Investment in Construction And Postwar Greek Economic Growth: A Correlation Analysis

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I. Introduction

In two recent articles, James Petras and A. Skouras have offered diametrically opposed theoretical explanations of the role of investment in construction in the postwar economic growth and industrialization of Greece.[1] The two arguments can be summarized as follows:

Petras's Thesis:

> Investment in construction (real property) limits the funds available for other more productive investments, such as machinery and equipment. In addition, investment in construction does not promote economic development, which is measured by the level of industrialization.

Skouras's Thesis:

> Investment in construction promotes economic growth and industrial development. It also increases other types of investment, including investment in industry, and has done so in Greece.

Both assertions appear plausible given the authors' logical

[1]James Petras, "Greek Rentier Capital: Dynamic Growth and Industrial Underdevelopment," *Journal of the Hellenic Diaspora,* Vol. XI, No. 2, Summer 1984, pp. 47-58.

A. Skouras, "Rentier Capital, Industrial Development, and the Growth of the Greek Economy in the Postwar Period: A Response to James Petras," *Journal of the Hellenic Diaspora,* Vol. XII, No. 1, Spring 1985, pp. 5-15.

explanations. However, only one can be true. One way of determining this is by analyzing the investment data of Greece for the postwar period. Both writers make little reference to this data. Unless an empirical verification of the above arguments is made, the debate, based as it is only on logical (theoretical) grounds, will remain inconclusive. A look at the actual data can shed some light on such a debate that, by its nature, requires a comparison of numbers.

The main objective of this study is to test empirically the conclusions reached by the theoretical analyses of Petras and Skouras. The method used is correlation analysis (explained briefly in the next section) on the investment and output numbers of Greece during the 1950-1985 period (the actual data are given in the appendix). The relevant hypotheses to be verified are:

(i) How much are output and the various types of investment related? Are these relations positive or negative?

(ii) Does a higher rate in one type of investment, such as construction, imply a lower or higher rate of investment in another type, such as equipment and machinery?

(iii) Does investment in construction produce structural changes (economic development) as these are measured by the share of industrial output to total output? In other words, does it promote industrialization?

The need for an empirical investigation of the above hypotheses arises because the theoretical explanations are contradictory. Intuitively, one might argue that an increase in construction activities requires, of necessity, an increase in the levels of production of construction-related industries, such as iron, cement, brick, glass, and wood product construction. However, other types of industrial output may decrease such as machinery and transportation equipment. Thus, the overall effect of investment in construction may be positive, negative, or zero. An input-output analysis can explain the intra-industry relationships, but it goes beyond the scope of this study. Instead, this study is concerned more with aggregate levels.

An attempt to answer the above questions is made in sections three and four below. Before that, we briefly discuss the technique of correlation analysis that is used in this study. We should

note here, however, that correlation analysis is by no means the best statistical method. The construction and estimation of an econometric model of the Greek investment sector would have been a better approach. The problem is that this approach requires extensive research in estimating the real rate of return on each of the five types of investment that are examined below. Such a task was beyond the scope of this study.

II. Correlation Analysis

Correlation analysis is the statistical technique used to evaluate the validity of the three previously mentioned hypotheses. Briefly stated, correlation analysis measures the strength of the relationship between two variables, i.e., between the investment in construction and investment in industry. A measure of this strength is given by the *correlation coefficient* usually denoted by (r) and any textbook in statistics discusses the correlation coefficient:[2]

$$r = \frac{Sxy}{(Sx)\ (Sy)}$$

where:

x,y : variables
Sxy : The covariance of x and y
Sx : The standard deviation of x
Sy : The standard deviation of y

The correlation coefficient is a unitless number such as a percentage and can take any value between (+1) and (−1). If the correlation coefficient is equal to one (r=1) for two variables, then it may be concluded that there is a perfect positive relationship between these two variables. If the correlation coefficient is equal to minus one (r=−1), then there is a perfect negative relationship. Finally, if the correlation coefficient is equal to zero (r=0), then it may be concluded that the two variables have no apparent relationship. For other values the

[2]See Edwin Mansfield's textbook of *Statistics for Business and Economics*, 2nd edition, 1983, p. 436.

correlation coefficient shows degrees of strength. Thus, the correlation coefficient can be used to show the type (positive or negative) and the degree (high or low) of the relationship between investment in construction, investment in industry, output and industrialization in the postwar period in Greece.

It should be stated that correlation analysis is not free from pitfalls. There are a number of them. First, correlation analysis does not imply causation. In other words, if it is found that investment in construction is positively correlated with investment in industry, this by no means implies that the former causes (determines) the latter or vice versa.[3] Second, correlation analysis is appropriate for *linear* relationships. We may conclude nothing on non-linear (curve-like) relationships. Third, even if the correlation coefficient is non-zero, a relationship (positive or negative) may not exist. In statistical jargon, we would say that the correlation coefficient is not statistically significant. There is always a probability that we get a false result, i.e., a non-zero r even though the true r is zero. The lower this probability, the better (more reliable) the results obtained. Probabilities that are higher than 10% can imply that the true correlation coefficient is not different from zero. Probability values below 10% can lead to the conclusion that the stated value of (r) is the true one.

In the next section we analyze the correlation coefficients (along with their probabilities) between five types of investment, gross domestic product (output), and the level of industrialization. Industrialization is defined as the percentage of industrial output to gross domestic product. The conclusions reached should be interpreted cautiously and one should keep in mind the limitations of correlation analysis. Nevertheless, correlation analysis can provide a little bit of evidence that both studies by Petras and Skouras lacked.

[3]In this study this is not a problem because the causality arguments are based on the theoretical arguments of Petras and Skouras. For example, both argue that it is investment in construction that "causes" economic underdevelopment (Petras thesis) or economic growth (Skouras argument).

III. The Results

The correlation coefficients presented in tables 1 and 2 (see the appendix) are between the following variables (below each coefficient we give the probability that (r) is equal to zero):

investment in dwellings (I1)
investment in other buildings (I2)
investment in other constructions and works (I3)
investment in transport and equipment (I4)
investment in machinery and other equipment (I5)
gross domestic product (Y)
level of industrialization (IND)

The breakdown of total investment is consistent with the one used in the Greek National Accounts. The sum of the first three investment variables (I1+I2+I3) constitutes the total investment in construction. The sum of the last two (I4+I5) defines total investment in industry. In table 2 we give the correlation coefficients of the growth rates of the variables in table 1. Notice that correlation coefficients cannot be calculated between levels and growth rates because this most probably would imply a non-linear relationship.

A number of observations emerge from the two tables. First, all five types of investment are positively correlated with the level of output. The relationship between output and investment in construction and in industry is very strong. The correlation coefficients range between (.84) and (.97) and all are statistically significant. The highest correlation is obtained for investment in industry but the difference cannot be considered very large. What is more important is how the growth of each investment relates to the growth of output. In table 2 (see the appendix) we give the correlation coefficients of growth rates. As can be seen, the growth of investment in construction (I1GR, I2GR and I3GR) is positively correlated with the growth of output. The growth of investment in industry (I4GR and I5GR) is positively correlated with output growth but statistically is not different from zero (the probabilities that the correlation coefficient is zero are very high: 55% and 88%).

Thus one may conclude that Skouras's argument on the positive relationship between investment in construction and output does get some support from correlation analysis. His argument is further supported by the fact that the growth of investment in dwelling (I1GR) had the highest correlation coefficient with output growth (equal to 50%) of any rate of growth of investment.

The correlation results can shed some light on the second hypothesis made in the first section. Petras has argued that investment in construction decreases investment in industry. His argument is not supported by correlation analysis. All five levels of investment are positively correlated (see table 1). The growth rates of the five investment types are all positively correlated, with the exception of investment in equipment and machinery (see table 2 in the appendix). In terms of growth rates, Skouras's theoretical argument that investment in construction is positively related to investment in industry is partially true. The growth of investment in construction is positively related to the growth of investment in transport and equipment, but has no apparent relationship with the other investment in industry of machinery and equipment.

Finally, the most important relationship on which both Skouras and Petras seem to center their attention is between investment in construction and industrialization as opposed to investment in industry and industrialization. As can be seen from table 1, all five investment types have very strong positive correlations with the industrialization index. What is of interest is that *investment in construction has a higher correlation coefficient than investment in industry.* Compare (.95), (.98) and (.97) in table 1 of the three investments in construction with (.84) and (.89) of the two investments in industry.

If we accept the causality arguments, which were assumed by both Skouras and Petras and held that investment of one type or another promotes industrialization and therefore development, then one may conclude that correlation analysis shows that the postwar Greek industrialization was the result of the high investment in construction. It appears that Skouras's argument in favor of investment in construction as a means to promote economic growth does get some empirical support.

Skouras's argument is further supported by the correlation coefficients of the growth of industrialization in Greece and the growth of investment. As can be seen from table 2, the growth of investment in construction has the highest correlation coefficient. Compare the correlation coefficients of (.68), (.68) and (.65) of industrialization and the three investment types in construction with the correlation coefficients of (.55) and (.25) of industrialization and the two investment types in industry categories. The growth of investment in dwellings had again the highest correlation coefficient.

We may then conclude that the empirical evidence of correlation analysis presented here supports Skouras's thesis. Investment in construction did not have any negative effect on output, investment in industry or industrialization. On the contrary, investment in construction has been very important and has contributed to postwar Greek economic growth and development. At least, it has been more important than investment in industry. Correlation analysis shows that investment in construction deserves more credit for the so-called "Greek economic miracle" of the postwar period than is usually accorded it.

IV. Some Policy Implications

The Petras and Skouras arguments have significant implications for the design of government investment policies. If Petras's argument is accepted, then policies that promote investment in industry and discourage investment in construction should be implemented. On the other hand, if Skouras's argument is taken seriously, then policies that promote investment in construction should be instituted. Both writers refer to specific policy recommendations, such as a tax on property income.

Given the evidence presented in this study, should we then suggest that government pursue policies to stimulate investment in construction? The ultimate goal of government intervention is economic growth and development. One of the main objectives of economic policy is to increase output. It has been shown in this study that investment in construction can be used

to achieve the goal of higher output. It follows that one may suggest to the Greek government to pursue policies that encourage investment in construction.

For reasons that cannot be gone into within the limited framework of this study, Greek policy-makers and the Greek public administratioon responsible for policy implementation are not noted for their efficiency. It is ironic that investment in industry that had the full support of all Greek governments throughout this period cannot be considered as the major reason for the unprecedented Greek postwar economic growth. On the other hand, investment in construction without government support was able to produce economic growth. If this was the case in the past, then I do not see the reason why investment in construction could not play the same role in the future without any government assistance. This does not imply that government should not try to reduce the social costs of this type of investment, such as urbanization. However, the diversion of private and social costs is not specific to investment in construction alone; it is a more general problem and applies to all types of investment.

V. Conclusions

The purpose of this study was to verify to what extent investment in construction has played a significant role in the economic development of Greece. The conclusions reached can be summarized as follows:

(1) Investment in construction does not decrease the funds available for other types of investment, such as for industry.

(2) Output growth is more related to growth of investment in dwellings than any other type of investment.

(3) Postwar Greek industrialization can be explained more by the unusually high level of investment in construction than the investment in industry.

(4) Given that investment in construction has played such an important role without government assistance, it was argued that government policies should neither promote nor discourage this type of investment.

Finally, I should say that even though the empirical evidence favors Skouras's arguments, this does not necessarily imply that his theoretical analysis is the right one. It is quite possible that another explanation might lead to the same conclusions. A correct class analysis of who is behind each type of investment might explain why some are more effective than others.

APPENDIX

TABLE 1
CORRELATION COEFFICIENTS: LEVELS (1950-1985)

	I1	I2	I3	I4	I5	Y	IND
I1	1.00000						
	0.0000						
I2	0.94911	1.0000					
	0.0001	0.0000					
I3	0.89927	0.94426	1.00000				
	0.0001	0.0001	0.0000				
I4	0.85833	0.87034	0.78424	1.00000			
	0.0001	0.0001	0.0001	0.0000			
I5	0.85398	0.92436	0.89383	0.91272	1.00000		
	0.0001	0.0001	0.0001	0.0001	0.0000		
Y	0.83500	0.89812	0.84406	0.95505	0.96761	1.00000	
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	
IND	0.94641	0.98048	0.96771	0.84495	0.89216	0.87017	1.00000
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000

See Table 3 for a definition of the variables.

TABLE 2
CORRELATION COEFFICIENTS: GROWTH RATES (1950-1985)

	I1GR	I2GR	I3GR	I4GR	I5GR	YGR	INDGR
I1GR	1.00000						
	0.0000						
I2GR	0.41843	1.00000					
	0.0111	0.0000					
I3GR	0.52607	0.36896	1.00000				
	0.0010	0.0268	0.0000				
I4GR	0.33557	0.26673	0.42181	1.00000			
	0.0454	0.1158	0.0104	0.0000			
I5GR	0.08458	0.19108	0.08731	-0.02810	1.00000		
	0.6238	0.2643	0.6126	0.8708	0.0000		
YGR	0.50357	0.28950	0.34427	0.10177	0.02653	1.00000	
	0.0017	0.0868	0.0398	0.5548	0.8779	0.0000	
INDGR	0.68222	0.67888	0.65484	0.55632	0.25462	0.21615	1.00000
	0.0001	0.0001	0.0001	0.0004	0.1340	0.2054	0.0000

TABLE 3
DATA ON INVESTMENT AND OUTPUT
(Million of Drachmas at 1970 prices)

YEAR	I1	I2	I3	I4	I5	I	Y	IND
1948	3107	655	2290	309	3074	9435	58288	16.9
1949	3577	1003	2273	861	2967	10681	69982	16.6
1950	4831	1516	3182	1646	5087	16262	74355	20.1
1951	4333	1370	2566	470	6356	15095	80511	18.4
1952	4491	1419	2636	311	5123	13980	80746	18.7
1953	6090	1668	3072	456	2966	14252	91291	19.5
1954	6095	1880	2771	464	3179	14389	94123	20.4
1955	7045	2155	2547	676	3521	15944	100533	21.0
1956	7818	2469	3712	936	4460	19395	109277	21.8
1957	6911	2098	4802	1196	4113	19120	115858	21.6
1958	8352	2783	5484	1715	5835	24169	120481	23.2
1959	7857	4281	6191	1464	5471	25264	125308	23.5
1960	8506	4552	8659	1821	5583	29121	129201	25.8
1961	9132	4734	9608	2181	5821	31476	143772	24.9
1962	10391	5030	9677	2626	6404	34128	144612	25.9
1963	11287	5761	9558	2378	7012	35996	159171	25.4
1964	13712	6675	10578	3151	9329	43445	171177	26.9
1965	15482	6124	13057	3216	11124	49003	187009	27.3
1966	15642	6687	12369	5299	10570	50567	197011	27.3
1967	13956	6554	12804	4772	11684	49770	206176	27.6
1968	19445	9068	14097	5036	12751	60397	217895	30.0

1969	23212	9729	15722	6636	16356	71655	238201	31.5
1970	19740	9579	16169	6548	18627	70663	258000	31.4
1971	23641	10504	19424	7083	19906	80558	278551	32.6
1972	29964	12472	21139	7021	22381	92977	303973	33.5
1973	30576	13951	20426	10236	24904	100093	329269	34.7
1974	15869	12381	15076	7418	23756	74500	323307	31.4
1975	20476	10170	16010	7050	20954	74660	339833	31.6
1976	21909	11258	16078	9346	21159	79750	360399	32.6
1977	26428	12204	15886	10788	20644	85950	371022	33.2
1978	30074	12513	15028	13395	20090	91100	394803	33.2
1979	31572	13960	15351	14556	23682	99121	409075	33.9
1980	27291	11622	15674	13987	24131	92705	417510	32.4
1981	21452	11636	17269	12445	22948	85750	416515	31.7
1982	20398	9252	14061	16427	23962	84100	416169	30.5
1983	21124	9529	15396	11207	25744	83000	417757	30.4
1984	16217	10509	15924	9090	26060	77800	430310	30.0
1985	17253	9327	17170	10530	26170	80450	439850	30.0

I1 : Investment in dwellings
I2 : Investment in other buildings
I3 : Investment in other constructions and works
I4 : Investment in transport and equipment
I5 : Investment in machinery and other equipment
I : Total investment
Y : Gross Domestic Product
IND : The percentage of industrial output to total output

Source: National Statistical Service of Greece (ESYE); various issues of monthly bulletins.