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Credit Constraints and Investment Finance: Evidence from Greece

by

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ABSTRACT

A firm which faces a borrowing constraint uses retained earnings as an additional source of investment finance. The division of profits between dividend payment and retained earnings is then determined by intertemporal optimization. Once this is the case, an increase in available credit does not translate one-for-one into increases in investment outlay. Further, an increase in the interest rate may lead to reduction in investment in spite of the greater availability of credit; this is due to the effect of the cost of borrowing on corporate savings.

Empirical analysis for the private manufacturing sector in Greece, for the period 1964-1986, supports these conclusions.

This paper questions the effectiveness of simple interest rate liberalization alone as a vehicle for promoting investment, and focuses on issues important in the design of financial reforms.

I. INTRODUCTION

Credit management has important effects on the availability of investible funds for the private sector and is quite often the cornerstone of financial reforms aimed at increasing investment, and hence, industrial growth rates. In this paper, we examine the potential impact of interest rate policies on investment in the mining and manufacturing sector of Greece.

Financial markets in Greece are not well-developed. The virtual non-existence of markets for bonds and equity results in a situation where the private sector depends on bank credit as its only source of external finance. Bank credit is heavily subsidized, so that both deposit and lending rates set by the Bank of Greece have been predominantly negative in real terms since 1973.

As a result, one would expect credit availability to be restricted, and private industrial investment to be constrained by the shortage of funds. Survey data from firms in the private manufacturing sector as reported in Deleau, et al. (1987), on the other hand, do not indicate this. Most individual firms surveyed do not perceive a funds shortage as restricting investment. In effect, even negative real interest rates do not provide an effective subsidy; this would appear to be somewhat of a puzzle. The "naive" explanation implies that the rate of return on capital has been negative, persistently across firms and types of productive activity; this, however, is difficult to maintain as a consistent explanation.

We argue here that a puzzle arises only if we think of bank credit as the sole source of long-term finance. Consider a firm which operates in a credit controlled environment; in addition to borrowing, the firm can finance its borrowing with corporate savings (retained profits). If borrowing is rationed, time after time, the firm will use profit retention as a source of finance to optimize on its investment outlay. We should visualize this firm as optimizing jointly over its investment budget and profit retention rate, taking into account the credit ceiling and debt servicing costs.

The model of credit-constrained investment financing has rather different implications from a more naive model where firms react passively by setting their investment budget equal to the credit ceiling. In the first place, this argument accounts for the apparent lack of perceived funds constraints which shows up in firm surveys: it simply reflects the fact that firms optimize in their retained earnings decisions. We estimate from aggregate data that a dollar's worth of increased credit availability will finance 96¢ of dividend payments, and only 4¢ of increased investment outlay. That credit availability is not perceived to be a major constraint on investment is to be interpreted as follows: firms would not turn down increases in offered credit at the prevailing interest rates. Yet they would use most of this new borrowing to substitute for retained earnings, and only a negligible part to finance increased investment.

It is easily demonstrated, at a formal level, that a firm which is subject to borrowing constraints will not, in general, equate the return on capital with the interest rate. This entails rather different qualitative effects of interest rate changes on investment outlay. To contrast this with a naive argument, consider for moment firms whose investment decisions are passive relative to borrowing constraints. Figure 1 describes the ex-post investment function in an economy where all firms equate their investment budgets with the level of borrowing. The savings function, $s(r;\cdot)$ determines the amount banks can lend to firms and $i(r;\cdot)$ is the ex-ante investment function. The ex-post investment function $\hat{i}(r;\cdot)$ is the minimum of ex-ante savings and investment. At low interest rates, $\hat{i}_r > 0$. Figure 2 demonstrates the ex-post investment function of firms which choose financing methods optimally relative to a credit constraint. $sh(r;\cdot)$ is household savings, the amount that banks can lend. Corporate savings out of profits is a function $s\pi(r;\cdot)$ which is unambiguously decreasing in r. Investment, both ex-ante and ex-post, equals $i(r;\cdot) = sh\ (r;\cdot) + s\pi(r;\cdot)$. It follows that $i_r < 0$ whenever $sh_r + s\pi_r < 0$. Our point estimates suggest that this is true for investments in the Greek manufacturing sector even for real interest rates as low as -10%.

For our argument to be empirically convincing, we need to establish that corporate savings are at once a major and a discretionary component of investment finance. Figures 3, 4 and 5 illustrate some evidence to this effect. In the first place, Figure 5, we notice that the proportion of investment financed by retained earnings has varied substantially from above 0.8 in the mid-60s to below 0.5 in the mid-80s. In Figures 3 and 4, we see that the time path of corporate savings displays properties very similar to that of investment; this apparent comovement points to its importance as a discretionary source. An important indicator, apparent in Figure 5, is the long-term decline in the role of corporate savings in financing investments. Others, including Tsoris (1984) and Deleau (1987), have noted that the in-debtedness of Greek manufacturing firms is high and increasing. Our argument associates this with declining profitability, and consequent cutbacks in real investment outlay.

The empirical analysis suggests that one of the major determinants of this decline in profitability is the long-term increase in product wage rates in manufacturing. This latter is a natural outcome of government policy measures aimed at increasing the standards of living of workers. The interesting questions to address in this situation deal with the design of financial reforms in the presence of redistributive measures.

A related set of questions, which we do not address here, deal with the role of interest rate subsidies in explaining the non-existence of securities markets. To a great extent, this must be explained by institutional factors, including the legal framework supporting the rights of investors. On the other hand, the availability of subsidized credit can support and perpetuate the existing structure of "family-based" enterprises which do not need to dilute control in order to increase their capital base with equity finance.

We think that questions on the lack of equity-financing are important precisely because of redistributive policy. If equity were a predominant source of finance, real wage increases would generate very different spillover effects on the investment activities of firms. A policy aimed at taking advantage of these effects must focus financial reforms at securities markets, rather than debt markets, which it apprears are anyway of limited effectiveness.

II. MODELLING THE INVESTMENT DECISION

2.1. The Firm; Credit Constraints

We consider a firm which has a given technology, using capital, k, and labor, ℓ, to produce an output, x. Each period, the firm faces a product price, a wage rate, and a price for the investment good. Investment decisions have to be made one period in advance: capital needs time to build. Each period, the firm starts with a given capital stock; it decides on its level of employment, and hence on total output; in addition, it has to decide on the amount of investment, i, so that next period's capital stock is $k' = i + (1 - \delta)k$, with δ as the one period depreciation rate for capital.

Investment is financed by one of two means: long-term borrowing from the banking sector; or retained profits by the firm (corporate savings). We shall assume, for simplicity, that all borrowing in period t has to be fully repaid in period t+1, so that the repayment period equals the time required for building productive capacity. We focus on a situation where interest rates are managed, so that real interest rates are low relative to the possible rate of return on capital; this implies that at the announced rate of interest, the firm is constrained in its borrowing, and can only borrow an amount b, a credit ceiling set by the bank; if it wishes to invest more than this, it must finance it from retained earnings.

The firm is owned by shareholders, who are paid dividends; profits of the firm are either retained to finance new investment, or paid out as dividends. In particular, we abstract from working capital needs, as well as constraints on short-term borrowing. The shareholders have to decide, in each period, simultaneously on the dividend payout rate and the level of investment, taking into account the credit ceiling faced by the firm. In fact, since the bank informs the firm about its borrowing limits, investment and dividend payouts are outcomes of the same decision.

The following identities summarize the basic structure of the problem:

(1) $$\pi = x - w\ell - \bar{b}(1+\bar{r}),$$

(2) $$x = f(k,\ell),$$

(3) $$k' = (1-\delta)k + i,$$

(4) $$qi = b + \pi - d,$$

where the product price is normalized to equal one; q is the relative price of investment goods; w is the real wage rate, r is the real (longterm lending) rate charged by the bank; and b the credit ceiling. Real profits, dividends, and investments are π, d and i, respectively. We denote variables determined in the previous period by "-" and in the following period by "'."

The production function $f(\cdot,\cdot)$ is increasing and concave in both arguments, and displays constant returns to scale. We assume, further, that shareholders care only about real dividend payments, so that x can be thought of as a composite consumption good.

It may be useful to think of the firm's decision as being taken in two steps; it begins a production period with a given capital stock. The firm, which is a price taker in the product and capital markets, first chooses a level of employment. In doing so, it maximizes profits, so that the marginal productivity of labor is equated to the product wage rate. Once profits are realized, the firm has to make a second decision: to split profits into dividends and corporate savings. At this point, the firm needs to know, in addition, the credit ceiling set by the bank, and to anticipate the real wages and the real interest rate it will face in the next period; once this is known, the shareholders know the (expected) contribution of retained earnings to profits in the next period, so that they choose to trade off dividends today for profits tomorrow. In the following Section, we indicate the nature of this optimization problem, and the determinants of investment financing.

2.2. Optimization and Dividend Decisions

A representative shareholder derives utility from dividend income; we summarize his objective function as a two-period utility function:

$$u(d) + v\{\pi' + q'(1-\delta)k'\} \tag{5}$$

where both u and v are increasing and concave in their respective arguments. The two-period representation can be justified either as representing shareholder myopia; or as a representation of a longer term optimization problem via the value function.

Since the firm operates by maximizing profits each period, it must be true that

$$f_\ell = w, \tag{6}$$

so that we can rewrite

$$x - w\ell = h(k,w), \tag{7}$$

with $h_k > 0$; $h_w < 0$. The function h is simply the potential operating profits achievable by the firm with a given capital stock, and facing a given real wage rate in the labor market. It follows that realized profits are operating profits minus effective debt-servicing costs:

$$\pi = h(k,w) - \bar{b}\,(1 + \bar{r}) \tag{8}$$

The budget constraint facing the representative shareholder is thus defined by (8), and, in addition,

$$k' = (1 - \delta)k + (b + \pi - d)/q \tag{9}$$

The firm now chooses its payout policy to maximizing (5) subject to (8) and (9); the optimal payout rule can be written either in terms of dividends or in terms of real retained profits, which is just the residual. Thus, optimal retained profits will be a function.

$$s\pi = \pi - d = s\pi\ \{\pi, k, q, \rho', w', b\ (1+r)\} \tag{10}$$

Notice that in order to implement this decision, the firm has to know the product wage rate in the next period, the inflation rate for its own output, and the inflation rate on capital goods $\rho' = (q'/q) - 1$; in the actual estimation procedure, we use both the "perfect foresight" as well as a "rational expectations" specification to examine the responsiveness of investment decisions.

2.3. Comparative Statics

The function h defines potential operating profits at a given capital stock and wage rate; from the linear homogeneity (constant returns to scale) of the production function, it follows that the rate of return on capital is constant for a given wage rate.

Writing this return as r(w), a decreasing function of w, we have

$$h(k,w) = r(w)k \tag{11}$$

Realized profits next period are then

$$\pi' = r(w')\{(1-\delta)k + (s\pi+b)/q\} - b(1+r') \tag{12}$$

The effective return on investment expenditure each period is

$$r^* = \{r(w')/q\}+\rho'(1-\delta) - 1, \tag{13}$$

It follows that for $r^* < r$, if the effective rate of return on investment is less than the real interest rate, the firm will disinvest, and in particular, will not borrow; since our interest is to model a situation where the interest rate subsidy is effective, and the credit ceiling does in fact bind, we assume that

$$\pi = r < r^* \tag{14}$$

A shareholder thus maximizes

$$u(\pi-s\pi) + v\{(1-\delta)k + (1+r^*)s\pi + (r^*-r)b\} \tag{15}$$

and the first order conditions are

$$u' = (1+r^*)v' ; \tag{16}$$

totally differentiating both sides, we obtain

$$\tau(d\pi-ds\pi) = (1+r^*)\{(1-\delta)/r(w)d\pi + (r^*-r)db + (1+r^*)ds\pi\} \tag{17}$$

with $\tau \equiv u''/v'' > 0$. It follows that

(18) $$ds\pi = \frac{\tau - (1+r^*)(1-\delta)/r(w)}{\tau + (1+r^*)^2} d\pi - \frac{(1+r^*)(r^*-r)}{\tau + (1+r^*)^2} db$$

$$\equiv s_1 \, d\pi - s_2 \, db.$$

The firm's propensity to save, s_1, is less than one. The negative impact of increased credit availability on corporate savings can be understood as follows: if the real rate of return is relatively constant, and higher than the unit cost of debt servicing, firms would like to borrow to finance their entire investment plans. They cannot, so that corporate savings finances the gap; whenever they are allowed to borrow more, this allows them to use current profits to finance a higher dividend payout. Notice that $s_2 < 1$ as long as $r > -1$; and further, that $s_2 > 0$ if and only if $r^* > r$, as we have in fact assumed. The hypothesis $r^* = r$ (firms are not constrained in their borrowing) is thus easily testable, either with aggregate data or with cross-sectional analysis.

The coefficient s_2 indicates the extent to which bank credit in fact subsidizes investment. Notice that for $\tau = 0$,

$$\frac{1}{(1-s_2)} = \frac{(1+r^*)}{(1+r)},$$

which gives us a point estimate of the markup of profitability over the interest factor.

III. DATA ANALYSIS AND EMPIRICAL EVIDENCE

3.1. On Empirical Implications

In the last Section, we modelled the internal decision making by a firm which determines the corporate savings component of its investment; the firm takes into account the fact that it can only borrow up to a preset credit limit, and then determines its total investment budget as borrowing plus own savings. The fact that it is constrained in borrowing alters the nature of its optimal investment. We showed that corporate savings are a decreasing function of total debt-servicing costs, hence, of the real interest rate and of the credit ceiling, even if the real interest rate is zero or negative.

This has important implications for the empirical analysis of the investment decision. In the simplest version of a constrained (or disequilibrium) investment model, the reduced form is derived as follows: total investible funds equals available savings, domestic and foreign, which is an increasing function of the real interest rate, as well as of variables such as disposable income, y; investment expenditure of the firm is a decreasing function of the real interest rate, and depends, in addition, on other factors affecting firm profitability, summarized as z. The equilibrium interest rate, $r_e = r(y,z)$ equates savings to ex-ante investment; if the government, or the banks, which manages the interest rate, offers an interest rate different from r_e ,and in particular, below r_e, the capital market is in disequilibrium, and actual investment is constrained by the availability of savings. This can be written as

(19a) $s = s(r;y)$

(19b) $i = i(r;z)$,

(19c) $\hat{i} = \text{Min}\ \{s(r;y);\ i(r;z)\} = \hat{i}\ (r;y,z)$,

where i is the ex-ante level of investment, and $\hat{i}$ the actual, or ex-post level. Clearly, for r, the administered interest rate, below r_e, actual investment is less than intended; and for this regime, the model predicts, empirically, that $\hat{i}$ is increasint in r and in y. Increasing the real interest rate will loosen the credit constraint on industry, and increase the availability of investible resources. This argument is a simplified version of the model familiar from both the "fixed-price" literature (e.g. Malinvaud (1977), (1982) and the literature on interest rate management (e.g. IMF (1987), referring to the well known Mackinnon-Shaw argument).

This argument envisages firms which formulate their investment decision a priori, and are then faced with a credit ceiling, time after time. On the other hand, firms which operate in a perpetually credit constrained environment are likely to take this into account when making their investment plans, and to organize their investment and financing decisions of this basis. The model of the previous section describes the nature of the constrained investment decision. To write the comparable reduced form for this model, we decompose total private sector savings into two components: household savings, sh, and corporare savings, sπ. This distinction is important precisely because interest rates are managed, which drives a wedge between the return on debt, the bank rate, and the return on equity, the rate of return on capital.

Household savings respond to r, the bank rate, as well as to personal disposable income, y. (Strictly speaking, y should include income from sources other than profits.) All household savings are held as bank deposits, which can be lent out to firms to finance investment; ignoring reserve requirements for the moment, this represents the credit ceiling set by the banking sector as a whole. Firms finance investment with borrowing and with corporate savings; corporate savings depend on current profits, on the credit ceiling and the bank rate, as well as on factors z which determine the rate of return on capital internal to the firm; ex-ante constrained investment is equal to available credit plus corporate savings:

(20a) $$sh = sh(r;y),$$

(20b) $$b \leqq sh,$$

(20c) $$s\pi = s\pi\{b(1+r);\ \pi, z\}$$

(20d) $$i = b + s\pi.$$

When the credit constraint is binding, i.e. b = sh, we can write the investment function in reduced form as

(21) $$i = sh(r;y) + s\pi\ \{sh(1+r);\ \pi, z\}.$$

It follows that

(22) $$i_{(1+r)} = sh s\pi_{b(1+r)} + (1+r)sh_{(1+r)} s\pi_{b(1+r)} + sh_{(1+r)}.$$

Envidently, i_r can be negative, and is strictly decreasing in y. Writing $\varepsilon(sh)$ as the interest elasticity of household savings, and $\varepsilon(i)$ as the interest elasticity of private investment, we have

(23) $$\varepsilon(i) = \alpha\{\varepsilon(sh) + s\pi_{b(1+r)}\ (1+ \varepsilon(sh))(1+r)\}$$

with α the proportion of total private savings held by households; it can be seen that at $r = 0$ $\varepsilon(i)$ is negative if

$$(24) \qquad \varepsilon(sh) < - s\pi_{b(1+r)}/(1+s\pi_{b(1+r)}).$$

Part of our interest in the empirical exercise is to focus on the differential impact of relaxing credit ceilings. If this change is autonomous, (e.g. funded by a net capital inflow), the net effect is to increase investment by a factor of $(1-s_2)$, which can be estimated from a direct estimate of equation (18). On the other hand, if this is induced by an increase in real interest rates, the net effect has to incorporate the effect of increased debt-servicing costs faced by the firm; and, as equation (23) shows, this is likely to reduce total investment. We estimate $s\pi_{b(1+r)}$ and $\varepsilon(sh)$, and from there, the implied interest elasticity of investment.

3.2. On Data and Trends

For the present, we concentrate on patterns of investment in the aggregate mining and manufacturing sector. All data are from the OECD *Economic Surveys for Greece* (1965)- (1987), which in turn is computed from raw data provided by the Bank of Greece. One of the problems is that direct data for corporate savings (either levels or rates) is not available; from 1967 onwards, the National Income Accounts of Greece includes business savings in the category of private sector and household savings, i.e. the residual after consumption and public savings. It is generally believed that "... the relatively small decline in private savings seems to conceal two divergent trends. Household savings appear to have increased since 1980, whereas business savings have fallen markedly" (OECD (1985).

We estimated the corporate savings component as the increase in nominal gross capital formation in mining and manufacturing, minus the increase of long-term lending by the banking and financial services sector; clearly, this makes two implicit assumptions; first, that the financing of long-term investment projects is obtained either from the banks or from corporate savings (including any possible inter-firm credit); and second, that all long-term lending is in fact spent on gross investment. There is some empirical basis for the first kind of assumption. Tables 1 and 2 below report recent data on the financing of investment in the Greek economy; Table 1 reports the sources of financing for aggregate investment, and Table 2 the sources of external finance for the private sector.

TABLE 1

Investment and its Financing as % of Resources Available for Investment

	1981	1982	1983	1984	1985
Net Lending from Abroad	24.4	20.7	23.5	29.5	39.5
Private Sector Savings	109.7	110.3	105.1	107.3	105.5
Public Sector	-34.1	-31.0	-28.5	-36.8	-45.0

TABLE 2

Financing the Private Sector as % of Total

	1982	1983	1984
Bank Credit	86.9	80.2	79.3
Short-term	(46.0)	(38.9)	(42.1)
Long and Medium-term	(40.9)	(41.3)	(37.2)
Security Issues, Net	00.2	00.3	00.7
Net Capital Inflows from Abroad	12.9	19.5	20.0
Real Estate	(9.7)	(13.3)	(14.2)
Business	(5.1)	(5.7)	(4.4)

The Tables demonstrate that the only source of financing available to private firms other than bank loans is foreign capital; we have ignored this component in calculating corporate savings. Apart from being of a small order of magnitude, some of this capital inflow is in the form of ownership, and is likely to be closely approximated by a proportional factor of corporate savings.

The next Table shows the average long-term lending rates for industry, the inflation rate in product prices, and the ex-post real interest rate. As evident from this Table, real interest rates have been largely negative from 1972 onwards.

TABLE 3

Interest Rates

Year	Lending rate %	Forward inflation %	Real interest rate (ex-post) %
1961	7.500000	1.458097	5.955072
1962	7.500000	1.676595	5.727380
1963	7.500000	1.766801	5.633663
1964	7.500000	3.009296	4.359513
1965	7.500000	3.483105	3.881692
1966	7.670000	1.628697	5.944485
1967	8.000000	-0.213671	8.231258
1968	8.000000	2.569604	5.294352
1969	8.000000	4.384100	3.464033
1970	8.000000	1.800001	6.090372
1971	8.000000	3.339899	4.509489
1972	8.000000	18.25100	-8.668848
1973	8.830000	22.58840	-11.22325
1974	10.83000	9.114801	1.571921
1975	11.00000	12.86060	-1.648583
1976	11.00000	11.23540	-0.211624
1977	11.00000	8.568705	2.239407
1978	11.58000	18.16580	-5.573356
1979	13.58000	24.32840	-8.645168
1980	17.25000	22.95920	-4.643166
1981	18.50000	18.96510	-0.390954
1982	16.50000	21.09150	-3.791760
1983	18.50000	20.16270	-1.383708
1984	18.50000	18.10490	0.334533
1985	18.50000	25.25070	-5.389751

- Inflation refers to manufactured goods prices.
- Long-term bank lending rates from Deleau (1987).

Figures 3-6 show trends in the calculated coprorate savings component over time, real and nominal and relative to investment and to revenue. The negative trend in the corporate savings rates is clearly discernible in Figures 5 and 6. Figures 7 and 8 show trends in variables which are exogenous to the investment decision: factor prices and the real cost of borrowing.

3.3. Emprirical Analysis

We estimate the parameters of the corporate savings function in two versions. In the first version, we estimate directly the linearized version of the reduced form specified by (10), or equivalently, (20.c). This yields a point estimate of the parameter $s_{b(1+r)}$, while direct estimation of (20.a) yields estimates for the interest elasticity of savings, i.e. $\varepsilon(sh)$. We can use this to simulate the interest elasticity of investment expenditure at different real interest rates.

In the second version, we use the approximation suggested by equation (18). The long-run, or steady state corporate savings decision depends on profits and the availability of credit; the estimation yields a point estimate of s_2, and hence, the long-run response of investment to changes in credit availability as $(1-s_2)$; this also gives us an approximation to the interest subsidy factor. We then model the deviation from the steady state corporate savings level as an adjustment process, affected by anticipations of the real wage rate and the interest rate. Even though constraints on the availability of data preclude more ambitious modelling at the moment, there is strong evidence that these deviations (or equilibrium errors) have some persistence over time, even though they dissipate in the long run. This means, for example, that a large increase in the real wage rate leads to a cutback in current investment expenditures, and this negative effect persists for a few periods, leading to investment cutbacks in subsequent periods as well.

Table 4 reports the results of the analysis of the corporate savings function. We used real revenues (i.e. value added deflated by a product price index) to approximate profits, because of the unavailability of reliable data on sector specific profits in the private sector. A first order moving average term is incorporated to account for possible effects generated by capital accumulation, since real investment is endogenous. As it turns out, this is not statistically significant. Equation 1.1 estimates the relation with the assumption of perfect foresight; Equation 1.2 reports the results of a "rational expectations" assumption, so that real wages and ex-post real interest rates are correctly anticipated on average, given current information. The estimation technique is Instrumental Variables; the current real wage rate and real interest rate are used as instruments.

TABLE 4

The Corporate Savings Function Estimates for 1962-1986

Coefficients
(t-ratios)

cs	c	rev	b(1+r)	w'	q	MA	R^2	D-W
Eq 1.1 (OLS)	0.1754 (3.95) *	0.2570 (5.87) *	-0.4309 (1.89) **	-0.0486 (1.96) **	-0.148 (3.39) *	0.18 (0.68)	0.87	1.94
Eq 1.2 (IV)	0.1433 (1.48) *	0.3021 (7.35) *	-0.3089 (2.33) *	-0.0820 (3.35) *	-0.1120 (1.06)	0.10 (1.09)	0.81	1.87

- All variables deflated by product price index.
- * = significant at 5%; ** = singificant at 10%.

Equation 1.1, i.e. the perfect foresight hypothesis, yields a point estimate of 0.4309 for $s\pi_{b(1+r)}$, whereas the rational expectations hypothesis Equation 1.2 yields 0.3089. In both versions, initial estimation with "rho" (capital goods inflation) showed that its coefficient was statistically in-significant from zero.

To complete this version, we estimate an equation representing the interest elasticity of credit availability; i.e. the responsiveness of long-term lending by banks to the mining and manufacturing sector to variations in the real interest rate. We estimate in log-linear form, to get direct point estimates for $\varepsilon(sh)$; as before, we estimate the perfect foresight Equation 2.1 and rational expectations Equation 2.2 versions. In both versions, the interest elacticity parameter is not significantly different from zero, even though we will use the point estimates to simulate the interest elasticity of ex-post investments. We have used the log of personal disposable income for the income variable.

TABLE 5

Credit Availability Estimates 1964-1986

Coefficients
(t-ratios)

Log(b)	c	Log(y)	Log(1+r)	R^2	D-W
Eq (2.1) (OLS)	-5.4760 (12.85) *	2.0690 (5.64) *	0.4077 (0.20)	0.79	1.73
Eq (2.2) (IV)	-5.4360 (3.75)	2.0342 (3.67)	0.1376 (0.02)	0.71	1.72

- * = significant at 5%.

Table 6 reports results of simulations for $\varepsilon(i)$, the interest elasticity of total investment, with $\alpha = 0.33$, the sample average for bank lending as a proportion of total investment.

TABLE 6

Simulations for $\varepsilon(i)$ Estimated Interest Elasticity of Investment

Real Interest Rate	(1)	(2)
-0.10000000	-0.04561265	-0.05895918
-0.05000000	-0.05562118	-0.06475735
0.00000000	-0.06562972	-0.07055553
0.05000000	-0.07563825	-0.07635371
0.10000000	-0.08564679	-0.08215188
0.15000000	-0.09565532	-0.08795006
0.20000000	-0.10566386	-0.09374824
0.25000000	-0.11567240	-0.09954641
0.30000000	-0.12568093	-0.10534459
0.35000000	-0.13568947	-0.11114277
0.40000000	-0.14569800	-0.11694094
0.45000000	-0.15570654	-0.12273912
0.50000000	-0.16571508	-0.12853730

\- (1) Uses OLS Point Estimates Eqs. 1.1, 2.1.
(2) Uses IV Point Estimates Eqs. 1.2, 2.2.

\- $\alpha = 0.33$ for both.

As is evident from this, the interest elasticity of total investment is negative, even at real interest rates as low as -10%, for both sets of point estimates. We had essentially the same results when simulations were done for actual levels of r and of α; these are not reported here but yielded negative estimates for the entire period 1964-1986.

It may be useful to compare this with a direct estimate of the interest elasticity of investment in the private manufacturing sector. To do this, we estimate the reduced form in log-linear form; the estimates are reported in Table 7 below. We included, as before, the log of personal disposable income, which affects credit availability; in addition, we included a measure of real wage increases, dlog(w); the coefficient of this turns out to be positive, which possibly captures the "income effect" of real wage increases on investment. In addition, it appears that investment "overreacts" to current inflation: equation 3 demonstrates the fact that inflation has a positive effect on real investment over and above its effect on the real cost of debt-servicing.

TABLE 7

The Investment Function

Log(i)	c	Log(rev)	Log(y)	Log(1+r)	Dlog(w)	Log(1+inf)	MA(1)	MA(2)
Eq3	-0.161	1.882	-1.201	-1.94	2.519	0.996	0,17	-0.06
(OLS)	(0.27)	(5.112)	(3.246)	(2.689)	(3.921)	(2.201)	(0.55)	(0.18)

$R^2 = 0.947$; D-W = 1.94

The estimate of the interest elasticity of investment is -1.94, which is considerably higher in absolute value than our simulations in Table 6. We had used the point estimates for the interest elasticity of bank credit,even though this was statistically insignificant; setting this equal to zero yields estimates of $\varepsilon(i)$ much closer to the estimate here: the average value is -1.654 for the sample period.

For the second empirical version, we estimated the "steady state" relation between real corporate savings, profitability and borrowing as follows.

TABLE 8

Corporate Savings: The Long Run
(1963-1986)

Coefficients
(t-Ratios)

cs	c	rev	b	MA(1)	MA(2)	R^2	D-W
Eq. 4	0.1457	0.1772	-0.9591	0.82	0.20	0.81	1.93
(OLS)	(1.45)	(2.29) *	(4.86) *	(2.21) *	(0.46)		

* = Significant at 5%.

This estimation yields a point estimate for s_2 which is 0.9591; thus, the effect of an autonomous increase in credit availability on investment is measured as 0.0409. In addition, the size of the estimated coefficient suggests that, on average, the private sector expects a very large effective subsidy rate on its borrowing -- the point estimate is 24.4, with the approximation of τ =0. The next and final Table reports a simple dynamic version of the process of adjustment. Suppose cs*(t) = i*(t)-b(t) is the "steady state" level of intended investment; define dcs(t) as the discrepancy between actual and intended levels of corporate savings. We model the current discrepancy as responding to past levels of discrepancies (following from dynamic error correction rule) and to current shocks. We restrict the dynamic specification to a first-order autoregression, whereas current values of q and (expected) real wages represent shocks in factor prices. We are unable to employ an appropriately richer specification because of the small number of observations.

TABLE 9

The Adjustment Process for Corporate Savings

Coefficients
(t-Ratios)

dcs	c	dcs(-1)	w'	w	q	(1+r)	R^2	D-W
Eq.5.1 (OLS)	0.1583 (1.88) **	0.3991 (1.79) **	-0.0126 (1.24)	...	-0.0214 (0.54)	-0.1125 (1.70) **	0.53	1.87
Eq.5.2 (IV)	0.1616 (2.16) *	0.3785 (1.85) **	...	-0.0190 (2.54) *	...	-0.1342 (2.01) **	0.53	1.87

* = significant at 5%; ** = significant at 10%.

Equations 5.1 and 5.2 underline the relative importance of persistence in deviations from the steady state via the autoregressive term. At this point we have basically 19 points of data, whereas the estimation of "error correction" models of adjustment to equilibrium need much larger parameterizations, and a correspondingly large data set. We use this last version as essentially indicative in nature; it can set up a framework to measure the longer run effects of changes in real wages and in real interest rates.

IV. CONCLUSIONS

We analyzed the investment decisions of firms subject to a borrowing constraint. It is widely believed that the low and particularly negative lending rates maintained by the banking sector in Greece have generated severe constraints on the availability of credit, and this may have accounted for the actual decline in real investment in the manufacturing sector.

If borrowing is indeed the major constraint on investment expansion, we should expect to observe an increase in corporate savings rates, and hence a decline in the ratio of borrowed funds to total investment. This, in fact, is not what happened. Aggregate data clearly demonstrate the rise in the "debt:investment"ratio; analysis of cross-sectional data (at the two-digit level of classification) by Tsoris (1984) bears out that, for the period 1958-81, there was an increase in this ratio, on average. Most of this was accounted for by major declines in the retained earnings rates of a few industries, which are precisely the ones to report secular declines in their profitability rates.

This analysis suggests, fairly naturally, that interest rate management will be of limited effectiveness in increasing investment. We say limited because, at the aggregate level, the empirical exercise predicts a negative effect, even though more detailed analysis of industry specific data would show up the differential effects on individual industries. When firms are credit constrained, the rate of return on capital, r^*, is in general not equal to the interest rate; this can also vary quite substantially between industries. As a result, the effect of interest rate increases can differ, at the margin, across industry groups, and quite substantially so.

The analysis entailed that the interest elasticity of investment depend on the interest elesticity of household savings. Our estimates of this parameter are small and statistically insignificant. Elsewhere, Giovannini (1985) found more or less the same fact with a large cross country study. There is one caveat to keep in mind: one presumes that the real interest rates in our study were significantly lower than the "world" rate; if the increase in the domestic rate allows it to catch up with the world rate, there should be a (discontinuous) jump in credit availability, at least in theory, because of the inflow of foreign capital; presumably $\varepsilon(sh)$ is infinite at this point. Alternately, we may think of this analysis as locally valid for r^* less than the world rate.

In an earlier paper, Wijnbergen (1983) also suggested that increases in the bank rate need not increase investment in the "medium-run". The argument there was based on the supply of loanable funds: if households can lend directly to firms -- in other words, if an unorganized money market provides secondary financial intermediation -- the total funds available for investment can actually decrease if they go through banks which must observe reserve requirements. Our argument is more directly on the ex-ante investment decisions of firms; among other things, the short run effect will in fact persist, and does not peter out in "long run" analysis.

This, of course, begs the question of why profitability rates have been decreasing, in spite of a fairly long period of declining investment.

The analysis shows that the long-term increase in the product wage rates must be one of the important factors, both in terms of statistical explanatory power in alternative parameterizations as well as by its persistence over a fairly long period. This is a consequence of directly redistributive policies followed by a succession of governments. A major policy instrument in this has been expansion in public sector employment at rising real wages.

The interesting questions that this analysis opens up relate to optimal or effective methods of financial reform which complement redistributive policy. In particular, we know, at least in theory, that in the presence of full equity markets, an increase in the wage bill can generate positive income-effects on investment. It is possible that the transition to perfect capital markets can be more effectively achieved with reforms in equity, as opposed to debt markets, when accompanied by redistributive policies.

FIGURE 1

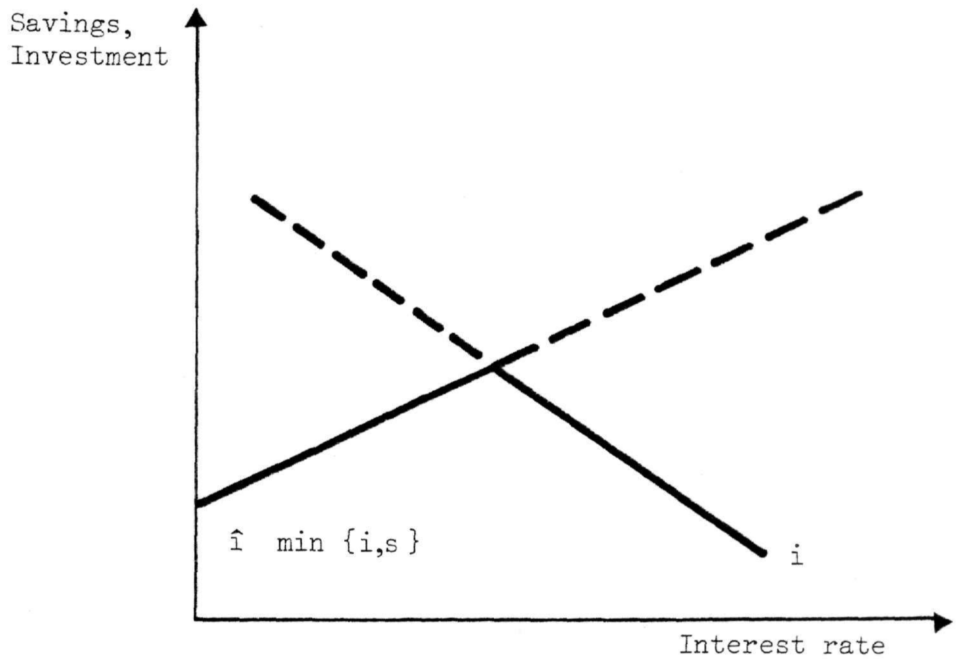


FIGURE 2

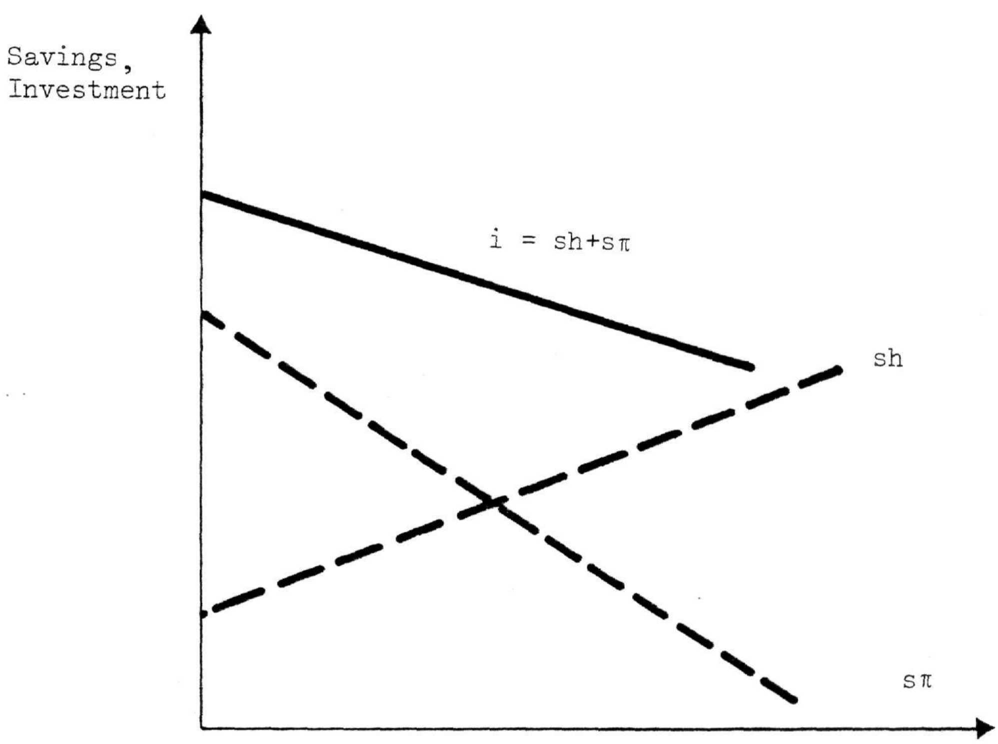


FIGURE 3

Investment and Corporate Savings:Mining and Manufacturing

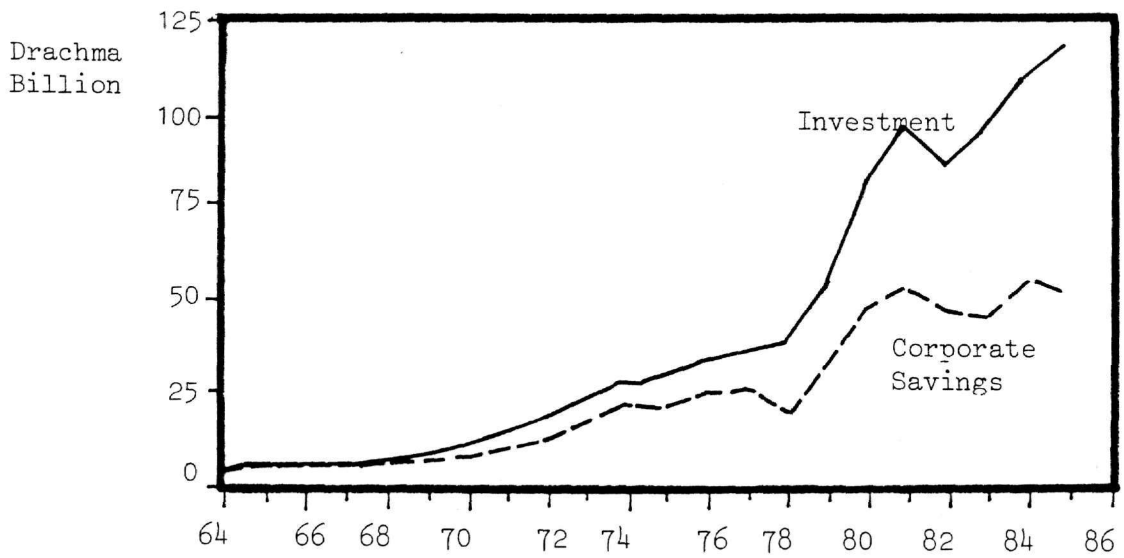


FIGURE 4

Real Investment and Corporate Savings (1970 prices)

FIGURE 5

Corporate Savings as a Percentage of Investment

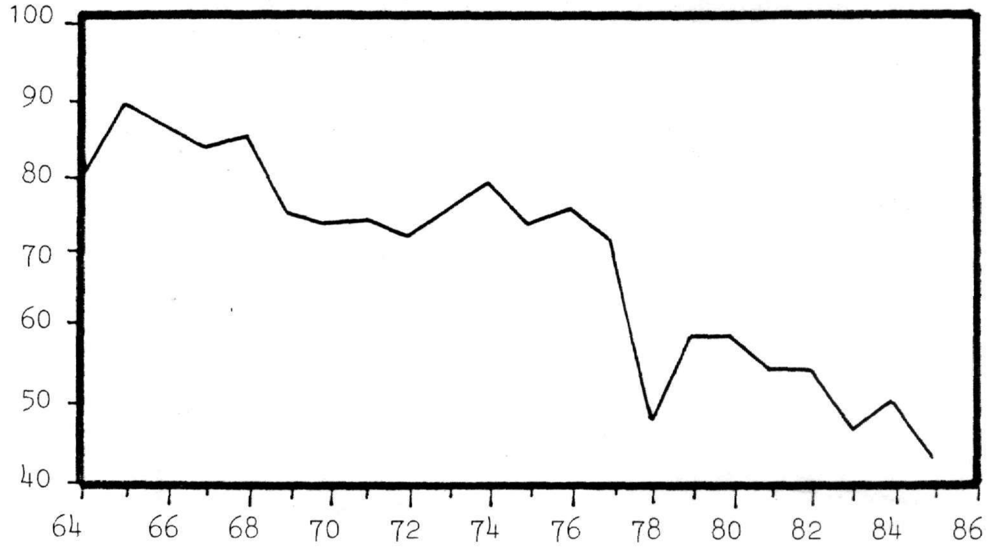


FIGURE 6

Corporate Savings as a Percentage of Revenue

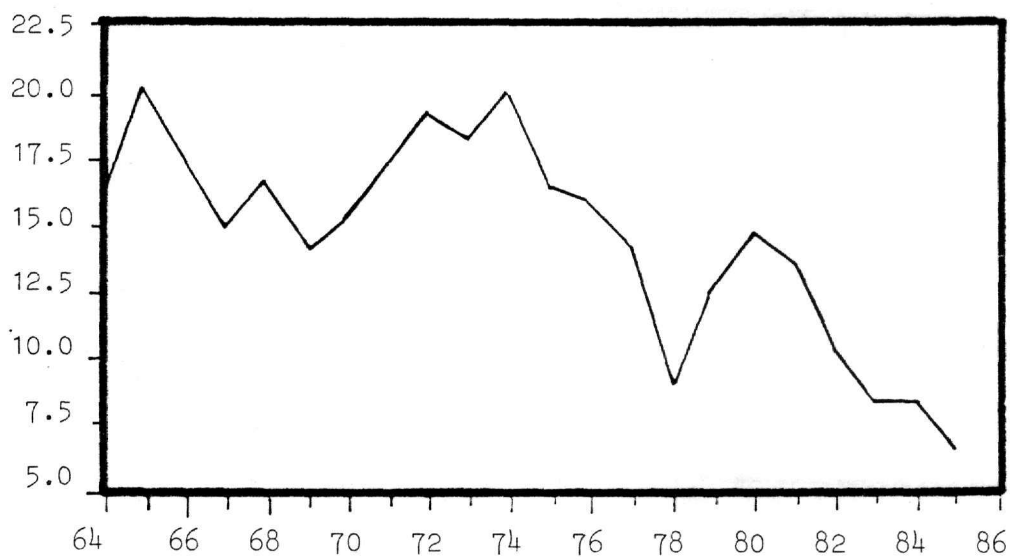


FIGURE 7

Real Wages (Nominal Wages/Product Price)

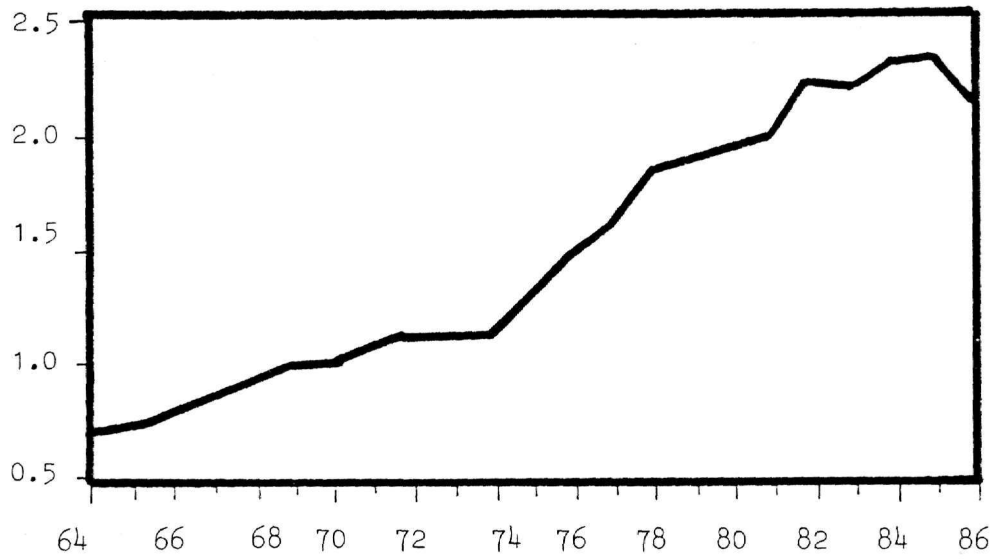
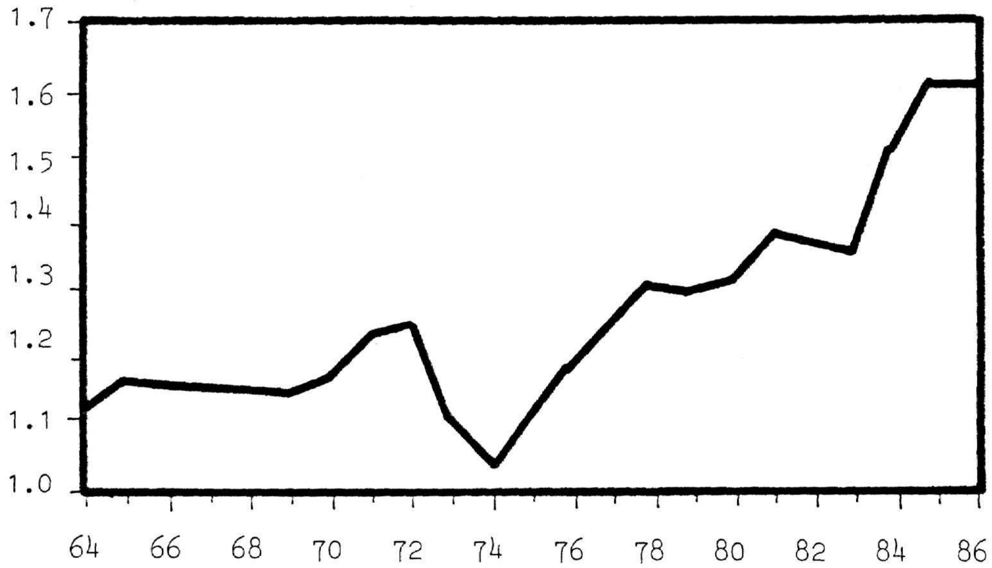


FIGURE 8

Relative Price of Capital Goods



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