & 0 \end{bmatrix}$$

Therefore, we have

$$\psi_i = \frac{r \pm \sqrt{r^2 - 4\phi'(q)\,k\,h'(k)}}{2}, \quad i=1,2 \tag{A1}$$

where the ψ_i are eigenvalues of A and

$$Tr(A) = r > 0 \quad and \quad Det(A) = \phi'(q)\,k\,h'(k) \begin{matrix} > 0 \text{ if } h'(k) > 0 \\ < 0 \text{ if } h'(k) < 0 \end{matrix} \tag{A2}$$

Consider first the case where h'(k) (evaluated at the corresponding steady state) is negative. In that case both eigenvalues are real, with one positive and one negative, as can be seen in (14).[27] Consider next the case where h'(k) is positive, as is the case at the steady state at k_M. Evaluated at that equilibrium both roots will be positive and real if $r^2 > \phi'(1)h'(k_M)k_M$. If the inequality is reversed, the roots will be imaginary with positive real parts.[28]

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[27]This is confirmed by analyzing the trace and determinant of A. Since Tr(A) equals the sum of A's eigenvalues, we conclude that at least one of them is positive. Recall also that Det(A) equals the product of its eigenvalues. If h'(k)<0 and therefore the determinant is negative, we conclude that one eigenvalue is positive and the other negative.

[28]Once again, notice that if h'(k)>0, the determinant of A is positive, as is the trace. We conclude that both eigenvalues are positive, or at least have positive real parts.

Appendix 2

Take the region enclosed by (but not including) the two saddle paths and the vertical lines at k_L and k_L. Remove from that region an arbitrarily small area containing the equilibrium point at $k=k_M$ and $q=1$. The resulting region D is a subset of the domain of the dynamical system (10)-(11).

Let x by any point in D, and consider the following definitions:

- A point $\ell \epsilon D$ is a limit point of x if a trajectory starting at x approaches ℓ as time goes to infinity.
- The set of all limit points of $x \epsilon D$ is the limit set of D.
- A limit cycle is a limit set whose graphical representation is a closed orbit.

Now apply the following theorem:

<u>Theorem</u> (Poincare-Bendixon): **A nonempty compact limit set of a dynamical system in R^2, which contains no equilibrium point, is a closed orbit.**

Hence, all trajectories inside D must converge to at least one limit cycle.

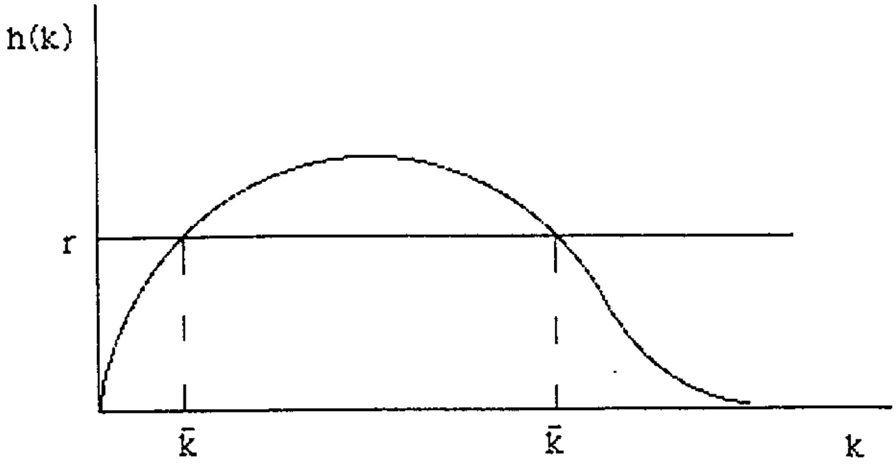

Figure 1A

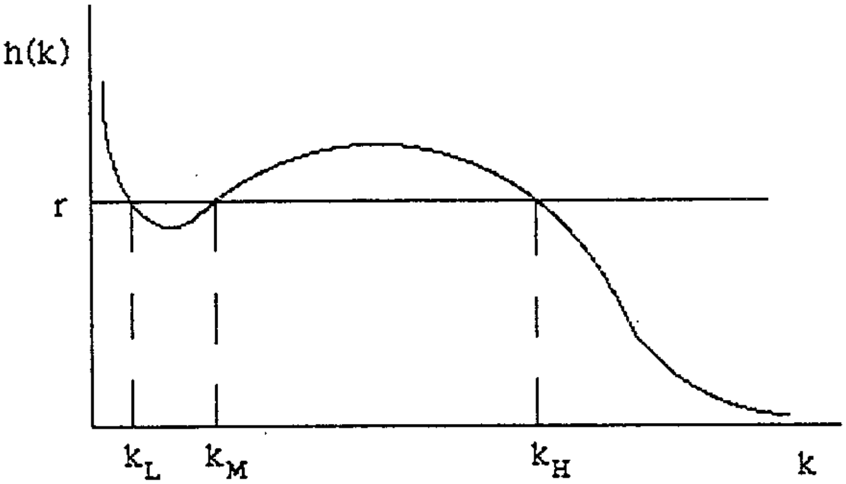

Figure 1B

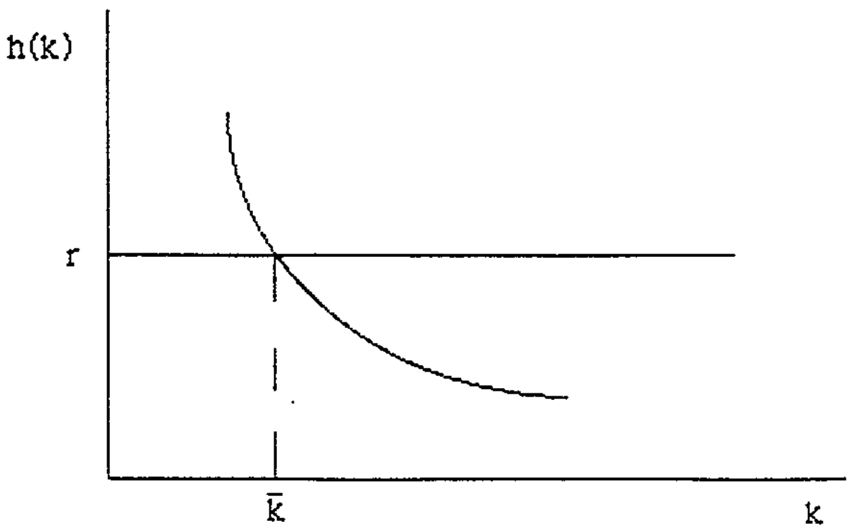

Figure 1C

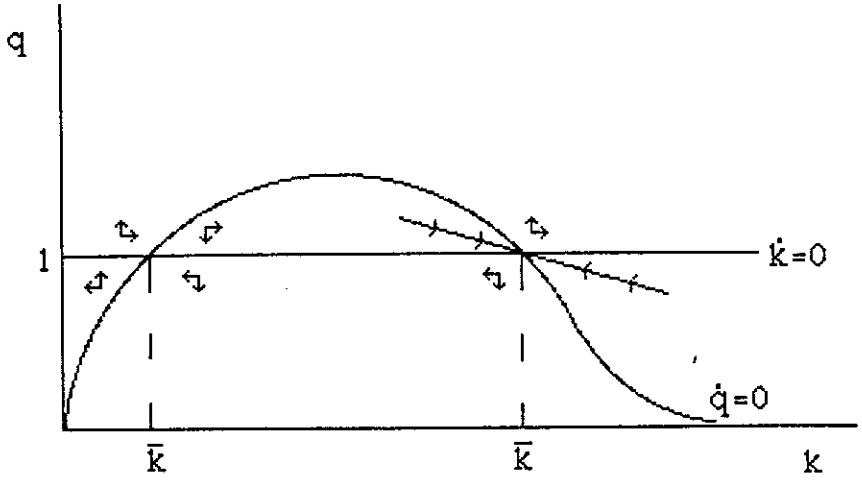

Figure 2A

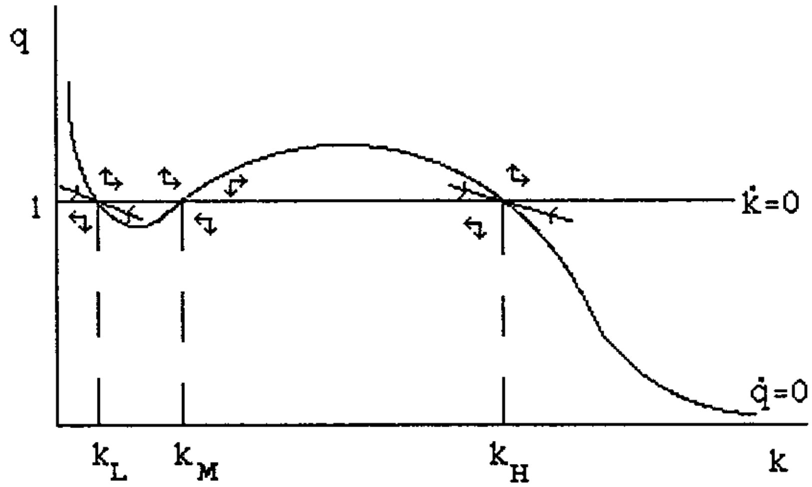

Figure 2B

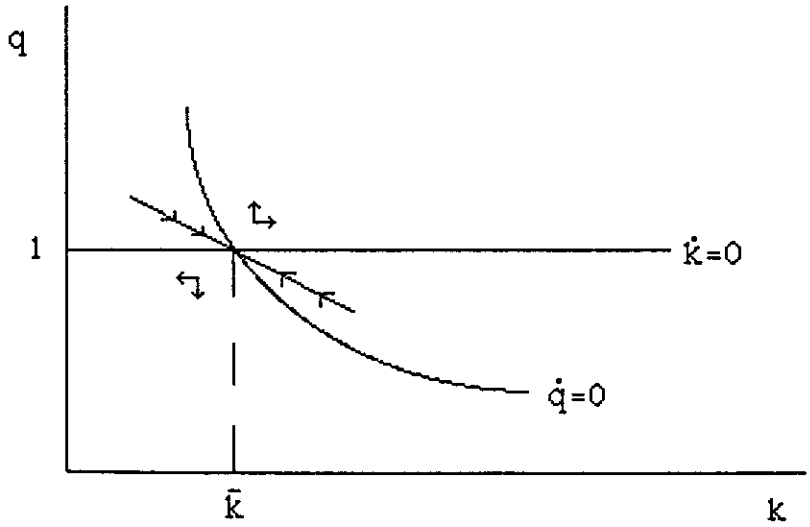

Figure 2C

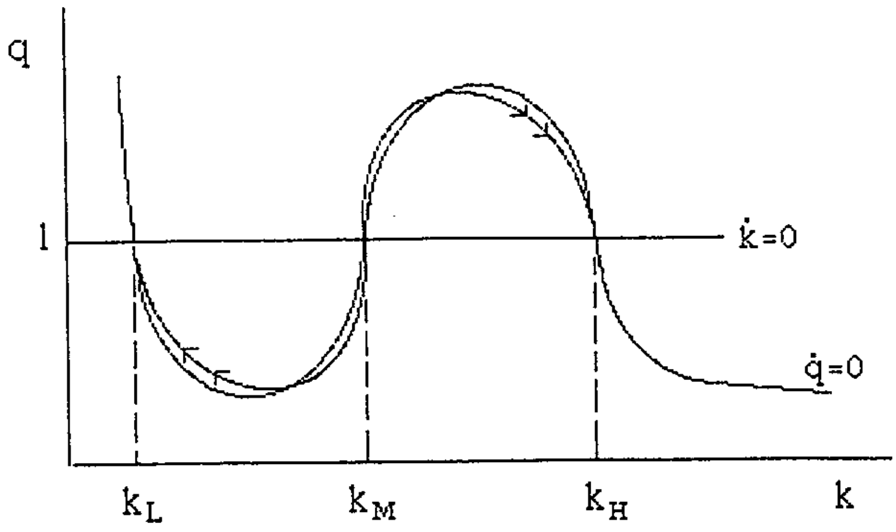

Figure 3A

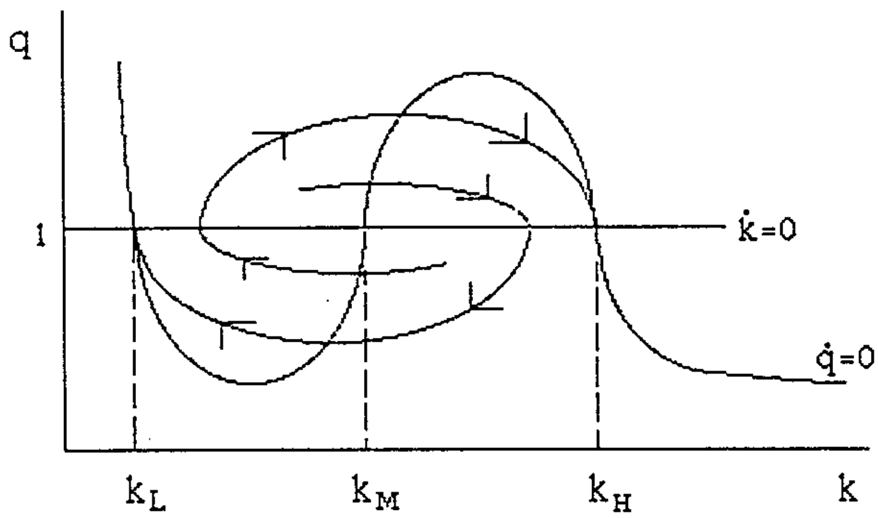

Figure 3B

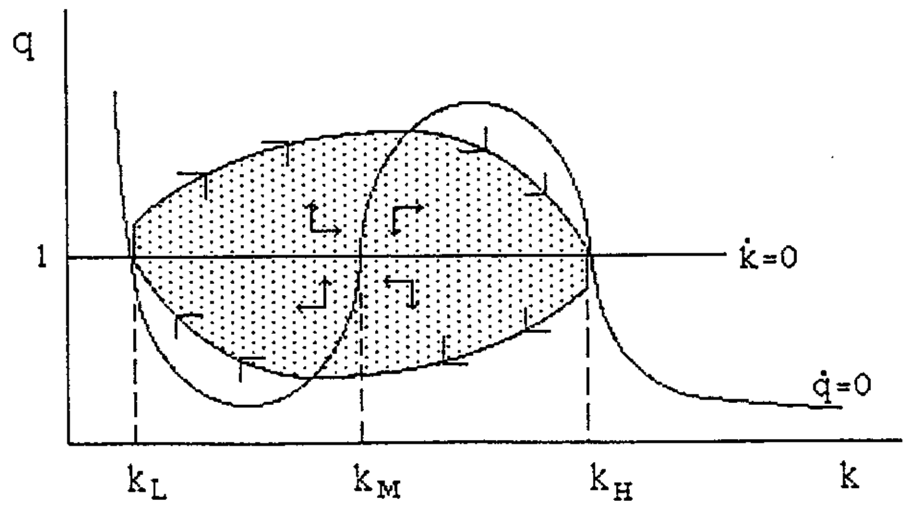

Figure 3C

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