Determinants of Sectoral Investment in A Developing Capital Market Economy*

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I. Introduction

A significant amount of literature has been written presenting the theoretical arguments relating to private fixed investment behavior on a macro basis. In most cases, the models developed evolve around the basic hypothesis stating that well functioning financial markets are performing the function of allocating funds based on the competitive pricing mechanism which establishes the market clearing interest rate. The general theoretical approach treats private fixed investment as a function of output, the level of lagged capital stock and/or the level of interest rates. In the case of developing economies, the basic theoretical models have to be modified to take into consideration the institutional rigidities and the weaknesses relating to capital markets (Billsborrow).

Some of the most recent literature makes references to the underdevelopment and inefficient operation of capital markets in some developing countries. James R. Tybout, who studied the issue at the micro level for Colombia, states that "·· in developing countries, extensive financial market interventions are often employed to promote growth in key sectors, funnel revenue to government and appease anti industry sentiments" (Tybout, 1983). Referring to McKinnon. Tybout further states "... that were inflation, interest controls and directed credit programs

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foster credit rationing, investment projects do not exhibit uniform returns at the margin. Instead, patterns of capital formation will reflect the fact that a favored enclave of firms enjoys access to credit at negative real costs, which other firms must rely nearly exclusively on internally generated funds" (Tybout, 1983).

Similar suggestions are made by others such as Evans regarding the economy of Israel, Corbo Lioi regarding Chile, Vernadakis, Tsoris and Halikias regarding the capital markets of Greece. Vernardakis, relating to the Greek economy, which is the emphasis of this study, states that the banking system is an oligopoly that has interfered with attempts to create a modern capital market. He further states that only the largest firms are backed by financial groups and that it is difficult for small or medium sized enterprises to borrow long or medium term and "···that credit rationing by the banking system with respect to the different sectors of the economy is far from optimal" (Vernardakis). Tsoris reinforces some of the above arguments by stating that "···for the whole economy we believe that the long-term credit is supply determined" (Tsoris). More recently, Halikias refers to the oligopolistic and non-competitive character of the banking system of Greece and further states that "···the Greek banking system has been and will continue to be, central in channeling savings to productive investment as long as the private capital market remains underdeveloped" (Halikias). He discusses the institutional arrangements and states that the Central Bank (Bank of Greece) sets the terms and guidelines for credit allocations, fixes the interest rates on loans and savings, sets the terms of loans, and controls the allocation of credit to the different sectors of the economy (Halikias). Halikias discusses extensively the imperfection prevailing in the Greek credit market and its oligopolistic character and its favoritism towards the big industrial enterprises.

Therefore, for the typical developing economy like Greece, the institutional rigidities and the relatively "immature" capital market structure with supply of capital constraints, private fixed investment behavior is expected to be different than that observed in advanced economies with relatively efficient capital markets. The allocation of financial resources is not likely to be a reflection of supply and demand conditions for loanable funds but rather may be a reflection of the allocative mechanism established by the

government (Central Bank), intervention by political favoritism, and by the imperfections and biases of the banking industry. Encompassed in government intervention are the interest rate controls, the setting of allocation guidelines for sectoral credit allocation, and the foreign exchange controls.[1] Among the biases of the banking industry, one notes the favoring of larger enterprises and preference for short-term versus long-term lending.

Even if profit maximization required additional investment, given the weaknesses of the capital market, the individual deciding to carry out an investment project is not guaranteed an equal opportunity to compete for long-term credit. This is a reflection of the institutional price fixing, favoritism, and government control of credit allocated to different industries. Interest rates typically do not reflect the conditions of demand and supply for loanable funds and for most of the period the real interest rate is negative resulting in excessive demand. It is hypothesized here that the supply of credit or the credit allocation decisions partially determine the level of private fixed investment in the different sectors of the economy. Therefore, when the capital markets are operating with rules that are not a reflection of the standard allocative market behavior which determines the cost of capital, these rules do not serve fully the allocative function. Thus investors face capital constraints that are unique in economies with developing capital markets.

Given the character of the financial markets of economies like Greece, this paper proposes to test the following relationships regarding determination of private fixed investment behavior: First, it is assumed that the primary source of investable funds for the current period must be the net retained earnings of enterprises in the previous period (which is determined by last year's production), and the expected net retained earnings of the current period. This assumption is especially true in developing capital market economies, such as Greece, where the institutional rigidities mentioned and the preference for short-term financing requires that most of the potential investors depend primarily on internal financing. Second, private fixed investment is hypothesized to be partially determined by the long-term credit allocated in

[1]Behram (1972) concludes that in the developing economy of Chile "... government can induce increased physical capital investment" through market intervention.

each sector. This proposition reflects our contention that the capital markets are operating inefficiently. In other words, private fixed investment decisions are impacted by supply of credit factors. Third, foreign capital inflows for investment purposes should be affecting the private fixed investment behavior, at least in some sectors of the economy, for it is likely to supplement domestic savings and fixed investment. As suggested in the literature,[2] net foreign capital inflows increase the amount of savings (directly and indirectly) and the availability of foreign exchange which may be used partly for the importation of foreign capital goods. As foreign investment increases it is likely to stimulate real incomes, productivity, employment, domestic private savings, and may encourage additional investments in other industries through induced demand. This may be reinforced, in a country like Greece, by the controls and regulation in the export of foreign exchange. Although there is the possibility that foreign capital may partly or in total substitute for domestic investment, depending upon government investment policy, domestic technological level, domestic emphasis on exports or import substitution, etc., it is not likely if the investments complement domestic investment. As stated by Meier.

> "Once foreign investment has been attracted, it should be expected to have an income effect that will lead to a higher level of domestic savings. This effect may be offset, however, by a redistribution of income away from capital if the foreign investment reduces profits in domestic industries. The consequent reduction in home savings would then be another indirect cost of foreign investment. But it is unlikely to be of much consequence in practice, for it would require that foreign investment be highly competitive with home investment. In a poor country, it is more probable that foreign capital will complement domestic investment and will give rise to higher incomes and profits in other industries, as already noted."

Therefore, given the domestic capital constraints and the overall economic structure of a developing capital market economy, it is hypothesized here that foreign capital inflows may be a determinant of private fixed investment behavior.

[2] For an extensive discussion on the costs and benefits (effects) of foreign investment see Meier, pp. 322-330.

We test these propositions estimating an aggregate investment function and alternatively estimating equations independently for the five disaggregated sectors (manufacturing, mining, construction, agriculture, and services). For the purpose of our study, the economy of Greece is used in testing our hypotheses. The results of our estimations and analysis allow us to state that there is some evidence favoring our propositions. Both long-term credit allocated and foreign capital inflows seem to play a significant role in determining private fixed investment.

II. The Empirical Model

To study the possible relationship between long-term credit allocation and/or foreign capital investment and private fixed investment behavior, we specify our function using as a basis of the flexible accelerator principle[3] and modify it to reflect the propositions tested. Net investment (I_t^n) for any given period depends on the gap that exists between the desired level of capital stock (K^*_t) of profit maximizing investors, and the actual level of the capital stock that is observed during the previous period.

Therefore,

$$(1) \qquad I_t^n = \alpha(K_t^* - K_{t-1}) \quad , \quad 0<\alpha<1$$

and since the desired capital stock for the current year is determined by expected production of the following period,

$$(2) \qquad K_t^* = \beta Y_{t+1}^* \quad , \quad \beta>0$$

Assuming that investors form expectations based on the past and future (Echaus), we apply the following adaptive expectations hypothesis and specify expected production for next period

(Y_{t+1}^*) as[4]

[3] See Tsoris for a detailed discussion on the applicability of such principle in the context of Greece.

[4] This basic model framework was also used by Kostakopoulos.

$$(3) \qquad Y^*_{t+1} = \gamma_0 + \gamma_1 \ Y_{t-1} + \gamma_2 \ (Y_t - Y_{t-1})$$

If we now substitute K^*_t and Y^*_{t+1} into equation (1) we derive the net private fixed investment function which reflects Schiantarelli's conclusion that "investment is a forward-looking process in which expectations about the future are crucially important." (Schiantarelli).

In other words,

$$(4) \qquad I^n_t = \alpha\gamma_0 + \alpha\gamma_1 Y_{t-1} + \alpha\gamma_2 \ (Y_t - Y_{t-1}) - \alpha K_{t-1}$$

and since gross fixed investment is given as

$$(5) \qquad I_t = I^n_t + D_t$$

where D_t is the value of depreciation of capital and where

$$(6) \qquad D_t = \delta \ K_{t-1}$$

adding D_t to both sides of the equation we obtain the equation of gross fixed investment as

$$(7) \qquad I^n_t + \delta \ K_{t-1} = \alpha\gamma_0 + \alpha\gamma_1 \ Y_{t-1} + \alpha\gamma_2 \ (Y_t - Y_{t-1}) - (\alpha - \delta)K_{t-1}$$

substituting (6) into (5) we have

$$(8) \qquad I_t = I^n_t + \delta \ K_{t-1}$$

and by renaming the coefficients of equation (7) we obtain

$$(9) \qquad I_t = \gamma^*_0 + \gamma^*_1 \ Y_{t-1} + \gamma^*_2 \ (Y_t - Y_{t-1}) + \gamma^*_3 K_{t-1}$$

where $\gamma^*_1, \gamma^*_2 > 0$ and $\gamma^*_3 < 0$

In order to incorporate and test our propositions, we modify

equation (9) to reflect our hypotheses (to be tested) that in a developing capital market economy -- that is capital constrained by its nature — the supply of capital decisions (long-term credit allocation to various sectors) and inflows of foreign capital resources are the primary explanatory variables of private fixed investment. The implication here is that, given the institutional rigidities that create excess demand for credit conditions, the amount of physical capital investment of primarily determined by supply of capital factors. The major issue involving investment decisions relates to the availability of investment financial capital rather than the previous years capital stock. Therefore, our modified general private fixed investment equation is expressed as

$$(10) \quad I_{i,t} = \varepsilon_0 + \varepsilon_1 Y_{i,t-1} + \varepsilon_2 (Y_{i,t} - Y_{i,t-1}) + \varepsilon_3 C_{i,t} + \varepsilon_4 FI_t + \varepsilon_5 DPOL + u_{i,t}$$

where the coefficients satisfy the conditions ε_1, ε_2, ε_3, $\varepsilon_4 > 0$ and

$I_{i,t}$ = private fixed investment in current period in sector i
$Y_{i,t}$ = gross domestic product in current period in sector i
$C_{i,t}$ = long-term private credit allocated in current period in sector i

FI = foreign capital inflows for investment purposes[5]
DPOL = a dummy reflecting political changes that affect investment behavior
$U_{i,t}$ = error term

The general formulation (equation(10)) is used in our study to estimate the aggregate investment functions and independently each of the five disaggregated sectors (manufacturing, mining, services, agriculture, and construction). Alternative specifications were also applied and the empirical results are presented in the next section.

[5] FI represents the inflow of capital from abroad under law 2687/53 which provides protection and incentives for foreign investors to Greece. Only a part of the overall inflow of foreign capital is reflected in FI and thus it serves as a proxy for domestic private fixed investment by foreigners.

III. Empirical Results

A. Data

We use annual time series data for all variables used in our estimations. The sample period is 1953-1981. The variables are expressed in real terms (1970 = 100) and are measured in millions of drachmas (drks). The data have been collected from the *National Accounts of Greece and the Statistical Yearbook of Greece,* both published by the National Statistical Service of Greece, and from the *Monthly Statistical Bulletin* and the *Annual Report of the Governor* published by the Bank of Greece. A detailed description of variables in estimated equations is presented in Table 1.

Our estimation of the parameters of equations (10) and of alternative specifications for all sectors tested use the traditional estimating procedure — Ordinary Least Squares (OLS). When the OLS regression results indicate some serial correlation in the residuals, based on the estimated value of the Durbin-Watson statistic, we employ a Maximum Likelihood procedure assuming first order serial correlation in the disturbance term.

B. Results of Total Private Fixed Investment Estimations

The basic total private fixed investment stochastic function estimated proposes that lagged national production (Y_{t-1}) and the change in the national production from the last period ($Y_t - Y_{t-1}$), in addition to total long-term private credit allocated (CT)and foreign capital inflows (FI), are the primary explanatory variables. All variables are expected to be positively related to the dependent variable. Thus our aggregate investment function, which reflects equation (10), is expressed as follows:

$$IT = a_0 + a_1\ Y_{t-1} + a_2\ (Y_t - Y_{t-1}) + a_3\ CT + a_4\ FI$$

$$+ a_5\ DPOL + u_6\ ,\quad a_1, a_2, a_3, a_4 > 0$$

A close examination of the results of equation (1) reported in Table 2, indicates that both long-term credit allocated and foreign capital inflows, in addition to change in production since last period, are statistically significant at the 0.05 level. The

Table 1

DEFINITION OF VARIABLES IN ESTIMATED EQUATIONS

Variables	Definition*
IA	Gross private fixed investment in agriculture, animal and fishing industries
IC	Gross private fixed investment in construction (dwellings)
IM	Gross private fixed investment in manufacturing
IMI	Gross private fixed investment in mining and quarrying
IS	Gross private fixed investment in service industries
IT	Total gross private fixed investment in overall economy
CA	Long-term private credit to economy, agriculture, animal and fishing industries
CC	Long-term private credit to construction of dwellings
CM	Long-term private credit to manufacturing
CMI	Long-term private credit to mining industries
CS	Long-term private credit to service industries
CT	Total long-term private credit
DPOL	Dummy for political changes; 1967 = -1, 1968—1969 = +.50, 1974—1975 = -1, 1981 = -1
FI	Foreign private fixed investment — capital flows based on law 2687/53
RA	Nominal interest rate for medium and long-term loans to agriculture
Y	Gross domestic product
YA	Gross domestic product of agriculture, forestry and fishing
YD	Personal disposable product of manufacturing industry
YM	Gross domestic product of manufacturing industry
YMI	Gross domestic product of mining and quarrying
YS	Gross domestic product of service industries

* All in mil. drks. and in real terms (1970 = 100) unless specified otherwise.

Table 2

ESTIMATED COEFFICIENTS FOR TOTAL PRIVATE FIXED INVESTMENT (IT)

Equation	CONSTANT	Y_{-1}	(Y_t-Y_{t-1})	Y	CT	FI	DPOL	R^2	D.W.	F-Stat.
1	-288.256 (-0.06)	0.0679 (1.36)	0.4084 (2.74)*		0.4311 (2.21)	3.6411 (2.93)*	2683.37 (1.14)	.97	1.89	173.55*
2[1]	2606.56 (0.46)	0.0622 (0.94)	0.3791 (2.60)*		0.4562 (1.80)**		2253.61 (0.95)	.92	1.78	75.54*
3	-9168.52 (-4.50)*	0.1768 (21.42)*	0.6327 (5.39)*			3.7536 (2.81)*	867.615 (0.36)	.97	1.77	185.65*
4	5484.6 (1.24)	0.0196 (0.36)			0.6511 (3.30)*	4.5000 (3.45)*	5978.61 (2.67)*	.97	1.81	183.90*
5[1]	4449.81 (0.66)			0.7215 (0.94)	0.444 (1.56)		4138.11 (1.85)**	.84	1.65	42.21*
6	-7585.56 (-3.30)*			0.1896 (21.60)*		5.3806 (3.59)*	4754.3 (1.83)**	.95	1.13	174.93*
7[1]	-6234.9 (-1.73)**			0.1868 (13.56)*		3.8858 (1.99)**	4061.98 (1.81)**	.87	1.71	52.59*

Values in parenthesis are t-values.
All variables are in real (1970 = 100) terms
* significant at the 0.05 level.
** significant at the 0.10 level.
[1] A maximum likelihood procedure assuming first order serial correlation in the disturbance term is used.

overall quality of the equation is evident as shown by the summary statistics. The explanatory variables explain 97% of the variation in the dependent variable. The expected coefficient signs are observed and there is no evidence of autocorrelation (based on the Durbin-Watson statistic). The results of alternative specifications estimated (equations (2)-(7)) also seem to be, in general, supportive of our propositions. In almost all equations, CT and FI are statistically significant. An interesting observation that can be made relates to the site of the estimated coefficient of FI. In all estimated equations, its value is greater than one. This implies that an one mil. drks. increase in foreign capital inflows contributes to 3.64 mil. drks. increase in total private fixed investment (equation (1)). One must use caution in interpreting the potency of foreign investment on local investment. The magnitude observed in the coefficient could be a reflection of foreign investors' accessibility of the local capital markets taping domestic credit, a reflection of partnership business relationship with local firms, and/or a reflection of government provision of part of the necessary financial capital.

The overall staistical results of Table 2 seem to generally support our basic contention that private fixed investment is explained by changes in production and the supply of capital variables. That is, expected net retained earnings, long-term credit allocated, and foreign financing of capital investment seem to be the primary determinants of aggregate investment behavior in Greece.

C. *Results of Private Fixed Investment in Manufacturing Estimations*

The equations structured for private fixed investment in manufacturing also reflect the main propositions put forward in this paper. Our basic function is a reflection of the general equation (10). We state that capital investment in manufacturing (IM) is not only dependent on the production or income generated in the manufacturing sector (YM) but also on long-term credit allocated to manufacturing (CM) and on foreign capital inflows (FI). On an *a priori* basis, we expect a substantially significant relationship between the dependent variable and FI due to the fact that most of the inflow of foreign capital is directed towards the manufacturing sector of the economy. The basic stochastic

function estimated is expressed as

$$IM = b_0 + b_1\ YM_{t-1} + b_2\ (YM_t - YM_{t-1}) + b_3\ CM$$
$$+ b_4\ FI + b_5\ DPOL + u_6\ ,\quad b_1, b_2, b_3, b_4 > 0$$

In examining the estimated equations of Table 3, we observe that the above specification provides a low Durbin-Watson (see equations (1), (2)) even after we apply an estimation technique that attempts to correct for autocorrelation. This weakness of our basic function points to the necessity for respecification of the equation. Alternative but similar specification estimations presented in Table 3 (equations (3)-(7)) assume a different stochastic behavior than our aggregate investment function. The results indicate that in all specifications long-term credit allocated to manufacturing is statistically insignificant or carries the wrong sign whereas foreign capital inflows is a statistically reliable variable to use as a determinant of IM. The best statistical results are observed in equation (7) where both current production and foreign capital investment carry the expected signs and are statistically significant at the 0.05 level. There is no evidence of autocorrelation and the explanatory variables explain 73% of the variation in the dependent variable. The YM estimated coefficient shows that the marginal propensity to invest (dIM/dYM = .15) is .15 in the manufacturing sector (equation (7)) which seems to be reasonable. The estimated coefficient of FI indicated that an one mil. drks. increase in foreign capital inflows contributes approximately 1.6 mil. drks. increase in capital investment in the manufacturing sector (dIM/dFI = 1.637). The magnitude of the coefficient, as stated in the previous section, is a reflection of the accessibility of local capital markets to foreign investors and of the partnership business relationships with local firms and/or the government.

Our results regarding private fixed investment in manufacturing, therefore, reveal that, although long-term credit allocated to manufacturing may have not played a significant role in explaining investment behavior in this sector, foreign capital inflows or investment purposes plays a significant role in influencing private fixed investment in manufacturing. The significance of FI was also observed in previous studies testing for structural changes resulting from the European Economic Community integration (Giannaros, 1981, 1984).

Table 3

ESTIMATED COEFFICIENTS FOR PRIVATE FIXED INVESTMENT IN MANUFACTURING (IM)

Equation	CONSTANT	YM_t	YM_{t-1}	$(YM_t - YM_{t-1})$	CM	FI	DPOL	R^2	D.W.	F-Stat
1	-469.869 (-0.92)		0.1031 (1.91)**	0.2576 (2.82)*	0.1728 (1.0)	1.5702 (4.28)*	-506.84 (-0.80)	.95	0.90	90.23*
2[1]	-104.146 (-0.81)		0.0967 (2.27)*	0.0484 (1.10)	0.1896 (1.64)	1.5389 (4.70)*	265.225 (0.93)	.70	1.25	9.56*
3[1]	638.544 (0.36)		0.1005 (1.71)**	0.0249 (0.41)	0.1883 (1.19)		265.707 (0.68)	.42	1.25	4.25*
4[1]	-177.665 (-0.16)		0.1561 (7.71)*	0.0705 (1.60)		1.5476 (4.55)*	220.264 (0.73)	.70	1.41	14.56*
5[1]	332.622 (0.28)		0.1482 (7.01)*			1.4809 (4.26)*	224.225 (0.73)	.66	1.41	15.67*
6[1]	453.489 (0.71)	0.1890 (3.03)*			-0.9921 (-0.48)		-883.037 (-1.034)	.90	0.59	75.06*
7[1]	-120.93 (-0.12)	0.1499 (8.54)*				1.637 (4.59)*	168.80 (0.52)	.73	1.72	21.94*

Values in parenthesis are t-values.
All variables are in real (1970 = 100) terms
* significant at the 0.05 level.
** significant at the 0.10 level.
[1] A maximum likelihood procedure assuming first order serial correlation in the disturbance term is used.

D. Results of Estimations of Private Fixed Investment in Mining and Services

The two basic independently estimated equations for investment in mining (IMI) and for investment in services (IS) are specified using the framework of our general equatioin (10) which incorporates our propositions to be tested. Each is expressed as a function of their sectoral production (YMI and YS respectively), the sectoral long-term credit allocated (CMI, CS respectively) and foreign capital inflows (FI). Thus, the basic stochastic function for private fixed investment in mining is

$$IMI = c_0 + c_1\ YMI_{t-1} + c_2\ (YMI_t - YMI_{t-1}) + c_3\ CMI$$

$$+ c_4\ FI + c_5\ DPOL + u_6,\quad c_1, c_2, c_3, c_4 > 0$$

and for private fixed investment in services

$$IS = d_0 + d_1\ YS_{t-1} + d_2\ (YS - YS_{t-1}) + d_3\ CS + d_4\ FI$$

$$+ d_5\ DPOL + u_6,\quad d_1, d_2, d_3, d_4 > 0$$

The results of the estimated equations are presented in Tables 4 and 5 (equation (1)). The main propositions put forward regarding credit allocation and foreign investment being determinants of investment do not seem to be supported by the statistical results of these two sectors. Neither long-term credit allocated nor foreign capital flows are statistically significant in explaining the variation in the respective dependent variables. The same is observed when we estimate alternative specifications of these investment sectors (see equations (2)-(7) and (2)-(5) in Table 4, 5 respectively). In both private fixed investment in mining and private fixed investment in services, the estimated equations indicate the only variables that show statistical significance are the production variables. They explain approximately 73% of the variation in the case of IMI and well over 90% in the case of IS.

Thus our independent estimations relating to investment in mining and investment in services reveal that neither long-term credit allocated nor foreign capital play a significant role in explaining investment behavior in these sectors. It is apparent that

Table 4
ESTIMATED COEFFICIENTS FOR PRIVATE FIXED INVESTMENT IN MINING (IMI)

Equation	CONSTANT	YMI_t	YMI_{t-1}	$(YMI_t - YMI_{t-1})$	CMI	FI	DPOL	R^2	D.W.	F-Stat
1[1]	-115.563 (-0.59)		0.2474 (7.08)*	0.0405 (0.192)**	0.0336 (0.164)	0.0525 (0.46)	-221.986 (-1.53)	.73	1.75	11.52*
2[1]	-92.898 (-0.69)		0.2473 (7.23)*	0.0460 (0.23)		0.0633 (0.70)	-221.438 (-1.56)	.73	1.75	16.56*
3[1]	-124.182 (-0.64)		0.2481 (6.97)*	0.0403 (0.20)	0.0818 (0.49)		-229.097 (-1.63)	.72	1.74	15.24*
4[1]	-114.41 (-0.60)		0.2478 (7.22)*		0.0399 (0.20)	0.052 (0.47)	-210.55 (-1.63)	.73	1.77	16.45*
5	-86.535 (-0.67)		0.2476 (7.35)*			0.0657 (0.75)	-0.2545 (-1.66)	.73	1.77	21.79*
6[1,2]	-6.1312 (-4.28)*	1.3285 (7.90)*			0.2755 (1.61)		-0.2545 (-1.53)	.65	1.77	14.95*
7	-115.563 (-0.59)	0.0405 (0.19)	0.2070 (0.96)		0.0336 (0.16)	0.0525 (0.46)	-221.99 (-1.53)	.73	1.75	11.07*

Values in parenthesis are t-values.
All variables are in real (1970 = 100) terms
* significant at the 0.05 level.
** significant at the 0.10 level.
[1] A maximum likelihood procedure assuming first order serial correlation in the disturbance term is used.
[2] Logarithmic transformation of variables applied.

Table 5

ESTIMATED COEFFICIENTS FOR TOTAL PRIVATE FIXED INVESTMENT IN SERVICES (IS)

Equations	CONSTANT	YS_t	YS_{t-1}	$(YS_t - YS_{t-1})$	CS	FI	IS_{t-1}	DPOL	R^2	D.W.	F-Stat
1[1]	-3002.46 (-3.04)*		0.1034 (6.80)*	0.1314 (4.48)*	-0.0328 (-0.24)	0.5054 (0.92)		1056.68 (1.29)	.94	1.75	65.05*
2[1]	-2644.88 (-2.67)*		0.1036 (6.68)*	0.1270 (4.48)*	-0.0354 (-0.25)			946.58 (1.19)	.93	1.75	71.78*
3[1]	-2913.57 (-3.50)*		0.1001 (18.77)*	0.1300 (4.85)*		0.4934 (0.95)		1082.04 (1.34)	.95	1.76	103.45*
4[1]	-1178.64 (-1.23)		0.0511 (2.07)*	0.1351 (4.79)*			0.4650 (2.04)*	898.19 (1.13)	.97	1.91	190.07*
5	-2981.03 (-3.52)	0.1019 (18.96)*				0.4947 (0.92)		1130.84 (1.47)	.93	1.70	113.391*

Values in parenthesis are t-values.
All variables are in real (1970 = 100) terms
* significant at the 0.05 level.
** significant at the 0.10 level.
[1] A maximum likelihood procedure assuming first order serial correlation in the disturbance term is used.

the primary determinants of investment are production related. In other words, since production (sales) is a determinant of profits, investors in these two sectors seem to rely primarily on the expected net retained earnings for capital investment.

E. Results of Private Fixed Investment in Agriculture Estimations

On an *a priori* basis in attempting to formulate the behavioral equation of private fixed investment in agriculture (IA), we expected that production in agriculture (YA) and long-term credit allocated to agriculture (CA) would be the primary explanatory varaibles. It was our expectation that foreign capital inflows would not be a statistically significant determinant of IA, primarily because foreign capital is not traditionally attracted to the agricultural sector. Our attempt to estimate IA using the same basic structure of equation (10) reinforced our expectation that the stochastic behavior of this sector is different. When we express IA as a function of lagged GDP in agriculture, the change in GDP of agriculture from the previous period, long-term credit allocated to agriculture, and foreign capital inflows, our estimated equations (equation (1), (2) in Table 6) reveal basic structural weaknesses. Not only are the summary statistics weak but the introduction of the credit variable (CA) causes the production coefficients to become negative which is contrary to what economic rationale predicts.

The specification of our basic stochastic function which excludes CA as an explanatory variable not only improves the overall performance of the equation but indicates that foreign capital inflows (FI) is statistically significant at the .10 level (equation (3)). This may lead one to believe that absorption of investment funds in this sector may be less than the allocated credit (non-binding constraint). This would mean that, for this sector, the cost of borrowing (interest rates) is more important in affecting decisions to invest or not to invest at the micro level. Estimations of alternative specifications (equations (4)-(6)) that exclude the credit variable but include FI imply the positive significant role that FI plays in influencing the dependent variable (IA). We view this with some caution given our *a priori* expectation that FI would not be significant but CA should.

In view of this, we estimated an alternative equation of invest-

ment in agriculture that reflects the credit through the cost of capital. The Bank of Greece intervenes extensively in manipulating the interest rates paid by farmers for medium and long-term loans (RA). The farmers in Greece, being the poorest sector of the population and operating at a small profit margin, are impacted in their decisions to invest more potently by the cost of borrowing. Thus, our alternative specification expresses IA as a function of production of agriculture and as a function of the rate of interest for medium and long-term loans to agriculture. This gives us

$$LA = e_0 + e_1\ YA_{t-1} + e_2\ (YA_t - YA_{t-1}) + e_3\ RA + u_4\ ,\quad e_1, e_2 > 0, e_3 < 0$$

The estimated results of the above equations (equation (7) presented in Table 6) indicate an overall improvement in the quality of the equation as shown by the summary statistics. The explanatory power increases to 86% and the expected coefficient signs are observed. A similar specification (equation (6) in Table 6) also shows that both expected production in agriculture and the cost of borrowing are statistically significant. This allows us to state that production or income generated in agriculture and the cost of borrowing for long-term loans seem to be the primary determinants of private fixed investment in agriculture.

F. Results of Private Fixed Investment in Construction Estimations

The construction sector of the economy has been absorbing over 30% of available capital for investment during the period studied. It is also this sector that has been used typically for adjustments relating to cyclical economic problems of the economy.

In developing our stochastic function for private fixed investment in construction (mostly dwellings), on an *a priori* basis, we expect that disposable income (Y_d) and long-term credit allocated for fixed investment (CC) in construction (IC) would be the primary explanatory variables. Therefore, since the Bank of Greece controls credit allocation, establishes guidelines, and fixes the interest rates for credit; and since this sector has been used to

Table 6
ESTIMATED COEFFICIENTS FOR PRIVATE FIXED INVESTMENT IN AGRICULTURE (IA)

Equation	CONSTANT	YA_t	YA_{t-1}	$(YA_t - YA_{t-1})$	CA	FI	RA	DPOL	R^2	D.W.	F-Stat
1[1]	1573.51 (1.07)		-0.0100 (-0.21)	-0.0448 (-1.31)	0.2707 (2.72)*	0.4056 (1.57)		273.051 (1.10)	0.46	0.02	3.42*
2[1]	1800.61 (1.10)		-0.0139 (-0.28)	-0.4121 (-0.26)	0.2845 (2.80)*			237.782 (1.02)	.27	2.08	2.19
3[1]	-1819.19 (-2.33)*		0.1182 (6.47)*	0.0237 (0.85)		0.4396 (1.73)**		297.058 (1.22)	.63	1.87	10.24*
4[1]	-1819.19 (-2.33)*	0.0237 (0.85)	0.0945 (3.61)*			0.4396 (1.73)**		361.80 (1.22)	.63	1.87	10.24*
5	-1619.30 (-2.36)*		0.1134 (7.10)*			0.4917 (2.03)*		366.309 (1.23)	.65	1.92	14.94*
6	-179.074 (0.28)	0.0417 (1.70)**	0.0836 (3.44)*				-267.86 (-4.43)*	237.496 (0.91)	.85	1.93	34.68*
7	-179.074 (-0.28)		0.1253 (10.72)*	0.0417 (1.70)**			-267.86 (-4.43)*	237.496 (0.91)	.86	1.93	34.69*

Values in parenthesis are t-values.
All variables are in real (1970 = 100) terms
* significant at the 0.05 level.
** significant at the 0.10 level.
[1] A maximum likelihood procedure assuming first order serial correlation in the disturbance term is used.

deflate or inflate the economy, CC should be a major explanatory variable of IC. We use disposable income rather than the GDP because production in this industry primarily involves the building of housing units whose sales are a function of disposable income. Thus, our basic stochastic function reflecting the general equation (10) is experessed as a function of lagged disposable income, the change in disposable income from the previous period, long-term credit allocated to construction, and foreign capital inflows (FI). This gives us

$$IC = f_0 + f_1\ Y_{dt-1} + f_2\ (Y_{dt} - Y_{dt-1}) + f_3\ CC + f_4\ FI$$

$$+ f_5\ DPOL + u_6\ ,\ f_1, f_2, f_3, f_4 > 0$$

An examination of the estimated results of Table 7 reveals that (with the exception of FI) explanatory variables are statistically significant at the 0.05 level. The equation overall behaves well as shown by the summary statistics and the explanatory variables explain 90% of the variations in the dependent variable. While on one hand long-term credit allocated to construction is statistically significant in all equations estimated (equations (1)-(6) in Table 7), on the other hand inflows of foreign capital (FI) is statistically insignificant in all cases.

Our findings regarding investment behavior in construction, therefore, reinforce our *a priori* expectations that income and long-term credit allocated are the primary determinants.

IV. Summary and Concluding Remarks

This study has attempted to shed some new light on the issue of investment behavior in economies with developing capital markets that are weak and operating inefficiently. There have been references in the literature regarding the inappropriateness in using typical developed economy structural equations to define the behavior of private capital investment in developing economies. Some have referred to the importance of the supply of capital factors in determining demand for fixed investment.

In this paper we proposed the hypothesis that sectoral expected net earnings, sectoral long-term credit allocation, and

Table 7

ESTIMATED COEFFICIENTS FOR PRIVATE FIXED INVESTMENT IN CONSTRUCTION (DWELLINGS)-(IC)

Equation	CONSTANT	Y_{dt}	Y_{dt-1}	$(Y_{dt}-Y_{dt-1})$	CC	FI	DPOL	R^2	D.W.	F-Stat
1[1]	971.37 (0.50)		0.0455 (2.89)*	0.1676 (3.52)*	0.3625 (2.00)*	1.1389 (1.31)	2762.53 (2.34)*	.90	1.75	34.42*
2[1]	1965.73 (0.92)		0.0409 (2.33)*	0.1692 (3.68)*	0.4302 (2.15)*		2658.55 (2.30)*	.86	1.68	35.40*
3[1]	-1760.94 (-1.26)		0.075 (13.33)*	0.2181 (4.97)*		1.3224 (1.51)	2877.29 (2.27)*	.90	1.81	51.23*
4[1]	3526.36 (1.52)	0.0348 (1.77)**			0.534 (2.39)*		3384.84 (2.51)*	.81	1.69	33.95*
5[1]	-1760.94 (-1.26)	0.2181 (4.97)*	-0.1435 (-3.24)*			1.3240 (1.51)	2877.29 (2.27)*	.89	1.82	51.23*
6[1]	1965.73 (0.92)	0.1692 (3.68)*	-0.1284 (-3.17)*		0.4302 (2.15)*		2658.55 (2.30)*	.86	1.68	35.40*

Values in parenthesis are t-values.
All variables are in real (1970 = 100) terms
* significant at the 0.05 level.
** significant at the 0.10 level.
[1] A maximum likelihood procedure assuming first order serial correlation in the disturbance term is used.

foreign capital inflows for investment purposes are the relevant explanatory variables of sectoral private fixed investment. To examine this, we constructed and estimated an aggregate investment function and estimated independently equations for the five sectors of the economy (manufacturing, mining, services, agriculture and construction). Our hypotheses were tested for the economy of Greece using the traditional estimation techniques.

The overall results give a fairly good indication of the propositions tested. Our estimation and analysis allow us to make the following conclusions. The summary results show some support for our tested propositions. Both credit allocated by sector and foreign capital investment seem to play a significant role in determining the level of private fixed investment in Greece. More specifically, our estimations and analysis indicate that there is some validity regarding our propositions. Our aggregate investment function results show that not only expected production or income but also long-term credit allocated and foreign capital inflows are determinants of overall private fixed investment. This supports fully our hypotheses. The results of our disaggregated investment functions, as would be expected, show a variable stochastic behavior - however to some degree reinforce our propositions. We find foreign capital inflows and expected production to play a significant role in explaining the variation of private fixed investment in manufacturing as expected on an *a priori* basis. In the case of private fixed investment in construction, expected disposable income and long-term credit allocated seem to be the primary determinants of investment in that sector. In all equations, we observe that expected production or income is a statistically significant determinant of sector a private fixed investment.

Our findings, therefore, indicate that in the disaggregated investment functions only two cases (manufacturing and construction) show conclusively that long-term credit allocated and/or foreign capital inflows are determinants of private capital investment. We also observed that our aggregate investment function is partially explained by both of these variables. One should have in mind, in analyzing the results, that the relative size of investment in manufacturing and investment in construction, in terms of overall capital investment, is such that their behavior would be reflected in the behavior of the aggregate investment equation. In

other words, the weight of these two sectors with regards to the total private fixed investment is large enough so that their independent variables become determinants of aggregate investment function.

It is evident from our analysis that the Central Bank credit allocation rules and related institutional rigidities have a potent impact on capital investment. Additionally, the importance of foreign capital in influencing fixed investment cannot be ignored. As the development of the capital markets continues (and it should be continued), it is therefore imperative for the Central Bank and the banking institutions to be prudish and efficient in allocating long-term credit. Attention should also be paid to the question of inflow of foreign captial since it seems to play a major role in influencing investment in the manufacturing sector.

Several questions remain to be answered in order to attain strong convictions in our conclusions that will allow us to generalize them. Application of these propositions to other economies with similar level of development and character of the capital markets is suggested before definitive general conclusions can be reached on the propositions tested. Hopefully, the preliminary results here will facilitate future research by ourselves and others on this issue.

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