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Macroeconomic Adjustment
and Growth

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Private Investment and Macroeconomic Adjustment

An Overview

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and
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This paper reviews current investment theories, recent models linking macroeconomic policies and private investment, and the effect of uncertainty and credibility on irreversible investment decisions. Empirical studies on the subject are also reviewed, and the general implications of this literature for the design of growth-oriented adjustment programs are discussed.

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Serven and Solimano review the literature on the macroeconomic determinants of investment, paying particular attention to the transmission mechanisms and likely effects of different macro policies on private investment.

What are the links between adjustment, investment, and growth? Correcting macro imbalances and achieving macroeconomic stability are prerequisites for achieving sustained growth. A strong response from private investors to incentives introduced as part of an adjustment program is crucial if the stabilization effort is to be followed by sustained growth.

Through what transmission mechanisms do macroeconomic policies affect private investment? Serven and Solimano discuss how different macro policies affect the variables — the real interest rate, the market price of installed capital, and the price of new capital goods — that influence the profitability of capital. Demand conditions and the availability of real

credit also influence how macroeconomic policies affect investment.

Serven and Solimano recommend more research in two areas:

- To improve the design of macroeconomic stabilization policies consistent with the resumption of growth, more research is needed on the implications for private investment of (a) fiscal adjustment (especially cuts in public investment) (b) changes in the exchange rate, and (c) monetary restraint under alternative financial market arrangements.
- A high research priority should be the development of models suitable for the *empirical* study of irreversible investment under uncertainty, a relevant issue for understanding the lack of investment response to incentives under unstable macroeconomic conditions. More work is also needed on the investment consequences of policy credibility, and the policy implications of the link between credibility and sustainability.

This paper is a product of the Macroeconomic Adjustment and Growth Division, Country Economics Department. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Emily Khine, room N11-055, extension 61763 (42 pages with charts).

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Table of Contents

1.	Introduction	1
2.	Investment Theory: A Brief Review	3
3.	Macroeconomic Policies and Private Investment	9
	3.1. Monetary and fiscal policy and private investment	10
	3.2. Exchange rate policy and private investment	13
4.	The incentive structure and investment response: credibility, uncertainty and irreversibility	21
	4.1 Irreversibility, uncertainty, and investment	22
	4.2 The role of credibility	27
	4.3 Empirical applications	30
5.	Concluding Remarks	36
	REFERENCES	38

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1. Introduction

The correction of external imbalances in many developing countries during the eighties has taken the form of major cuts in investment rates rather than increases in domestic savings. This investment decline, which mirrors the decline in the external resource transfer since 1982, has been especially sharp in the highly indebted countries, and has been accompanied by a slowdown in growth in all LDC's. Both public and private investment rates have fallen, although the latter more drastically than the former. If this trend is maintained, it will lead to a slowdown in medium term growth possibilities in these economies and will reduce the levels of long run per capita consumption and income, endangering the sustainability of the adjustment effort.

The observed reduction in investment in LDC 's seems to be the result of several factors. First, the lower availability of foreign savings has not been matched by a corresponding increase in domestic savings. Second, the deterioration of fiscal conditions due to the cut in foreign lending, to the rise in domestic interest rates, and to the acceleration in inflation forced a contraction in public investment. Third, the increase in macroeconomic instability associated with the external shocks and the difficulties of domestic governments to stabilize the economy has hampered private investment. Fourth, the debt overhang has also discouraged investment, through its implied tax on future output and the ensuing credit constraints in international capital markets.

In this paper we review current investment theories, recent models of investment behavior and empirical studies on the subject in order to examine the linkages between macroeconomic adjustment and private investment. The

review serves two purposes: on the one hand, to get a further understanding of the behavior of investment in LDC's during the eighties. On the other hand, we seek to identify research areas relevant for the design of policies that can bring about adjustment with growth.

The paper is organized as follows. First we review in Section 2 different theories of investment, starting from Keynes and covering the Accelerator, Neoclassical, Tobin's Q, Disequilibrium, Two-Gap and Irreversibility theories of investment. In Section 3, we discuss the literature on macroeconomic policies and private investment, examining the effect of monetary, fiscal and exchange rate policy on private investment, paying attention to some economic or institutional features specific to LDCs (e.g., the degree of intervention in financial markets, the possible complementarities between public and private investment, or the high reliance on imported capital goods) that may affect the transmission mechanisms through which some standard macropolicy measures influence investment. In the fourth section we review the recent literature on credibility, uncertainty and irreversibility in investment decisions, which is very useful in order to understand the response of private investment to the change in economic incentives that comes along with an adjustment program. Because investment is at least partially irreversible, and because it is guided by the uncertain future profitability of capital, it is also extremely sensitive to economic and/or political instability. We discuss how such factors contribute to determine the investment response to a given set of economic incentives, which is a key mechanism for stabilization to be followed by a resumption of growth. Finally, Section 5 presents some concluding remarks.

2. Investment Theory: A Brief Review

Keynes was perhaps the first economist to call attention to the existence of an independent investment function in the economy in departure from the prevailing notion (i.e., the Wicksellian loan market) that all available saving is automatically invested provided an appropriate interest rate exists in the economy. Keynes' (1936) basic insight was that investment depends on the prospective marginal efficiency of capital relative to some interest rate reflecting the opportunity cost of the invested funds. In addition, he pointed out the intrinsic volatility of private investment, due to the fact that any forecast of the returns of investment accruing in the future will be necessarily incomplete and uncertain. According to Keynes, in such an environment investors would be left to their "animal spirits" in making their investment decisions rather than to a rational calculation of an inherently uncertain distant future.

After Keynes, the evolution of investment theory was linked to simple growth models in the Harrod-Domar tradition. This gave rise to the accelerator theory, popular in the fifties and early sixties and widely used even today in practical growth exercises. The accelerator theory makes investment a linear proportion of changes in output, as derived from a fixed proportions production technology. This extreme simplicity explains the popularity of the approach: given an incremental capital-output ratio (ICOR), it is easy to compute the investment requirements needed to achieve a given output growth target. In this model, profitability, expectations and cost of capital considerations play no role in the determination of investment.

These overly restrictive assumptions led Jorgenson (1967) and Hall-Jorgenson (1971), among others, to formulate the Neoclassical approach to investment. This approach introduces factor substitution in the derivation of the demand for capital from the firm's cost minimization (or profit maximization) problem. The desired capital stock is shown to depend on the rental cost of capital (which in turn depends on the price of capital goods, the real interest rate and the depreciation rate) and the level of output. Decision and delivery lags (or implicitly adjustment costs) create a gap between the current and desired capital stocks, giving rise to an investment equation, namely an equation for the change in the capital stock.

This approach, in turn, has been subject to several criticisms regarding the consistency, and plausibility, of its assumptions: (i) the assumptions of perfect competition and exogenously given output are inconsistent; (ii) the assumption of static expectations is inappropriate, since investment is essentially a forward looking process; (iii) delivery lags are introduced in an ad hoc manner.

An alternative formulation of the investment function is the "Q" theory of investment associated with Tobin (1969). In this approach the ratio of the market value of the existing capital stock to its replacement cost (the Q ratio) is the main force driving investment. Tobin provided two reasons why Q may differ from unity: delivery lags, and increasing marginal costs of investment. Abel (1981) and Hayashi (1982) reconcile the neoclassical and Q approaches, by showing that the latter follows from the firm's optimal capital accumulation problem under (convex) adjustment costs. In this setting what matters for investment is marginal Q, i.e., the ratio between the increase in

the value of the firm due to the installation of an additional unit of capital, and its replacement cost. However, marginal Q is not observed; moreover, it will generally differ from the observed average Q (which is just the market value of existing capital in terms of new capital), except under conditions of perfect competition and constant returns to scale (see Hayashi (1982)). They will also differ if firms face quantity constraints in real or financial markets. In that case, average Q will not provide all the relevant information for investment decisions; the latter will also depend on the relevant quantity constraints.

The basic assumption of convex installation costs is highly questionable. While such an assumption is necessary to bound the rate of investment (so that a meaningful investment demand function can be defined), it can be argued that the cost of additions to an individual firm's capital stock is likely to be linear (or even concave) in investment, due to the 'lumpy' nature of many investment projects. More importantly, disinvestment, if at all possible, is much more costly than positive investment: capital goods often are firm-specific, and have a low resale value. An extreme but useful view of this asymmetry is to consider investment completely irreversible. In this case, the adjustment cost function is asymmetric with infinite adjustment costs for negative investment rates. The notion of irreversible investment was first introduced by Arrow (1968), who characterized the dynamics of irreversible investment under conditions of certainty. He showed that irreversibility creates a wedge between the cost of capital and its marginal contribution to profits. However, it is under conditions of uncertainty when irreversibility can have important implications for investment decisions: as a recent literature (e.g., Bernanke (1983), McDonald and Siegel (1986), Pindyck (1988b,1989),

Bertola (1989)) has emphasized, irreversible investment can be very negatively affected by risk factors. The intuitive reason is that if the future is uncertain any addition to productive capacity today increases the probability that the firm may find itself tomorrow with 'too much' capital, which cannot be (costlessly) eliminated due to the irreversible nature of investment; hence firms will be extremely cautious in their capacity expansion decisions. As we shall discuss below, this suggests that uncertainty may be more relevant for investment decisions than other conventional variables such as interest rates or taxes.

In the disequilibrium approach to investment (Malinvaud (1980, 1982), Sneesens (1987)), investment is a function of both profitability and output demand considerations. In Malinvaud (1982), investment decisions are separated in two stages: the decision to expand the level of productive capacity, and the decision about the capital intensity of that additional capacity. This last decision depends on profitability variables like the relative cost of capital (including the real interest rate) and labor. On the other hand, the capacity decision depends on the degree of capacity utilization in the economy as an indicator of demand conditions. The distinction between both decisions is meaningful due to the assumption of a putty-clay technology, so that factor proportions are flexible ex-ante but rigid ex-post. In Sneessens (1987), net investment is positively related to the gap between actual and long run equilibrium capacities. This in turn is a reflection of differences between actual and equilibrium rates of capacity utilization and between actual and equilibrium markup rates. Therefore investment depends both on profitability (discrepancies between actual and equilibrium mark-up rates) and on sales

constraints (discrepancies in rates of capacity utilization). The investment decision, in turn, takes place in a setting in which some firms may be facing current and expected future sales constraints, an important departure both from the Neoclassical (Jorgenson) and the Q models.

Disequilibrium models have often been criticized due to the simplicity of their expectational assumptions. However, market disequilibrium and rational expectations are not necessarily inconsistent. Neary and Stiglitz (1983) have shown that rational expectations and excess supply in the goods and labor markets can coexist, in a context of forward-looking agents that anticipate future sales constraint in a world of wage and price rigidities (see also Precious (1985)). This is particularly relevant for investment since the outcomes of decisions made today will be observed in the future, so expectations play a crucial role. On the other hand, important problems of macroeconomic adjustment, like deviations of output from full capacity in the face of demand shocks, are associated with (transitory) disequilibrium in the goods and labor markets. In such conditions, a combination of expectations and disequilibrium may be needed for a an adequate understanding of investment behavior.

In the developing countries context investment may be subject to other constraints besides that of sales. Rama (1987) has formulated and estimated investment equations in terms of profitability and sales and financing constraints. At the aggregate level, savings availability may be limited because of a lack of foreign savings in economies with a significant stock of outstanding foreign debt. Large fiscal deficits also reduce the volume of domestic savings available to finance private investment. At the micro level firms may face binding financial constraints if quantity adjustments rule in

domestic capital markets. This may be the case because of the existence of controlled interest rates and also because credit rationing may be a feature of the equilibrium in the loan market, as demonstrated by Stiglitz and Weiss (1981). Asymmetric information, adverse selection and incentive effects may make interest rate changes an inefficient device to sort out good borrowers from bad borrowers. Under those conditions, credit rationing and quantitative constraints may become a preferred tool for lending allocation by the creditors.

There is a growing literature on the effects of financial constraints on investment (see Fazzari Hubbard and Petersen (1988a, 1988b), Calomiris and Hubbard (1989), Mayer (1989), Mackie-Mason (1989)). Its main contention is that internal finance (retained profits) and external finance (bonds, equity or bank credit) are not perfect substitutes. The discrepancy in the cost of different sources of financing is due to asymmetric information: lenders in capital markets cannot evaluate accurately the quality of firms' investment opportunities, thus making the cost of new debt and equity differ substantially from the opportunity cost of internal finance generated through cash flow and retained earnings. According to this view, investment will be very sensitive to financial factors such as the availability of internal finance or the access to capital markets. This new strand is clearly a departure from the perfect capital market approach where the financial structure of the firm is irrelevant for investment decisions; in this new setting the market value of a firm is not independent of its financial structure.

Empirical research along these lines has been undertaken for the U.S. by Fazzari, Hubbard and Petersen (1988a). They test the role of the financial structure of the firm in the Q, neoclassical and accelerator models of

investment discriminating by firm size. The general finding is that financial effects are important for investment in all firms, but also that consistent differences exist across firms regarding the sensitivity of investment to balance sheet variables that measure liquidity, depending upon their retained earnings policies. An important macroeconomic dimension of these findings is that, provided fluctuations in firms cash flows and liquidity are correlated with movements in aggregate economic activity and the business cycle, macroeconomic instability may affect investment also through financial channels, mainly for firms relying heavily on internal (and external) finance .

Another relevant feature of investment in LDCs is the high import content of capital goods. This raises an important point emphasized in two-gap models (Chenery and Bruno, 1962 and Bacha, 1982), namely that the lack of foreign exchange may constitute a major constraint to sustain high rates of investment and growth in LDCs. In fact, in economies where domestic and foreign capital goods are highly complementary the lack of foreign resources to import machinery and equipment will be an impediment to growth (in the medium run import substitution of capital goods and export promotion would ease the foreign exchange constraint). The foreign exchange constraint also has important implications (discussed below) for the impact of exchange rate policy on investment demand.

3. Macroeconomic Policies and Private Investment

In this section we examine the effects of macroeconomic policies on private investment. In particular we are interested in studying the impact on investment of different tools of monetary, fiscal and exchange rate policy aimed

at correcting unsustainable macroeconomic imbalances. The traditional macro package includes restrictive fiscal and monetary policies supplemented with a real devaluation of the exchange rate. We review the most relevant literature on the macroeconomic determinants of investment, paying particular attention to the transmission mechanisms and likely effects of different macro policies on private investment.

A summary of the linkages between adjustment, investment and growth appears in Chart 1. The basic notion here is that the correction of macro imbalances and the achievement of macroeconomic stability is a prerequisite for achieving sustained growth. In turn, a strong response of private investment to the set of incentives put in place by an adjustment program is a basic element for the stabilization effort to be followed by sustained growth. Chart 2 offers a schematic view of the transmission mechanisms through which macroeconomic policies affect private investment. The first three columns show the variables that influence the profitability of capital (the real interest rate, the market price of installed capital, and the price of new capital goods) and how they are affected by the different macro policies. The fourth and fifth columns single out demand conditions and real credit availability as other determinants of investment that may be affected by macroeconomic policies. We now turn to a more detailed discussion of these effects.

3.1. Monetary and fiscal policy and private investment

Restrictive monetary or credit policies aimed at reducing inflation and/or the current account deficit may affect investment through two "price" channels. One is the rise in the real cost of bank credit, a major source of investment financing in LDC's. The second is the increase in the opportunity

cost of retained earnings, also an important source of investment financing in most developing countries, due to higher real interest rates. Both effects lead to an implicit or explicit (in the case of organized equity markets) reduction in the market value of existing capital relative to its replacement cost (the Q ratio is expected to fall with a monetary contraction), and thus to a decline of investment. In repressed financial markets, credit policy affects investment directly through the stock of credit available to firms with access to preferential interest rates and through interest rates for firms operating through the unofficial money market (for models of credit policy and growth in financially repressed economies see Van Wijnbergen (1983a and 1983b)). The institutional set-up of the financial markets in developing countries is certainly an important feature determining the impact and transmission mechanisms of monetary and credit policy on investment (an empirical analysis of monetary stabilization policies for Korea with endogenous determination of investment is provided by Van Wijnbergen, (1982)).

High fiscal deficits also push up interest rates and crowd-out private investment. However, the way a fiscal deficit is corrected also matters from the viewpoint of investment. Different mixes of tax increases and/or spending reductions can be expected to have different effects on private investment. In particular, due to institutional and political rigidities in the ability of governments to reduce current public expenditure, fiscal adjustment often takes the form of reduced public investment, some of whose components may be complementary with private investment. In fact, the empirical evidence from data on developing countries analyzed by Blejer and Kahn (1984) indicates that public investment in infrastructure is complementary with private investment

(and other types of public investment are not). Similarly, Musalem (1989) finds evidence of complementarity between private and public investment in a time-series study of investment in Mexico.

However, Balassa (1988) reports cross section statistical results showing that public and private investment are negatively correlated, with a one per cent increase in public investment being associated with a 0.55 percent decline in private investment. Furthermore he finds a negative correlation between the share of public investment in total investment and the size of incremental output-capital ratios, arguing for a lower efficiency of public investment relative to private investment.

The general issue is how monetary and fiscal policies affect total and private investment and what are the more relevant transmission mechanisms at work. A plausible mechanism for restrictive demand policies to affect private investment is through the market value of capital. As recent econometric evidence shows (see Solimano, 1989) aggregate investment profitability is highly procyclical. Tobin's Q increases in upturns and falls in downturns- so we should expect the market value of capital to fall in the short run in response to a slowdown in economic activity following restrictive demand policies. Another relevant topic for research in this area is the sensitivity of private investment to cyclical changes in activity levels. Econometric estimates of investment functions show, in general, a strong response of investment to changes in output. This is a puzzling finding since a non-negligible part of output fluctuations appear to be transitory (therefore they should not affect investment), and it is costly to install capital (so adjusting to transitory shocks is also costly). Then this excessive output- related variability of

investment in the cycle remains largely unexplained (see Blanchard's discussion of Shapiro, (1986)). However, myopic expectations and short investment horizons may be consistent with the observed large fluctuations of investment associated with output changes.

The initial downturn in economic activity often associated with macroeconomic adjustment may also affect investment through its effect on expectations. In fact, a current recession could form the basis for "pessimistic" expectations, leading investors to postpone investment until the recovery arrives; this, in turn, may prevent a take-off of investment (particularly of projects with short gestation lags) and delay the recovery itself, and the economy may get stuck in a low activity equilibrium because of insufficient investment arising from self-fulfilling pessimism on the part of investors. How to avoid such an outcome is an important consideration in the design of restrictive demand policies that minimize the potentially adverse impact on investment and growth.

3.2. Exchange rate policy and private investment

A key element of almost any adjustment and stabilization plan seeking a reduction in the size of the current account deficit is a combination of expenditure reducing with expenditure switching policies. The latter refers basically to a real devaluation. A real depreciation may affect investment through several channels:

i) The profitability of investment: a devaluation may affect the profitability of investment through its impact on the relative price of capital in the economy. In fact, Buffie (1986) and Branson (1986) show that if capital

goods have an import content then a devaluation raises the supply (or reposition) price of capital in terms of home goods; *ceteris paribus*, this effect tends to depress investment in the home goods sector. An empirical confirmation of the presumption that a real depreciation reduce investment (in the short run) is provided by Musalem (1989) for the case of aggregate investment in Mexico.

In these models, investment is treated as a composite good produced by combining domestic (i.e., construction or infrastructure) and foreign components (i.e., machinery and equipment). In this setting, a real depreciation of the exchange rate acts as an adverse supply shock in the "production" of investment goods. Branson (1986) explicitly calculates the impact of a devaluation on Tobin's Q in the home goods sector, concluding that profits fall (and along with them the market value of capital) and the cost of capital (and its reposition price) rises following a real depreciation. Solimano (1989) finds a negative effect of real devaluations on investment in his empirical simultaneous equation model for Chile; his results show that the economy-wide Tobin's Q falls when the real exchange rate rises because of a dominant reposition price effect following a real depreciation (in principle the market value of capital rises for the traded goods sector after a devaluation, but this effect may be too small relative to the reposition price effect and the effect of devaluation on the market value of capital in the home goods sector). The issue is also reviewed, conceptually, by Lizondo and Montiel (1988), who distinguish between investment in the traded and non-traded goods sectors in a model in which capital is sector-specific. They decompose the effect of devaluation on profitability into three components: a) its impact on the cost

of capital, b) its effect on the product wage in both sectors (also examined by Van Wijnbergen (1986) and Rísager (1984)), and c) its impact on the cost of imported intermediate inputs. Their conclusion is that the net effect of a real depreciation is generally ambiguous, since it tends to increase investment in the traded goods sector and reduce it in the home goods sector.

Another channel through which devaluation may affect the profitability of investment is the real interest rate. Consider first the case of an unanticipated devaluation (we discuss below the anticipated devaluation case), and assume that interest rates are determined in domestic assets markets (i.e., in the money market). In this case a devaluation will increase the price level through its impact on the cost of imported intermediate inputs and wages under indexation; if monetary policy does not fully accommodate the increase in the price level, real money balances will fall pushing up the real interest rate for a given rate of (expected) inflation. Thus devaluation will depress the market value of capital exerting an adverse effect on investment. On the other hand, if devaluation was anticipated and if it succeeds in eliminating devaluation expectations, then it may result in an investment expansion, since the required return on capital would tend to fall reflecting the reduction in the anticipated rate of depreciation (whether this will be so depends on the degree of capital mobility and the import content of investment; see below).

ii) Financial effects of devaluation: the debt crisis of the eighties, and the adjustment policies adopted thereafter, has brought renewed attention to the effects of devaluation on the real value of liabilities denominated in dollars held by domestic firms, banks and financial intermediaries.

In the case of foreign-indebted firms devaluation automatically raises the burden of debt, hence reducing their net worth. If domestic credit markets are imperfect (as it is often the case in LDCs) these firms may subsequently have to face credit constraints, or will have to bear higher costs of outside financing as creditors raise their lending rate to compensate for the increased default risk. These financial pressures will lead directly to reduced investment for those highly indebted firms in risk of bankruptcy. The increase in the real value of firms' foreign debt also affects investment indirectly due to its adverse impact on the financial system. As the net worth of indebted firms falls so does the quality of domestic creditors' portfolios (i.e., banks and financial intermediaries). In fact, they may be forced to reduce their exposure by cutting their loans -- or may simply go bankrupt. The ensuing tightening of credit markets may result in a reduced supply of credit (or higher interest rates) even for firms that had no foreign currency liabilities. This tightening of credit conditions, in turn, discourages investment as financing becomes more scarce or more expensive.

The financial effects of an unanticipated devaluation are sometimes so significant that firms and/or financial intermediaries have been bailed out by the public sector to avoid an epidemic of bankruptcies that could result in a major economic crisis and lead to the failure of the adjustment package. The financing of the bailout, however, may lead in the future to a domestic debt overhang, as the treasury has to issue bonds to cover the foreign exchange losses of commercial banks and/or firms indebted in dollars terms. The ensuing higher stock of public debt associated with the rescue of indebted firms puts an upward pressure on interest rates, crowding out private investment. It is

interesting to note the implicit trade-off between supporting investment today (via subsidization of indebted firms) versus investment tomorrow (arising from the crowding-out effect of public debt issued in previous periods).

Empirical studies of the financial effects of devaluation and its impact on investment are scarce; exceptions are Easterly (1989) and Rosensweig and Taylor (1989). Easterly (1989) sets up a Computable General Equilibrium model (CGE) for Mexico, extended to include financial flows in order to trace the impact of a currency devaluation on investment (which is assumed to be self-financed and/or face credit constraints). In this model a devaluation is shown to result in a fall in both GDP and private investment, but with the latter contracting substantially more than the former. The main cut in investment comes from corporations, and is due to a sharp increase in their real foreign indebtedness. Easterly reports that the cash flow of corporations declines substantially in the simulations as a result of capital losses on dollar debt, while the replacement cost of capital rises sharply. Rosensweig and Taylor (1989) arrive to mixed results using a CGE model for Thailand with endogenous portfolio choice. In their simulations GDP increases following a real depreciation, under the assumption of a strong export response to relative prices incentives and no capital losses from devaluation. In turn, higher net worth provides more deposits to banks, credit supply rises, and the interest rate falls. The result is an increase in investment. However, in their simulations including capital losses on foreign liabilities associated with a devaluation, domestic capital formation can be crowded out, and the expansionary net exports effect may be offset.

iii) Devaluation, activity levels and investment: A third channel through which devaluation may affect investment is provided by its effect on aggregate demand. This may be especially important when firms face sales constraints, so that the degree of capacity utilization or other variable representing demand considerations has a strong systematic effect on investment (such effect is often found empirically; see e.g. Musalem (1989) and Solimano (1989)). If devaluation reduces aggregate demand ex-ante, then ex-post investment will fall. Moreover, if investment has a significant import content, then output expansion is likely to be a necessary (but not sufficient) condition for investment not to fall ex-post. The literature on contractionary devaluation (Krugman and Taylor, 1978; Van Wijnbergen, 1986; Edwards, 1987; Serven, 1986; Solimano, 1986; Lizondo and Montiel, 1989) emphasizes the slow working of substitution effects arising from devaluation; hence in the short run the impact of a real devaluation on aggregate demand is dominated by its adverse income effects. The latter operate through two main channels: one arises from the likely initial trade imbalance, which results in a real income transfer to the rest of the world (even at given terms of trade); the other from the negative impact on consumption of real income redistribution from wages to profits. On the supply side, three transmission mechanisms may contribute to output contraction: the increased real cost (in terms of domestic goods) of imported inputs, the rise of working capital costs, and real wage resistance. If the net effect of a currency devaluation is contractionary, i.e., GDP falls, then the slump in economic activity is likely to form the basis for investors to cut investment spending -- unless they clearly perceive the slump to be transitory. However, with sufficiently strong substitution effects (e.g., a large impact of

devaluation on exports) an expansionary outcome will result, and so devaluation may raise real income and stimulate investment spending as the degree of capacity utilization increases.

The discussion until now has focused on devaluation without making any explicit distinction between **anticipated** and **unanticipated** devaluation. An **anticipated** devaluation can affect investment through two additional channels: the real interest rate and the import content of capital goods.

iv) The real interest rate channel: The effect of an anticipated devaluation on interest rates depends crucially on the degree of capital mobility (that is, the costs of portfolio adjustment) and on the substitutability between domestic and foreign assets. Let us consider the general case of imperfect capital mobility and imperfect substitutability between domestic and foreign assets. In this context, asset market equilibrium makes the domestic real interest an increasing function of the foreign real interest rate plus the expected rate of depreciation of the real exchange rate. Hence the perception by the public that the real exchange rate is overvalued and a real depreciation is imminent will lead to higher real interest rates and reduced investment; in addition, this effect will be more important the higher the degree of substitutability (and also of capital mobility) between domestic equity and foreign assets. However, under conditions of imperfect asset substitutability or restricted capital mobility, it is also possible that investors will shift their portfolios towards imported capital goods in the expectation of a devaluation. Let us explore this case now.

v) The speculative hoarding effect of imported capital goods: The anticipation of a real devaluation may also have a positive effect on investment

demand, when capital goods have a significant import content, before a devaluation actually takes place. The mechanism that could produce this outburst of investment is the **speculative hoarding effect**, which would increase the purchases of imported capital goods in anticipation of a future devaluation that would raise the replacement cost of investment. As argued by Dornbusch (1984), the more plausible dynamics is the following: firms and importers will attempt to increase their purchases of foreign capital goods when a devaluation is expected in order to collect the anticipated capital gain; then, when the devaluation actually occurs and the implicit subsidy embodied in the overvaluation is eliminated, a sharp cut in investment may follow. The speculative hoarding of foreign capital goods may give way to a period of depressed investment after the devaluation, as the over-accumulation is reversed. (A similar time pattern would emerge in the case of transitory trade liberalization, when the latter includes a temporary reduction of tariffs on imported capital goods.) Obviously, a crucial assumption for this pattern to emerge is that of imperfect capital mobility and/or imperfect substitutability between domestic equity and foreign assets, a requirement which in principle seems quite realistic for most LDCs. A close study of the observed dynamics of imports of investment goods during devaluation episodes is worth to be undertaken, if we want to learn more on the dynamics of investment (and the current account) during an adjustment program.

4. The incentive structure and investment response: credibility, uncertainty and irreversibility

A key ingredient of most macroeconomic adjustment packages is a change in economic incentives that switches spending towards domestic goods (offsetting the deflationary bias of the usual monetary and fiscal restraint) and raises profitability in the tradable sector. This change in incentives is expected to lead to an outburst of investment in the tradable goods sector, increasing productive capacity and enhancing economic growth -- and thus ensuring the sustainability of the adjustment effort.

In practice, however, the investment response often is unexpectedly weak, and involves long delays. This poses major difficulties for the adjustment effort, since in the absence of an investment expansion the short-run deflationary consequences of the expenditure-restraining measures may be magnified, leading to a persistent reduction in growth. In this way, the lack of an adequate investment response in the tradable sector to the change in economic incentives increases the cost of the adjustment in terms of employment and growth; ultimately, it may render the stabilization effort socially unacceptable and thus unsustainable.

Therefore it is essential to improve our understanding of the reasons that underlie this slow reaction of investment, in order to improve our ability to design sustainable adjustment policies. In the theoretical framework of symmetric convex adjustment costs to investment, this inertia could be explained by a combination of high adjustment costs with sluggish expectations on the part of investors. However, the assumption that firms face rapidly increasing marginal costs to capacity expansion appears questionable on

empirical grounds, and there is also no clear justification for a myopic expectational behavior by investors. A more satisfactory explanation can be offered by emphasizing the importance of risk factors in investment decisions, which would make investors reluctant to undertake fixed investment projects in a context of high uncertainty about the future economic environment and, in particular, about the future incentive structure.

Chart 3 provides a schematic illustration of the implications of uncertainty for asset decisions. When there is uncertainty about the economic environment or about the permanence of economic incentives, irreversible decisions will be delayed to avoid long lasting mistakes. In particular, fixed investment decisions will be postponed, with the corresponding negative consequences for growth, in favor of more flexible positions in liquid assets. Among these, capital flight will be a preferred option whenever there are major doubts about the sufficiency or the sustainability of the adjustment effort.

4.1 Irreversibility, uncertainty, and investment¹

As an emerging literature has emphasized (see Pindyck, 1989) for references), the key role of uncertainty in investment decisions follows directly from the irreversible nature of most investment expenditures. These can be viewed as sunk costs, because capital, once installed, is firm- or industry-specific and cannot be put to productive use in a different activity (at least without incurring a substantial cost). The decision to undertake an irreversible investment in an uncertain environment can be viewed as involving the exercising of an option -- the option to wait for new information that

¹ The material in this section is largely based on Pindyck (1989).

might affect the desirability or timing of the investment. Thus, the lost value of this option must be considered as part of the opportunity cost of investment -- an issue which is overlooked in the conventional net present value calculations (which would therefore underestimate the opportunity cost and overestimate investment). As recent studies have shown, this opportunity cost can be substantial, and is also very sensitive to the prevailing degree of uncertainty about the economic conditions that determine the future returns to the investment. As a consequence, changes in uncertainty can have a very strong impact on aggregate investment; from a policy perspective, the stability and predictability of the incentive structure and the macroeconomic policy environment may be much more important than tax incentives or interest rates. In other words, if uncertainty over the economic environment is high, tax and related incentives may have to be very large to have any significant impact on investment.

It is important to note that this effect of uncertainty is completely independent of investors' risk preferences or of the extent to which their risks may be diversifiable. Investors may be risk-neutral (as assumed by most of the irreversibility literature) and their risks completely diversifiable; yet investment would continue to depend negatively on the perceived degree of uncertainty. The latter becomes important here simply because the fixed investment decision cannot be 'undone' (at least at zero cost) if future events turn out to be unfavorable. In general, there will be a value to waiting (i.e. an opportunity cost to investing today rather than waiting for information to arrive) whenever the investment is irreversible and its net payoff evolves stochastically over time.

From a macroeconomic perspective, there are different forms of uncertainty which may be relevant for investment decisions. Consider for example the investment decision of a firm facing uncertain future demand, which has been analyzed by Pindyck (1988b) and Bertola (1989). If investment is irreversible, then some of the firms' installed capacity may go unutilized if demand turns out to be low. Ex-ante, this will make firms want to hold less capacity than they would under conditions of reversibility. Moreover, Pindyck and Bertola also show that increased demand volatility will generally lead to reduced investment, by worsening the 'worst case' scenario in which the firm regrets the irreversible capacity expansion (it also makes the 'high demand' scenario better, but this can be taken care of by installing additional capital if needed, i.e. the adjustment cost function is asymmetric). The firm's optimal investment rule equates the expected discounted value of profits from the marginal unit of capital to the installation cost plus the 'value of waiting' lost by undertaking the capacity expansion.

The case of uncertain real exchange rates has been studied by Dixit (1987), Krugman (1988), and Krugman and Baldwin (1987), who consider the behavior of a firm who must decide whether to enter (or exit) the foreign market. They show that sunk entry costs combined with uncertain future real exchange rates will cause firms not to enter the market even though favorable exchange rate movements would seem to make entry profitable. Similarly, Caballero and Corbo (1988) show that uncertainty over future real exchange rates can depress exports. Dornbusch (1988) examines the related issue of capital flight reversal following a real depreciation; he argues that in order to attract the previously evaded capital to irreversible fixed investment, an

over-depreciation of the exchange rate may be needed, to compensate the uncertainty faced by investors with a frontloading of the returns to investing in the domestic country.

Ingersoll and Ross (1988) examine the role of interest rate uncertainty in a context of irreversible investment where future returns are known with certainty (see also Tornell, 1988). As with uncertainty over future cash flows, this creates an opportunity cost for investing. They conclude that the effect of interest rate variability on the optimal timing of investment may be quite sizeable; moreover, they show that a fall in expected future interest rates need not lead to increased investment. The reason is that such a change also lowers the cost of waiting, and thus can have ambiguous effects on investment. In other words, interest rate volatility may be more important for investment than interest rate levels.

The relevance of these results for macroeconomic policy, especially in developing countries, cannot be overemphasized. Consider, for example, the problem of relative price volatility. Many developing countries suffer from high and unpredictable inflation, which is usually matched by high relative price variability. The irreversibility approach suggests that this would reduce the effectiveness of relative price changes in stimulating investment. Specifically, a history of frequent relative price swings would make investors extremely cautious in reacting to a policy-induced change in sectoral incentives; substantial time may elapse before investors become convinced that the change is permanent -- and before they are willing to give up their option to postpone investment. Notice also that the implementation of an adjustment package may well increase uncertainty in the short run, as private agents start

receiving mixed incentive signals -- some associated with the previous policy rules, some with the stabilization package, and some with the structural reforms aimed at restoring medium term growth. An example along these lines is provided by van Wijnbergen (1985), who shows that a trade reform which is suspected to be only temporary can in fact lead to a fall in investment -- as economic agents postpone investment in both the home and traded goods sectors in order to receive additional information.

The debt overhang faced by many high-indebted countries creates a similar problem, which has been emphasized by Sachs (1988). It arises from the need to carry out an external transfer to the country's creditors, and represents another source of instability of the macroeconomic environment: in a context of uncertainty, the level of the real exchange rate and/or the demand management policies consistent with the required transfer also become uncertain; the size of the transfer itself is not known with certainty, as it depends on uncontrollable factors such as the future level of world interest rates and the terms of trade. Carrying out the transfer may require future real exchange rate changes, fiscal contraction, or both. Thus investors must face the risk of large swings in relative prices, taxation, or aggregate demand; as we saw above, each of them would lead to reduced investment.

In practice, this effect may be hard to identify, since foreign debt may affect investment adversely through two additional channels (emphasized by Borenstein (1989)). First, the debt overhang, which acts as an anticipated foreign tax on current and future income: since part of the future return on any investment will accrue to the creditors as bigger debt service payments, it discourages capital accumulation and promotes capital flights. Second, the

credit rationing effect: a highly indebted country is likely to face credit constraints in international capital markets, which is equivalent to facing higher real interest rates, and this will also discourage investment.

4.2 The role of credibility

From a policy perspective, an extremely important source of uncertainty is the imperfect credibility of policy reforms. The latter is related to the public's perceptions about both the internal consistency of the adjustment program and the government's willingness to carry out the program despite its implied social costs. Unless investors view the adjustment program as fully credible in both senses, the possibility of a future policy reversal will become a key determinant of the investment response. As argued by Dornbusch (1988), any adjustment program can be undone by reverting economic policies -- while investors cannot undo their fixed capital decisions. In such conditions, the value of waiting arises from the losses (the 'irreversible mistake', in Bernanke's (1983) terminology) that investors would incur if policy were in fact reversed in the future. Clearly, the larger the perceived probability of a future policy reversal, the less willing investors will be to undertake fixed investment projects -- or the larger the current return they will require in order to compensate for the possibility of an irreversible mistake.

This implies that any given set of policy measures can have widely different effects on investment depending on the prevailing degree of 'confidence' of the public. In particular, stabilization may entail large social and economic costs if credibility is low -- since the investment

response will be insufficient to offset the deflationary bias of the usual fiscal and monetary restraint measures; thus, a persistent recession may develop before investors become confident enough that the adjustment measures will be maintained. This may be particularly relevant in economies with a past history of frequent policy swings or failed stabilization attempts -- two features shared by many highly indebted countries -- in which the private sector has learned to view adjustment programs with considerable skepticism.

Hence setting the right economic incentives is a required precondition for investment and growth, but it does not guarantee that they will in fact take place (Dornbusch, (1989)). Obviously, high credibility would help speed up the investment response and reduce the costs of the adjustment. However, the question of how can credibility be affected by government actions remains largely unresolved. Specifically, an important issue here is the choice between gradual and abrupt stabilization. The former would set initially modest objectives, which can be achieved with near certainty, in order to build up the government's reputation. The latter would start with an overadjustment (e.g., an over-depreciation of the exchange rate) to frontload the incentives to resource reallocation (but also the costs of the adjustment). As argued by Edwards (1988), the choice may largely depend on the specifics of each country; the social distribution of adjustment costs implicit in the program, together with past policy experience, are likely to be important issues here.

It is important to emphasize that policy reversal is an endogenous outcome in this framework, since current private sector decisions affect the opportunity set of future policy actions and ultimately determine the sustainability of the adjustment policy. As an example, consider again the

case of a large real depreciation that due to low confidence fails to attract investment to the tradable sector. Its only visible effects will be a deflationary real income cut and an income redistribution from labor to capital, especially in the traded goods sector; however, because the depreciation is not sufficient to compensate for the lack of credibility, the increased profits will be reflected in increased capital flight. Social pressure and balance of payments problems may eventually force policy reversal, thus confirming the initial skepticism of investors.

The alternative situation starts with high confidence, which allows an investment boom and validates the adjustment program. In both cases expectations may be self-fulfilling, which reflects the possibility of multiple equilibria in this framework -- an indeterminacy that also arises in the literature on investment under monopolistic competition (see e.g. Kiyotaki (1988), Shleifer and Vishny (1989)). In this case, it is due to the presence of an externality that creates a wedge between the social and private returns to investment: higher aggregate investment helps sustain the adjustment effort and therefore results in higher returns to investment, a mechanism that will be ignored by the individual investor. Since the 'high confidence' equilibrium is clearly better in a meaningful sense than its alternative, it is crucial to investigate what specific policy measures (e.g., additional temporary investment incentives) can lead the economy to this superior outcome. As argued by Dornbusch (1989), sufficient external support to the stabilization effort may play an important role by raising investors' confidence in the sustainability of the adjustment, thus giving way to the investment takeoff.

4.3 Empirical applications

The empirical literature on uncertainty and irreversibility still remains very scarce. A simple nonstructural approach is used by Pindyck (1986), who tests for the effects of uncertainty by introducing the variance of stock returns as an explanatory variable in an otherwise conventional investment equation; his results with aggregate U.S. data indicate that the variance of stock returns is an important factor for investment growth. Solimano (1989) also investigates the effects of economic instability in an empirical simultaneous equation model applied to Chile. He finds that the volatility of the real exchange rate and output exert a significant negative impact on private investment, and argues that the large swings in both variables in Chile during the eighties may have resulted in a substantial reduction in private investment as compared to a counterfactual scenario of lower relative price and output variability. Dailami and Walton (1989) also argue that macroeconomic instability may be one major cause of low investment in Zimbabwe.

A different approach is used by Bizer and Sichel (1988), who develop a structural model of capital accumulation with asymmetric costs of adjustment; in their framework, irreversibility would imply higher downward adjustment costs than upward ones. Their preliminary results using industry data for the U.S. manufacturing sector are somewhat mixed, perhaps due to aggregation problems. More work along these lines, perhaps using a cross-section of country data, should be a research priority. However, it should be noted that sample variances (or other sample measures of variability) represent imperfect measures of risk; in particular, they cannot capture the 'peso-problem' type of

uncertainty associated with the possibility of a regime change (e.g., a policy reversal), which may be very hard to measure empirically. Moreover, the role of irreversibility may be masked in aggregate data; as Bertola (1989) points out, the irreversibility constraint is probably much more relevant at the disaggregated level.

Simulation models provide an alternative way to assess the practical importance of irreversibility. Rough numerical calculations reported by several authors suggest that it may be very large indeed for 'reasonable' parameter values. The development of a structural simulation model should be another priority in the research agenda. Such a model, parameterized to fit a particular country or industry, could be very useful to evaluate the impact on investment of policy changes and of changes in specific forms of uncertainty. In particular, it could be used to analyze explicitly the effects of perceived possible shifts in the policy regime -- i.e., credibility changes.

Chart 1

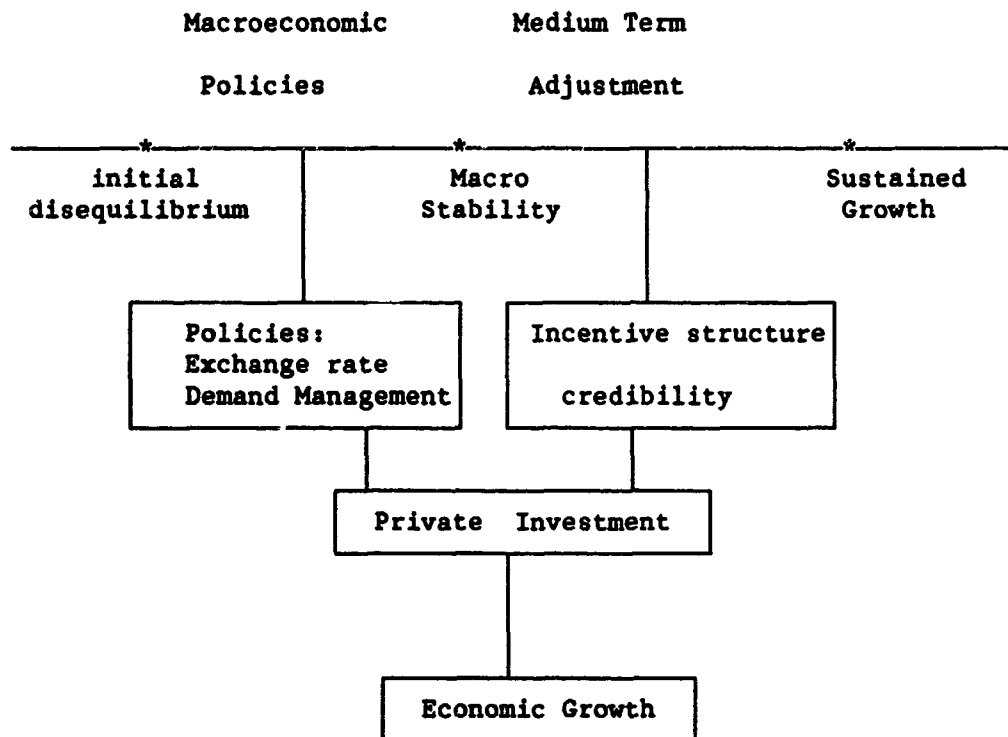


Chart 2

Macroeconomic Policies and Private Investment

transmission mechanism	real interest rate	market value of capital	reposition price of capital	demand levels	real credit availability
policy					
1. monetary contraction	+	-	-	-	-
2. fiscal adjustment					
i) spending reduction	-	+/-	-	-	+
ii) tax increase	-	-	+/-	-	+
3. devaluation	+/-	+/-	+	+/-	-

Chart 3

Incentives and Investment Response

	Liquid assets	Irreversible capital
Uncertainty	Capital Flight	Postponement of Investment

Chart 4

Effects on Private Investment of:
(Empirical Studies)

	Real depreciation of the exchange rate (short run)	Increase in capacity utilization	Increase in public investment
Blejer and Khan (1984)			Positive for public invest- ment in infrastructure
Balassa (1988)			Negative
Musalem (1989)	Negative	Positive	Positive
Solimano (1989)	Negative	Positive	

5. Concluding Remarks

In this paper we have reviewed the linkages between macroeconomic adjustment and private investment. From the policy viewpoint, there are three broad areas relevant for research. The first concerns the effects of macroeconomic adjustment policies on private investment. There are some institutional or economic features shared by many LDCs that may modify in a substantial manner the transmission mechanisms through which fiscal, monetary, and exchange rate adjustment affect investment decisions. To advance in the design of macroeconomic stabilization policies that minimize the adverse short-term impact on investment, we need to know more about the implications for private investment of fiscal adjustment (and especially public investment reductions), of monetary restraint under alternative financial market arrangements, and of exchange rate changes.

The second research area concerns the implications of irreversibility and uncertainty. A more complete understanding of their effects on investment decisions is a crucial prerequisite for the design of adjustment programs that introduce credible incentives for the expansion of investment, leading to a resumption of growth and making the adjustment effort sustainable. The development of models suitable for the empirical study of irreversible investment under uncertainty should be a top priority in the research agenda. More work is also needed on the investment consequences of policy credibility, as well as on the policy implications of the investment externality introduced by the credibility/sustainability link.

The third research area is concerned with the links between the reduction in the transfer of external resources and the drop in investment

observed in many LDCs. A further understanding of the transmission mechanisms at work and the related policy implications are clearly very relevant areas for policy oriented research in the field of macroeconomic adjustment and private investment.

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