

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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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

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

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 principle³ 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,

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

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

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

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

$$(Y_{t+1}^*) \quad \text{as}^4$$

³ See Tsoiris 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.

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

$$(10) \quad I_{i,t} = \epsilon_0 + \epsilon_1 Y_{i,t-1} + \epsilon_2 (Y_{i,t} - Y_{i,t-1}) \\ + \epsilon_3 C_{i,t} + \epsilon_4 FI_t + \epsilon_5 DPOL + u_{i,t}$$

where the coefficients satisfy the conditions $\epsilon_1, \epsilon_2, \epsilon_3, \epsilon_4 > 0$ 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 purposes⁵

$DPOL$ = 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.

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.

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 size 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 tapping 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 statistical 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

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.

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.

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 variables. 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-

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)*		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)*				-267.86 237.496 (-4.43)* (0.91)	.85	1.93	34.68*
7	-179.074 (-0.28)		0.1253 (10.72)**	0.0417 (1.70)**			-267.86 237.496 (-4.43)* (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.

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.

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 capital 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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