The Relationship Between Public and Private Investment

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Abstract

This paper investigates the relationships between private sector investment spending and government provision of public capital utilizing the major private investment models. Overall, the empirical results indicate that private sector equipment investment is inversely related to government investment spending and directly related to the existing public capital stock. Also, private equipment investment is much more sensitive to public provision of capital than either structures investment or measures of total investment. Short-run empirical estimates indicate that each additional one percentage point increase in public infrastructure and government investment spending is associated with an approximate three-fifths of a percentage point increase in private sector equipment investment per year. Long-run estimates were obtained by estimating the Securities Valuation-Cash Flow Investment model using the Stock-Watson method for testing for long-run relationships when variables are integrated of higher-order, including different orders. These estimates indicate an increase of an approximate two-fifths of a percentage point increase in private equipment investment per year. Projections reveal that if the rate of growth of public capital stock had continued from 1966 through 1987 at the 1947-1965 average growth rate (instead of decreasing), the growth rate of private sector equipment investment would have been between 4 to 6 percentage points above the actual rate of growth.

I. Introduction

The relationship between changes in government spending and changes in aggregates such as output, employment, prices, etc., has been the subject of many theoretical and empirical studies. Recently, however, interest in the relationship between government spending on the provision of public capital and various measures of aggregate economic activity has been stimulated, due to Aschauer's [1989a, 1989b] work in this area.

Many of the empirical studies focus on the relationship between government spending on the core infrastructure, a concept which includes the provision of highways and streets, bridges, water and sewer systems, transit systems and airfields, for example, and economic growth at national, regional and state levels, with mixed statistical results. For example, studies by Aschauer [1989a], Eberts [1986], and Munnell [1990] indicate a statistically significant positive relationship. The estimates of the elasticity of output with respect to public infrastructure capital vary widely, and reported elasticities using national time series data are larger than studies that use state-level data. This difference may be due to the fact that the state and regional level studies may be attempting to measure productivity effects using a geographic area that is too small to include all of the external benefits emanating from public infrastructure capital. On the other hand, Tatom [1991], finds no statistically significant correlation. Other studies that examine the relationship between public capital and costs of private production, finding a statistically significant reduction in private costs, include Dalenberg and Eberts [1992], Morrison and Schwartz [1992], and Nadiri and Mamuneas [1991].

In addition to focusing on the possible impact on economic growth, Aschauer [1989b] and Erenburg [1993] have examined at the aggregate level the impact of public provision of infrastructure capital on private investment activity directly, finding a positive correlation. Because private investment activity enhances future growth of real income, these statistical results support the assertion that public policy has permanent effects on real output. This paper adds to that literature by utilizing the major private investment models in order to examine the correlation between private investment and government provision of public capital.

The idea that infrastructure capital has an impact on private investment activity and economic growth is discussed in the literature by Buiter [1977]. He asserted that a complementary relationship between public and private investment was obvious, citing public investment in projects such as dam construction, etc. As Munnell [1992] has argued, "Everyone agrees that public capital investment can expand the productive capacity of an area, both by increasing resources and by enhancing the productivity of existing resources."

These arguments are based on economic principles of social goods, recognizing that private market failure occurs when externalities exist, providing a rationale for government participation in a system of mixed capitalism based on efficiency. When external costs or benefits are associated with the production or consumption of goods and services, the private market system will fail to provide the socially optimal quantities, causing an inefficient use of resources. Inefficient uses of resources also occur when production is characterized by decreasing costs, i. e., natural monopolies. When the government supplies goods or services (or regulates their production) which cannot be provided efficiently by private firms because production is subject to decreasing costs, a more efficient use of existing resources occurs. If the publicly provided (or regulated) goods can be produced at a lower cost than that of private production, avoiding unnecessary duplication of goods and/or services, then resources available in an economy at any point in time are used more efficiently, and productivity will be enhanced.

At the firm level, cost per unit of output shifts downward. In the aggregate, an outward shift in the aggregate supply curve will occur when public provision of public infrastructure results in a more efficient use of existing resources, given economies of scale and spillovers. This is where the critics of mixed capitalism become confused. Their argument that a system of tariffs and tolls will make the use of an existing infrastructure more efficient may be correct, but it addresses the issue of pricing the use of the existing infrastructure. More importantly, their argument cannot be used to support the claim that infrastructure should be provided by the private sector because it ignores the nature of social goods and private market failure, thereby bypassing the vital aggregate issues of economies of scale, externalities and resource reallocation. The positive impact that public capital exerts on productivity, and, therefore, private investment activity is indeed a separate issue.

How does the provision of public capital, then, affect private investment decisions? As industry combines their private capital stock with public capital stock, the productivity effect causes the value of the firms to increase. As the expected value of the firm increases, investment in capital increases. In terms of new private investment, assuming that firms judge the profitability of an investment project based on the internal rate of return, the following benefit/cost expression can be used to examine how the return to private investment projects is enhanced by public infrastructure:

(1) $$\sum_{j=0}^{n} \frac{B_j - C_j}{(1+r)^j} = 0$$

The impact on costs and benefits is obvious. Clearly, start-up costs are less when public infrastructure is provided and if the costs of materials are less (due to improved transportation systems, for example); or if the benefits are greater (future stream of income is greater, for example, due to infrastructure), then the rate of return will be greater. Simply put, this means that private investment will be greater with infrastructure than without. Holding everything else constant, the net present value of any investment project is increased, expanding private investment activity, and enhancing future growth of real income, given resources.

If the provision of public infrastructure capital increases the productivity of private capital and profitability of private investment, then the direct effect of government spending on public capital should be modelled separately in order to capture these effects. This possibility changes the focus of the usual neutrality implications of the New Classical model. The neutrality position assumes that when agents anticipate an increase in demand generated by an expected increase in government spending, wages rise in anticipation of the expected aggregate price increase, shifting aggregate supply to the left. This aggregate supply response offsets any expansionary effect on real output. If agents instead anticipate an increase in supply, due to an increase in the marginal productivity of capital generated by an expected increase in public infrastructure, as well as an increase in expected demand, real output will change.

II. The Existing Models of Business Investment and Public Investment and Infrastructure

One way to examine the impact of the provision of public infrastructure on private investment activity is to augment the standard investment models that have been used in the literature. These investment models can be broadly categorized as Accelerator, Accelerator-Cash Flow, NeoClassical and Securities Valuation. The determinants of these investment models include various measures of output, profits, cost of capital, return to capital, and cash flow.

However, all of these models ignore the possible effect of public capital on private investment decisions. As shown in equation (1) above, if the profitability of private capital is affected by the public capital stock, then public sector investment spending and infrastructure in place should be included in any attempt to explain private investment decisions. Accordingly, the equations described below embed public sector investment spending and public capital stock. Following Clark [1979] and others, the basic investment models are broadly developed as follows:

Accelerator: This model is based on the assumption that the desired capital stock is a function of output. Adding infrastructure to this model yields:

(2) $KT^d = \alpha Y + \mu KG$

KT^d = desired private capital stock
KG = public capital stock
Y = output

The idea behind this accelerator model of private investment is that adjustment to changes in output is not immediate, but rather takes place over a number of time periods. Adding a lagged term to represent replacement investment, a public capital term to represent infrastructure in place in order to measure any productivity effect, and dividing through by the private capital stock, KT, yields the following public capital augmented accelerator investment model.

Public Capital augmented Accelerator:

$$(3) \quad \frac{I}{KT} = \frac{\alpha}{KT} + \sum_{t=0}^{N} b \frac{\Delta Y_{-t}}{KT_{-t}} + d \frac{KT_{-1}}{KT_t} + \sum_{t=0}^{N} e \frac{IG_{-t}}{KT_{-t}} + f \frac{KG_t}{KT_t} + u$$

Where: I = private sector investment
IG = public sector investment

Adding cash flow as a measure of internal funds vs external finance, or a profits variable as a measure of future profitability of a firm and its concomitant impact on future output yields:

Public Capital augmented Accelerator-Cash Flow:

$$(4) \quad \frac{I}{KT} = \frac{\alpha}{KT} + \sum_{t=0}^{N} b \frac{\Delta Y_{-t}}{KT_{-t}} + \sum_{t=0}^{N} c \frac{CF_{-t}}{KT_{-t}} + d \frac{KT_{-1}}{KT_t} + \sum_{t=0}^{N} e \frac{IG_{-t}}{KT_{-t}} + f \frac{KG_t}{KT_t} + u$$

Where: CF = Cash Flow Variable

The idea behind the accelerator-cash flow augmented model of private investment is that adjustment occurs not just to changes in output, but also to public investment spending and public capital. If the public capital stock increases the productivity of private investment projects, then private investment activity should increase.

Ceteris Paribus, if both the public and private sectors are competing for the same resources to implement private/public investment projects, then current public investment spending may crowd out private investment spending, while existing public capital stock may crowd in private investment spending. Modeling private investment decisions in this manner is an attempt to determine how private investment decisions are affected by public infrastructure decisions, and to what degree.

Many empirical studies include the concept of adjustment to changes in actual output compared to potential output, rather than mere changes in output in an attempt to capture adjustments over the business cycle. In this study, capacity utilization was used as a measure of the demand gap. In addition, the public capital stock to private capital stock ratio was adjusted for capacity utilization rate. See Hulten [1990] and Nadiri [1991].

The cash flow variable used in this paper is the ratio of profits after taxes, adjusted for inventory valuation and capital consumption allowance, to corporate income, in real terms. Taxes represent the price firms must pay for the provision of public goods, and the effect of taxation is addressed by using tax adjusted profits.

Neoclassical: Jorgenson and others have developed an investment model based on the neo-classical principle that factor inputs should be a function of their relative prices, assuming a Cobb-Douglas production function. Adding public capital to the neoclassical expression of desired capital stock yields:

(5) $KT^d = \gamma \frac{pY}{C} + \mu KG$ Where γ = share of capital in output

p = price of output

C = Cost of capital

Parallel to the adjustment to the previous investment models, a public capital term is included to represent infrastructure in place, yielding:

Public Capital Augmented Neoclassical:

$$(6) \quad \frac{I}{KT} = \frac{\alpha}{KT} + \sum_{t=0}^{W} c \frac{CF_{-t}}{KT_{-t}} + \sum_{t=0}^{W} g \frac{\frac{r_k}{r_c}}{KT_{-t}} + \sum_{t=0}^{W} e \frac{IG_{-t}}{KT_{-t}} + f \frac{KG_t}{KT_t} + u$$

Where r_k = rate of return on capital

r_c = real rate

The variables used in this model include cash-flow and relative cost of capital separately. This empirical form is based on Jorgenson's development of the reduced form of the optimal demand for capital. This form "allows the demand for capital to be expressed on a function of the relative cost of capital services alone; the effect of other factor prices is captured by including the level of output or sales in the model. In this case, the neoclassical model with partial-adjustment assumptions takes a form similar to the accelerator model" Fazzari, Hubbard and Petersen, p. 177 [1988]. The tax-adjusted profits variable and the ratio of the return to capital relative to the cost of capital are included in this model.

The proxy for the return to capital was the price-dividend ratio of Standard and Poor's Composite Index, and the real rate used was the 10 year U. S. Treasury rate adjusted for inflation. This particular measure was used in order to allow for changes in the rate of return to capital as well as for changes in the real rate. If the increase in the rate of return to capital is greater than the increase in the cost of capital, measured by the real rate, private investment should increase. Other interest rate variables were used, including the real rate alone and the ratio of sales to the real rate. None of these variables performed well.

Securities Valuation-Cash Flow: The securities valuation investment model differs from the others described above because investment is assumed to occur on a financial basis in terms of portfolio balance. The key variable in the investment demand equation is the q-ratio, which is the ratio of the market valuation of the firm's outstanding stocks and bonds to the replacement cost of the firm's capital stock. When firms maximize the value of their shareholders' equity, investment occurs when the market valuation of the firm's outstanding equities exceeds the replacement cost of the capital goods. The use of q in an investment model allows for expected profitability. Following Fazzari, Hubbard and Petersen [1988], cash flow has been added. Augmenting the securities valuation-cash flow private investment model with public capital yields the following:

Public Capital Augmented Securities Valuation-Cash Flow:

$$(7)\quad \frac{I}{KT} = \alpha + \sum_{t=0}^{N} m q_{-t} + \sum_{t=0}^{N} c \frac{CF_{-t}}{KT_{-t}} + \sum_{t=0}^{N} e \frac{IG_{-t}}{KT_{-t}} + f \frac{KG_{t}}{KT_{t}} + u$$

The variable used in this study is tax-adjusted q constructed over the time period 1961 to 1987 by McMillin-Parker [1990]. This time period was used to estimate the Securities Valuation-Cash Flow Investment model.

The time period from 1952 to 1990 was used for the Accelerator-Cash Flow and Neo-Classical Investment Models. A longer time series, beginning in 1925, is available for public investment and public capital stock data. However, it is obvious that the structural characteristics of the macroeconomy are dramatically different when considering the 1920's, compared to the world depression of the 1930's and certainly the world war years of the 1940's. Much of public investment in the 1940's involved war goods production, a period when government spending as a percent of GNP during the early 1940's peaked at 49%. Private investment was restricted (as the nation operated at full-employment) until peace-time conversion from war goods production to consumer goods production occurred. Some of the government capital stock that was used to produce war goods became private capital stock after the war. Figure Ia shows real private (KT) and public capital stock (KG) from 1925 to 1990. Figure Ib shows the relationship between private sector investment/capital stock ratio ((I/KT) and public sector investment/capital stock ratio (IG/KT). The large spike that occurs during the early 1940's clearly illustrates this point.

III. Empirical Results

The private investment models of Accelerator-Cash Flow, Securities Valuation-Cash Flow and Neo-Classical were estimated and the results are discussed below. The Securities-CF model measuring private equipment investment generally outperformed the other models in terms of expected sign and size of the coefficients. The Neo-Classical model did not perform well. Private investment in structures, equipment, and total were estimated separately (which is common in the empirical investment literature) in order to determine whether the effect of public provision of infrastructure is uniform or varies according to the type of investment. Figure II shows the ratios of private sector investment in equipment (IE/KT), structures (IS/KT) and total (I/KT) to private capital stock, and the ratio of government sector investment to private capital stock (IG/KT) from 1947. There is a clear downward trend in both the private sector investment to private capital stock ratio and the government sector investment to private capital stock ratios occurring since 1966.

Tables I, II and III show the empirical results of estimating Neo-Classical, Accelerator-Cash Flow and Securities Valuation-Cash Flow investment models. Table I lists the results of estimating each model using log levels while Table II is based on results obtained using differences in logs. Table III reports the empirical results obtained using the Stock-Watson method of testing for a long-run relationship among nonstationary variables. Overall, the results indicate the following relationships.

A. Log Levels: (Refer to Table I)

1. The statistical fit in terms of Adjusted R^2 of all three investment models is improved when public capital stock and government investment spending is included.

2. Private sector equipment investment was most sensitive to public capital stock and public investment spending. Private sector investment in structures was least affected by infrastructure. The statistical results were mixed in the estimates of the empirical relationship between public capital and total private investment since the latter included both equipment and structures.

3. In all three investment models, there is a statistically significant relationship between public capital stock and total private investment and private equipment investment, indicating that the hypothesis that the coefficients on public capital stock in place is zero is rejected. The effect varies across investment models and type of private investment as indicated above.

4. In all three investment models, the inverse relationship between government investment spending and private investment spending is statistically significant for private sector equipment investment. In terms of equipment investment, this may indicate evidence of financial sector crowding out. However, it may also indicate that given evidence that the stock of public infrastructure will be larger in the future, firms who benefit from public capital will postpone equipment investment plans in order to take advantage of the expected increase in the rate of return.

5. The size of the coefficient on Tobin's q for equipment and structures is quite similar to those reported by Clark [1979] which is remarkable given the difference in time periods. The overall effect of the capacity utilization rate and Tobin's q is positive and statistically significant for equipment and total private investment. The profit variable exerts a positive and statistically significant effect on structures and total private investment in the Securities Valuation-Cash Flow and Neo-Classical models. However, the return to

capital/cost of capital variable used in the Neo-Classical model does not perform well in terms of the lack of statistical significance and expected size and sign of the coefficients.

In order to control for the influence of changes over time, these equations were re-estimated with a linear and quadratic trend. Neither changed the statistical results.

In order to address the possible problem of spurious correlations that may exist in time series data when variables are not stationary, all variables were differenced, as per Granger and Newbold [1974]. Overall, the results indicate the following relationships:

B. Short Run Relationships - Differences in Logs: (Refer to Table II)

1. Effects of Public Capital Stock

   a. Securities Valuation-Cash Flow Model: The positive effect of public capital stock on private sector equipment investment, +.89, retains its statistical significance, and is larger in size than the effect in the log level model shown in Table I, i.e., first differencing does not reduce its effect or significance. The direct effect on total private investment spending, +.55, is greater and significant.

   b. Neo-Classical Model: The direct effect of public capital stock on equipment investment and total private investment is still positive and significant, while the direct effect on investment in structures is now significant, changing from +.11 to +.38.

   c. Accelerator-Cash Flow Model: The effects of public capital are mixed.

2. Effects of Government Investment Spending

   a. Securities Valuation-Cash Flow Model: The size and significance of the inverse effect of government investment spending on private equipment investment is not affected by first differencing. The inverse effect of government investment spending on total private investment and private investment in structures is still indicated, but the coefficients remain not significant.

b. Neo-Classical Model: The effects on total private investment and equipment investment remain statistically significant. Government investment spending continues to have no statistically significant effect on structures.

c. Accelerator-Cash Flow: The negative effect on total private investment becomes significant. First differencing does not alter the size or significance of the effect on equipment investment. Structures investment is not significantly correlated with government investment spending.

3. Other Variables

a. Capacity utilization continues to exert a combined direct effect on total and equipment investment. The coefficient on structures is now positive and statistically significant. The effect of Tobin's q on private equipment investment is positive and statistically significant, while the effect on total investment is no longer significant. The profit variable is positive for all types of investment in both the Accelerator-Cash Flow and Securities Valuation-Cash Flow models. Only the coefficient in the Securities Valuation-Cash Flow model of private equipment investment is statistically significant.

b. The return to capital/cost of capital ratio remains statistically insignificant.

c. No significant changes occurred when the first-differenced equations were re-estimated with a time variable.

Simple differencing is ad hoc, and over differencing may enter a trend when the series is already stationary. In order to determine the stationarity of each time series, unit root tests were run for the levels and first differences of the variables used in the equations based on ADF and Stock-Watson tests. Using annual data, the rate of return to capital/real interest rate ratio, the capacity in level form. The remaining variables are stationary in first-difference form with the exception of Tobin's q which is I(2).

(The lag length n for each variable was determined by the Akaike Information Criterion. The augmented Dickey-Fuller statistics are based on the estimated coefficient of y_{t-1} in the following equation:

$$\Delta y_t = \alpha + (\rho - 1)y_{t-1} + \Sigma \beta_i \Delta y_{t-i} + \gamma t + \epsilon_t$$

The statistics are not reported here, but are available upon request from the author)

One of the difficulties with addressing the problem of possible spurious regression by differencing the data is that it eliminates the possibility of examining the long-term relationship between private and public investment. As Munnell has suggested, "researchers should examine not just whether variables grow over time, that is, the extent to which they are non-stationary, but also whether they grow together over time and converge to their long-run relationship, that is, the extent to which they are co-integrated." Munnell [1992], p. 192. In order to examine long-run relationships between variables, the data set was re-estimated, using the estimation procedure suggested by Stock and Watson [1989]. Their method is applied when variables are integrated of higher order, including different orders. The method involves including as right-hand variables the significant leads and lags of the first-differences of both the dependent and independent variables. The coefficients on the level-form of the variables indicate the long-run relationships between the variables.

Table III reports the statistical results of testing for long-run relationships among variables integrated of higher order. Only the Securities Valuation-Cash Flow investment model was estimated since the other two investment models include capacity utilization rate and rate of return/cost of capital variables that are of order I(0), i.e., they are stationary in levels. The equations measuring private sector equipment investment and private sector structures investment were estimated. The equation with total private sector investment/private capital stock was not estimated using the Stock-Watson method because this variable is of order I(0). Because the data are limited to annual observations, each variable was entered with one lead and one lag. The results of estimating the private sector equipment investment and structures investment models are reported in Table III and are discussed below:

C. Long-Run Relationships - Stationary Series:
(Securities Valuation-Cash Flow Investment Model)

1. Effects of Public Capital Stock

The coefficient on public capital stock is positive and statistically significant for both private equipment investment, +.91, and structures investment, +.43, indicating a long-run statistical relationship between the existing public capital stock and private sector investment activity.

2. Effects of Government Investment Spending

The coefficient on public investment spending, -.52, is statistically significant in the equipment investment equation. The coefficient, +.35 is positive and significant for structures.

3. Other Variables

a. The coefficient on Tobin's q is positive, statistically significant and of the expected size for equipment investment. It is positive but remains statistically not significant for structures.

b. The coefficient on the profits variable is not significant in the equipment equation.

In the equipment investment equation, the statistically significant coefficients indicate the presence of a long-run relationship between private sector equipment investment and public infrastructure, government investment spending and Tobin's q. The profits variable is not significant.

The negative effect of government investment spending on private equipment investment is outweighed by the positive effect of the public capital stock, and both exhibit a positive relationship with private structures investment.

Conclusions:

Rather than focusing on the statistical relationship between the provision of public capital and economic growth, this paper empirically investigates the relationship between public capital and private investment decisions. Embedding public capital stock and government investment spending in the major investment models yields a statistically significant direct relationship between private investment activity and public capital stock and an inverse relationship with government investment spending in both the short-run and long-run. Private equipment investment is most sensitive to public infrastructure, with a coefficient that ranges from +.89 in the first difference model to +.91 in the long-run model. Private investment in structures reveals no statistically significant relationship in the short-run, first-difference model, but a significant +.43 coefficient in the long-run. Additionally, the effect of government investment spending on structures is a significant coefficient of +.35, while the effect on equipment is a significant coefficient of -.52. These findings indicate that public infrastructure has an over-all stimulative effect on private investment activity in the U.S. over this time period. These results confirm those of Aschauer's [1989] while addressing concerns of spurious correlation. (In the area of economic development, Shafik [1992] reports significant coefficients ranging between +.54 and +.71 when estimating levels regressions and +.43 when estimating difference regressions, on government infrastructure in his private investment equation for Egypt. He employed the Engle and Granger two-step estimation procedure which tests for long-run relationships at first the levels stage then estimates the dynamic relationships.)

Using the coefficients from the short-run, first difference Securities Valuation model, each additional one percentage point increase in public infrastructure and government investment spending is associated with an approximate three-fifths of a percentage point increase in private sector equipment investment per year. Using the coefficients from the long-run Securities Valuation model, each additional one percentage point increase is associated with an approximate two-fifths of a percentage point increase.

Figure IIIa shows the dramatic decline in the public capital stock/private capital stock ratio from 1947 through 1990. On average, from 1966 to 1990, the ratio of government capital to private capital stock from 1966 through 1990 would have been ten percentage points higher if the growth rate of government infrastructure had remained at its 1947 through 1965 average. Figure IIIb compares actual public capital stock (real $) to estimates of public capital stock if the historic rate of growth had been maintained. Figure IV compares the actual annual growth of private sector equipment investment to the short-run and long-run growth estimates over the last two decades assuming the growth of public infrastructure remained at the historic rate of growth. Everything else constant, these adjustments indicate that, based on equipment investment alone, if the rate of growth in government capital stock had remained the same as its historic average, instead of declining, private investment would have grown at a faster rate.

The importance of disaggregation in measuring the effects of public capital on private investment is obvious when these results are combined with the strong association between equipment investment and growth that Jorgenson and DeLong and Summers report. Work by Jorgenson [1988, 1990] has demonstrated a strong correlation between equipment investment and total factor productivity growth using U. S.data. DeLong and Summers [1991] also report a strong association between equipment investment and growth using cross-country data. They also find that the relationship between rates of equipment investment and growth is very different from the relationship between structures investment and growth. As they have argued, "In neoclassical models steady-state growth rates are independent of investment rates. However, investment rates may influence growth rates as shifts in investment rates cause economies to transit between steady-state growth paths," pp. 480-481. Specifically, between 1960-1985, DeLong and Summers find that "each extra percent of GDP invested in equipment investment is associated with an increase in GDP growth of one third of a percentage point per year. This is a much stronger association than found between growth and any other components of investment," p. 445. Applying their estimates to the U. S., higher public capital investment increases private sector equipment investment between .4 and .6, which is associated with an increase in growth of between one eighth and one fifth of a percentage point per year. Increasing public infrastructure by ten percentage points (based on the historic average), private sector equipment investment would have been between 4 to 6 percentage points higher, and applying DeLong and Summer's estimates, annual GDP growth would have been between 1.3 and 1.9 percentage points higher.

The domestic policy implications are obvious. Neglecting infrastructure needs has a deliterious effect on private sector equipment investment and economic growth. Equally as important, these results can also be applied to the U.S. as it actively attempts to pursue a competitive position in the global economy. As Joseph P. Quinlan has stressed in an editorial in the Wall Street Journal concerning southeast Asian markets, "To tap these burgeoning markets, U. S. companies should carefully assess the following strategic variables: . . . Infrastructure. Severe infrastructure limitations have raised the cost of operating in Asia, prompting some multinationals to invest elsewhere. Following five years of strong growth, the physical infrastructure of the region is straining at the seams - the roads are crowded, the ports are clogged and the airports are jammed. Pollution and environmental degradation compound matters. The upshot is infrastructure gridlock, which threatens not only to strangle growth and trade, but also to curtail new foreign investment." Quinlan [1993] p. A10. This caution certainly applies to the U. S. as well as the global economy expands. If global firms seek to locate in a profitable environment, then it becomes mandatory for the U. S. to provide an up-to-date, viable infrastructure in order to continue to attract new foreign capital.

List of Variables

Capacity Utilization Citibase 1947 - 1990	IPXCA	Capacity Utilization Index
Capital Stock Bureau of Economic Analysis 1947 - 1991	Private Capital	Net Stock of Private Fixed Nonresidential Capital in 1987 \$ Equipment and Structures
	Public Capital	Net Stock of Government Owned Fixed Capital in 1987 \$ Federal, State and Local Equipment and Structures Excluding Military
Cash Flow Citibase 1947 - 1990	GJPATX	Ratio, Corporate Profits after taxes, IVA & CCA adj./Corporate Domestic Income Real \$
	GJPAT8	Corporate Profits with IVA & CCA adj. for taxes Real \$
Inflation Rate Citibase	PUNEW	Inflation Rate - Total
Interest Rate Citibase	FYGL	Interest Rate, U.S. Treasury Composite, 10 year plus long-term
Investment Bureau of Economic Analysis 1947 - 1991	Private	Fixed Nonresidential Private Investment in 87 \$ Equipment and Structures
	Public	Fixed Nonresidential Government Investment in 87 \$ Federal, State and Local With and without Military Equipment and Structure
National Income Citibase	GY82	National Income, Real \$
Return to Capital	FSEXP	Earnings to Price Ratio
Securities Valuation	Tobin's q - Tax adj.	Source - McMillin-Parker, 1990
Sales, Final Citibase	GNSM	Final Sales, Real

Fig. 1a Private and Public K Stock

1987$ 1925-90

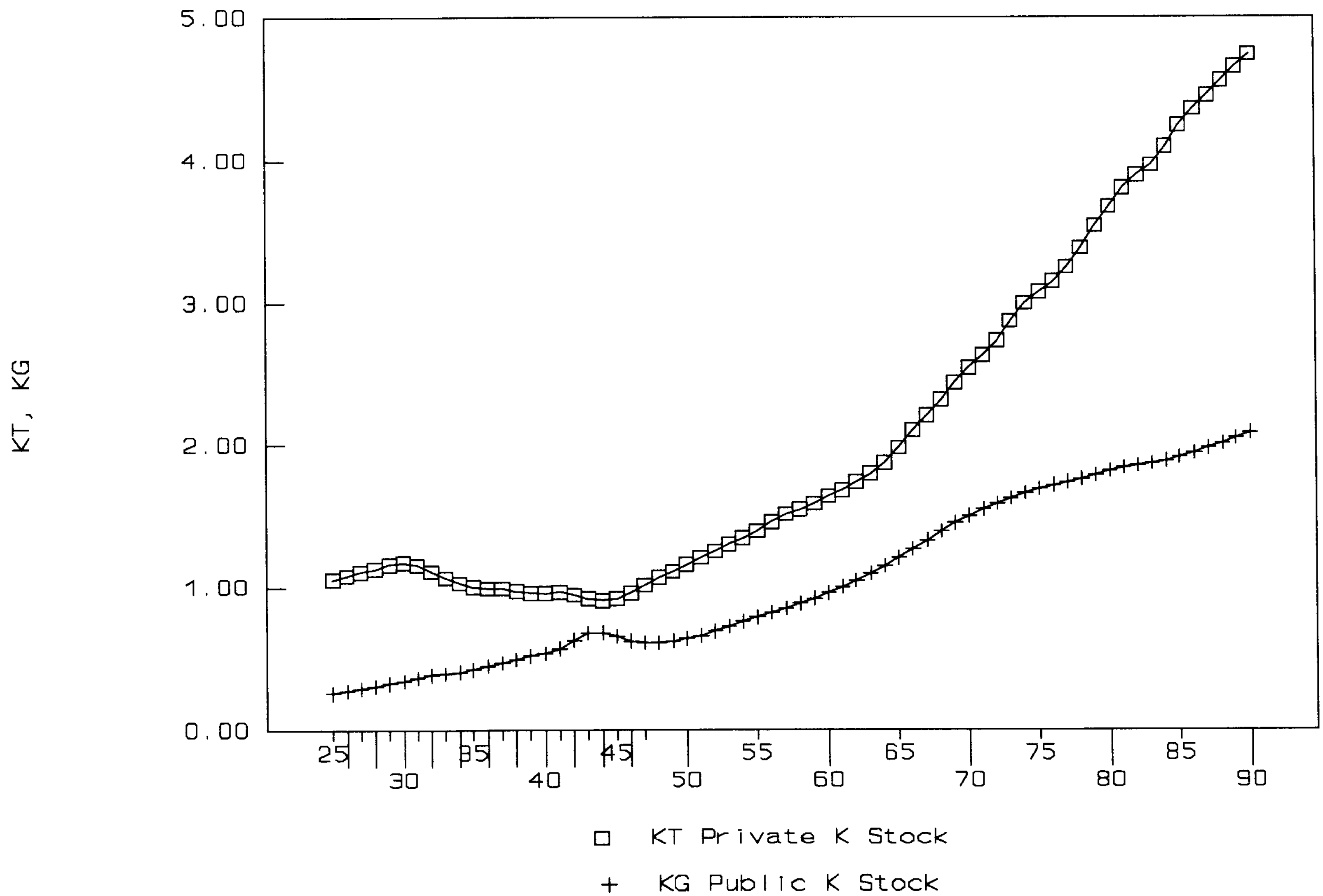


Fig. Ib I/KT, IG/KT

1987$ 1925-90

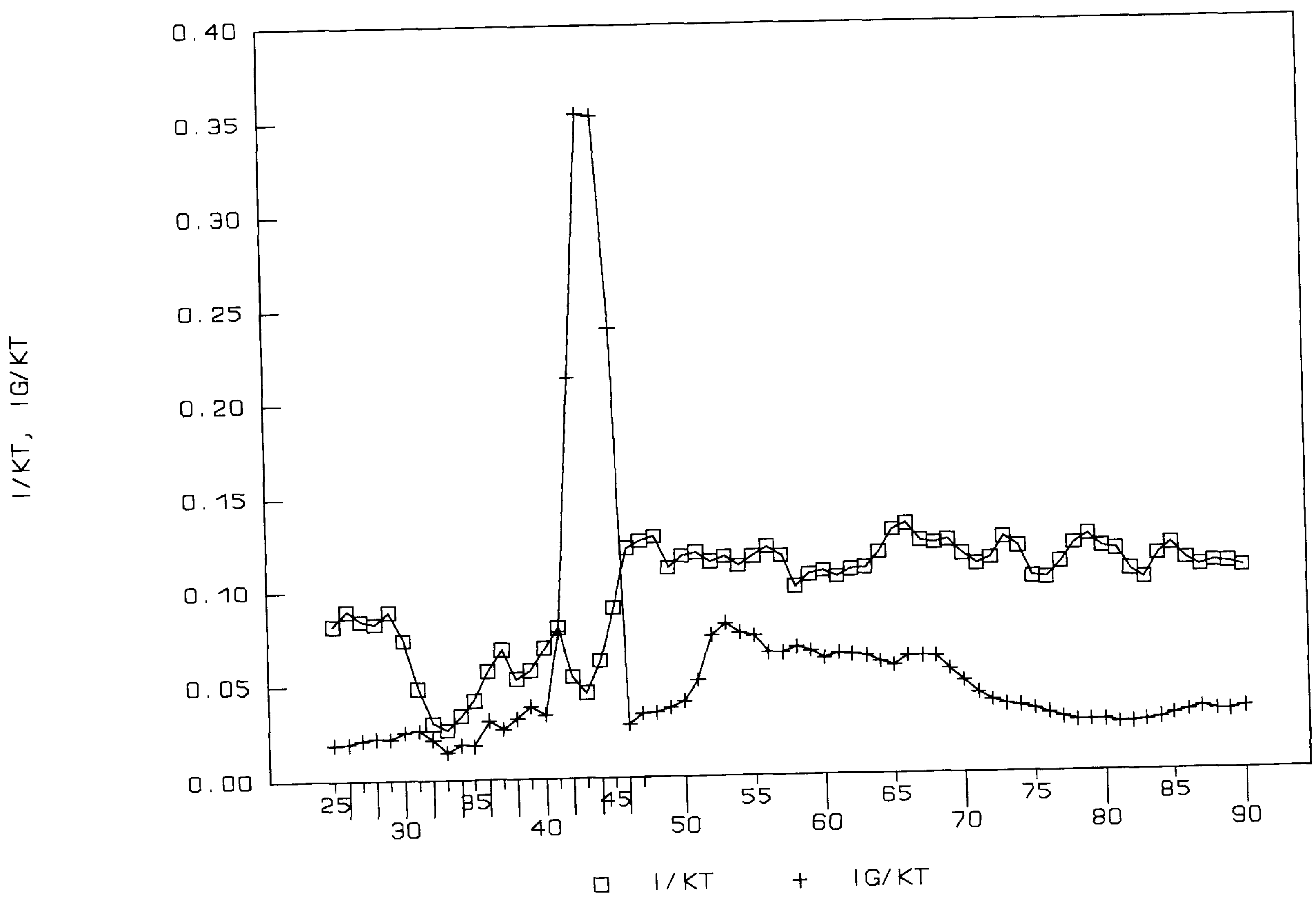


Fig. II Investment to Private K Stk

1987$ 1947 - 90

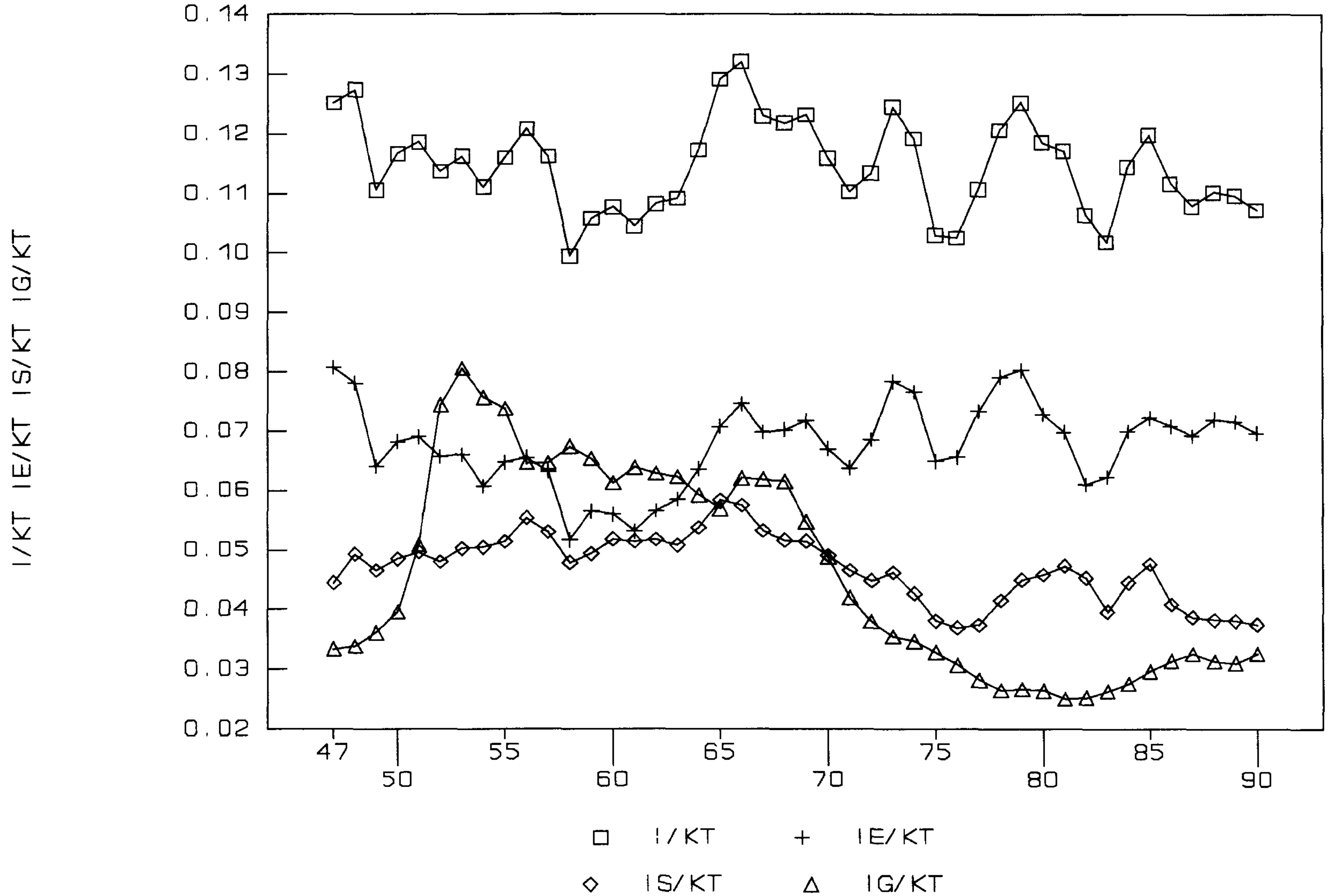


Table I
Comparisons of Private Investment in Equipment, Structures and Total
No Government Capital (log levels)

	Accelerator-Cash Flow*				Securities Valuation-Cash Flow				Neo-Classical		
	Total	Equipment	Structures		Total	Equipment	Structures		Total	Equipment	Structures
Adj. R2	.78	.92	.82		.38	.51	.74		.38	.56	.82
Constant	-2.15*	-2.33*	-.38		-1.06	-1.10	.55		-.68	-.63	-.57**
	(.60)	(.67)	(.51)		(.87)	(1.20)	(.87)		(.41)	(.73)	(.24)
Ratio, Profits/	-.01	.02	-.04		-.03	.11	-.03		-.09	.01	.03
Corp. Income	(.05)	(.04)	(.08)		(.10)	(.12)	(.10)		(.07)	(.10)	(.06)
	-.005	-.07	.08		.05	-.13	.13		.12	-.01	.17**
(-1)	(.05)	(.05)	(.08)		(.10)	(.12)	(.11)		(.07)	(.10)	(.07)
Capacity	.01*	.017*	.005**	Tobin's	-.06	-.07	-.006	RK/RC	-.60	-.59	-.70
Utilization	(.001)	(.001)	(.002)	Q	(.05)	(.07)	(.06)	(-1)	(1.42)	(1.9)	(1.40)
(-1)	-.002	-.007*	-.003		.08	.12	-.01		-3.54*	-4.17**	-1.59
	(.002)	(.002)	(.003)		(.06)	(.05)	(.07)		(1.43)	(1.90)	(1.39)
Lag. Dep. Vbl.	.53*	.76*	.72*		.37***	.72*	.63*		.44*	.74*	.65*
	(.15)	(.09)	(.11)		(.21)	(.20)	(.16)		(.16)	(.15)	(.10)
With Government Capital Ratios											
Adj. R2	.89	.96	.85		.80	.95	.77		.72	.90	.80
Constant	-1.94*	-3.04*	.85		1.29	.08	3.58**		.47	.08	-.40
	(.52)	(.53)	(.66)		(1.32)	(.91)	(1.72)		(.65)	(.59)	(.32)
Ratio, Profits/	.03	.06**	.02		.04	.06	.04		-.06	-.03	.02
Corp. Income	(.04)	(.03)	(.08)		(.07)	(.04)	(.11)		(.05)	(.05)	(.09)
	-.01	-.08**	.10		.14**	.05	.27**		.14**	.05	.20**
(-1)	(.04)	(.03)	(.08)		(.07)	(.05)	(.13)		(.05)	(.05)	(.09)
Capacity	.04*	.03*	.03***	Tobin's	-.006	-.01	-.01	RK/RC	-.026	.38	-.36
Utilization	(.008)	(.007)	(.017)	Q	(.04)	(.02)	(.07)	(-1)	(.97)	(.92)	(1.50)
(-1)	-.03*	-.017**	-.029		.11*	.15*	.07		-1.63	-1.59***	-1.13
	(.008)	(.007)	(.02)		(.04)	(.03)	(.08)		(1.02)	(.96)	(1.56)
Public	-2.29*	-1.18***	-2.39		.40	.79*	-.08		.81*	1.26*	.11
K Stock/Kt	(.73)	(.64)	(1.50)		(.24)	(.16)	(.46)		(.15)	(.13)	(.25)
	2.30*	1.26**	2.11		-.42	-.66*	-.24		-.70*	-1.04*	-.16
(-1)	(.72)	(.61)	(1.51)		(.29)	(.18)	(.37)		(.18)	(.15)	(.22)

Public Invest spending/KT	-.06 (.08)	-.12*** (.06)	-.23 (.17)	-.31 (.21)	-.27** (.13)	-.47 (.36)	-.22** (.10)	-.18** (.09)	-.12 (.12)
(-1)	-.05 (.05)	.01 (.05)	.21** (.11)	-.06 (.18)	-.11 (.11)	.09 (.27)	.09 (.08)	.97* (.10)	.09 (.10)
Lag. Dep. Vbl.	.32* (.13)	.48* (.09)	.81* (.12)	.77* (.22)	.80* (.10)	.95* (.21)	.84* (.17)	.52* (.18)	.73* (.13)

*Lagged values of the private capital stock are included in the public capital stock/ private capital stock ratio variable. No statistical significance is indicated when lagged private capital stock is included as a separate independent variable.

* .01 level of sig.
** .05 level of sig.
*** .10 level of sig.

(Standard Errors in Parentheses)

Table II
Comparisons of Private Investment in Equipment, Structures and Total
No Government Capital (Δ log levels)

	Accelerator-Cash Flow Total	Equipment	Structures		Securities Valuation-Cash Flow Total	Equipment	Structures		Neo-Classical Total	Equipment	Structures
Adj. R2	.78	.86	.34		.61	.71	.16		.40	.37	.23
Constant	.002	.004	-.001		.017***	.02*	.004*		.017***	.02**	.006
	(.005)	(.005)	(.01)		(.009)	(.009)	(.014		(.009)	(.01)	(.01)
Δ Ratio, Profits/Corp. Income	.03	.055	.007		.16*	.25*	.06		.08	.15***	-.01
	(.04)	(.04)	(.07)		(.06)	(.06)	(.10)		(.06)	(.08)	(.07)
(-1)	.05	.013	.09		.16*	.13*	.19**		.26*	.27*	.23*
	(.04)	(.04)	(.07)		(.06)	(.06)	(.09)		(.05)	(.07)	(.06)
Δ Capacity Utilization	.01*	.015*	.005**	Δ Tobin's Q	-.06	-.06	-.05	Δ (RK/RC)	.30	.86	-.55
	(.001)	(.001)	(.002)		(.04)	(.04)	(.06)		(1.04)	(1.27)	(1.18)
(-1)	.003**	.001	.004**		.11*	.16*	.04		-1.46	-1.48	-1.74
	(.001)	(.002)	(.002)		(.04)	(.04)	(.06)		(1.07)	(1.32)	(1.21)
Lag. Dep. Vbl.	.12	.26***	.14		.30**	.32**	.24		.17	.16	.20
	(.13)	(.13)	(.15)		(.15)	(.14)	(.19)		(.15)	(.16)	(.15)
With Government Capital Ratios											
Adj. R2	.86	.91	.48		.77	.93	.13		.77	.86	.33
Constant	-.0005	-.0005	-.0003		.008	.01**	-.002		.005	.007	.002
	(.005	(.005)	(.009)		(.008)	(.006)	(.016)		(.006)	(.005)	(.01)
Δ Ratio, Profit/ Corp. Income	.035	.05	.018		.075	.10*	.05		.003	.018	-.013
	(.03)	(.03)	(.06)		(.06)	(.04)	(.11)		(.04)	(.04)	(.07)
(-1)	.01	-.03	.06		.06	.01	.13		.04	-.004	.09
	(.03)	(.03)	(.07)		(.06)	(.04)	(.11)		(.04)	(.04)	(.09)
Δ Capacity Utilization	.026*	.018*	.04 *	Δ Tobin's Q	-.03	-.04**	-.0007	Δ (RK/RC)	.01	.27	-.52
	(.006)	(.006)	(.01)		(.03)	(.02)	(.065)		(.66)	(.62)	(1.14)
(-1)	-.013***	.001	-.03*		.06	.09*	.04		-.97	-1.03	-1.36
	(.007)	(.007)	(.01)		(.04)	(.03)	(.08)		(.66)	(.64)	(1.14)
Δ Pub/Pri. K Stock	-1.30**	-.24	-2.92*		.55**	.89*	.04		.86*	1.24*	.38***
	(.53)	(.53)	(1.04)		(.21)	(.14)	(.44)		(.12)	(.12)	(.20)
(-1)	1.33*	.24	2.99*		.27	-.06	.40		.26***	.05 *	.38**
	(.54)	(.53)	(1.06)		(.22)	(.20)	(.31)		(.14)	(.17)	(.18)

Δ Public Inv. Spending/KT	-.10***	-.15*	-.04	-.16	-.13**	-.22	-.16**	-.16*	-.16
	(.06)	(.05)	(.11)	(.14)	(.09)	(.28)	(.07)	(.06)	(.12)
	.005	-.05	.10	-.14	-.17**	-.08	-.015	.38*	.07
(-1)	(.05)	(.05)	(.10)	(.13)	(.08)	(.26)	(.07)	(.14)	(.11)
Lag. Dep. Vbl.	.11	.14	.21*	.24	.36**	.21	.23	.52*	.21
	(.11)	(.12)	(.14)	(.20)	(.16)	(.23)	(.15)	(.18)	(.16)

(Standard Errors in Parentheses)

Table III

Comparisons of Private Investment in Equipment, Structures

		Securities Valuation-Cash Flow	
		Equipment	Structures
Adj. R2		.88	.75
Constant		-4.66* (.69)	-4.53** (1.09)
Ratio, Profits/ Corp. Income		-.06 (.06)	-.17** (.08)
Tobin's q		.15* (.04)	.03 (.06)
Public/Private K Stock		.91* (.15)	.43** (.21)
Public Invest. Spdg/Pri.K Stk		-.52* (.08)	.35* (.12)
Δ Dep. Variable	(+1)	-.64* (.16)	
	(-1)		.45*** (.23)
Δ Ratio, Profit/ Corp.Income	(+1)		
	(-1)	.11*** (.06)	
Δ Tobin's q	(+1)		
	(-1)	-.085** (.04)	
Δ Public Inv. spending/KT	(+1)		.72** (.31)
	(-1)	.34** (.16)	

(Standard Errors in Parentheses)

Fig. IIIa Public K Stk/Private K Stk

1987$ 1947 - 90

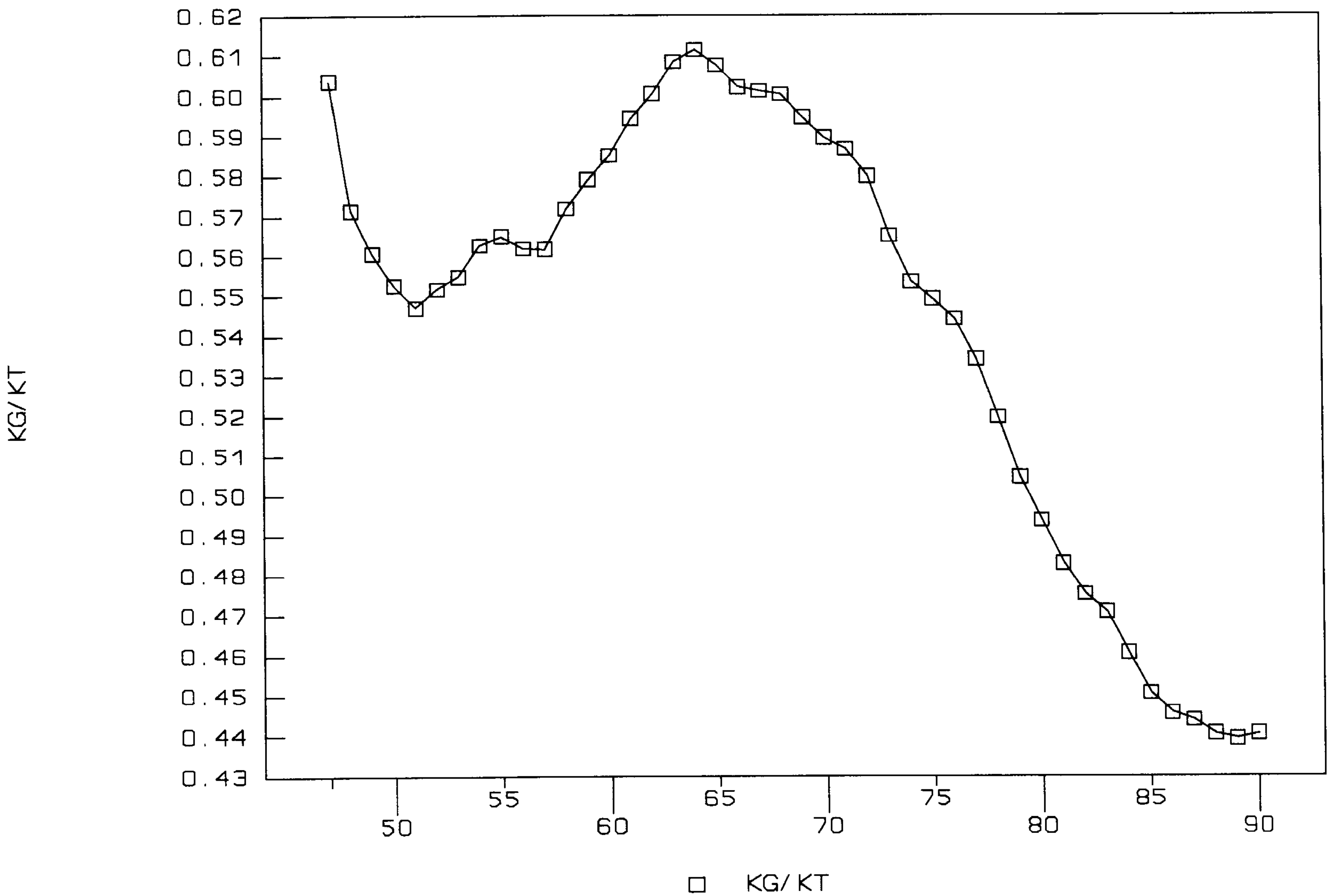


Fig. IIIb Private and Public K Stk

1987$ 1947 - 90

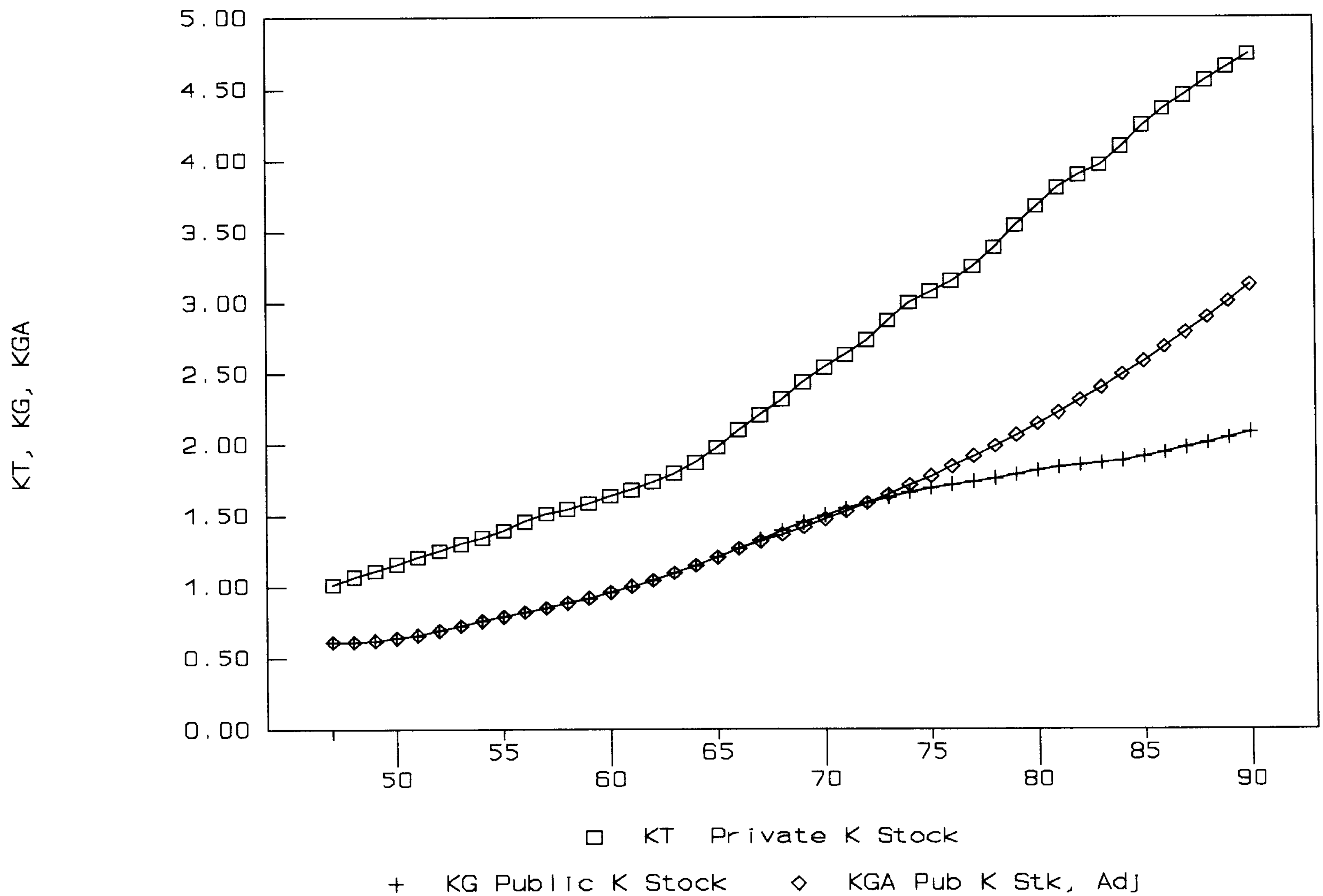
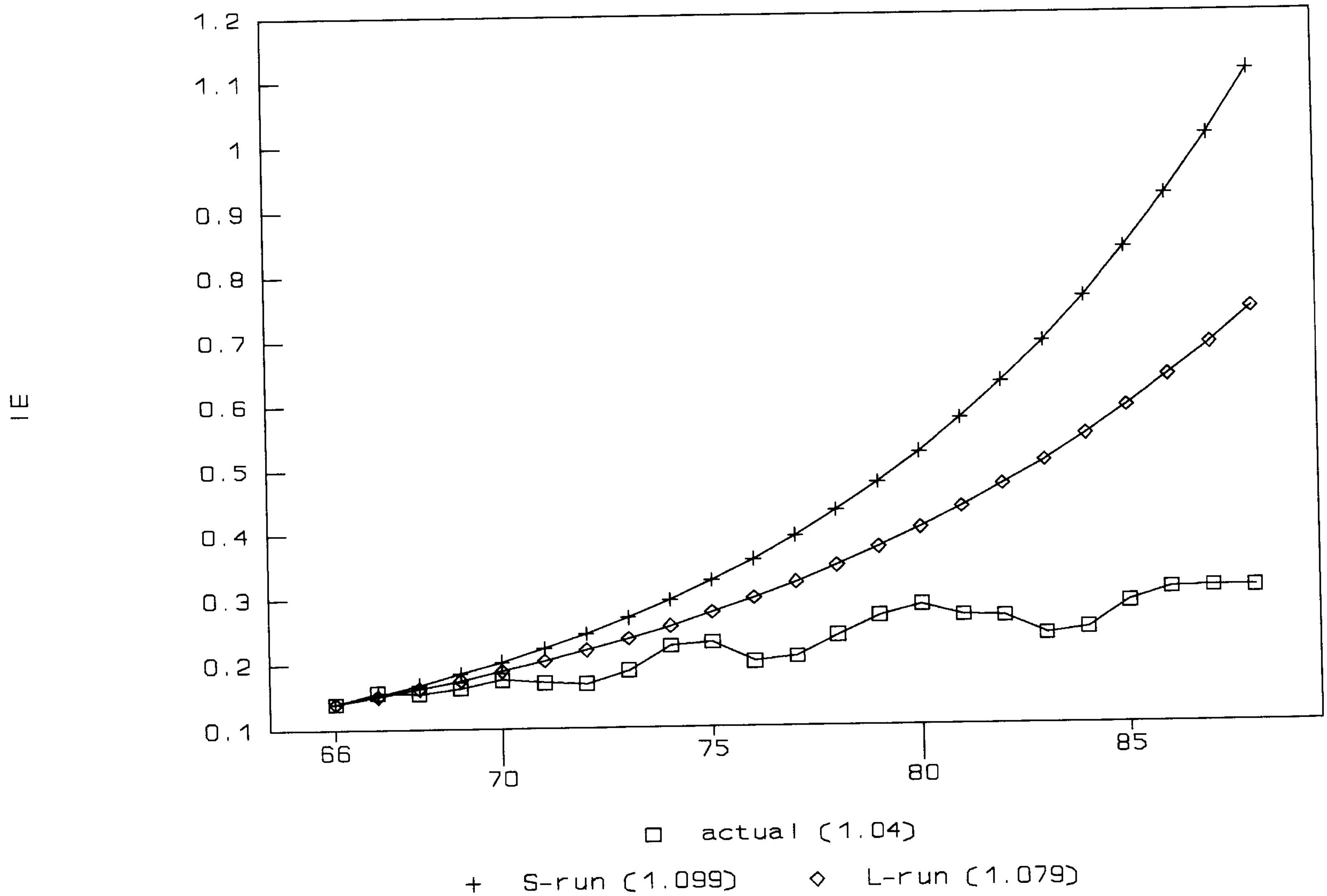


Fig. IV Private Equipment Investment

1987 $ 1966-87



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