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Economic Growth in a Cross Section of Countries*

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In two previous papers (Barro, 1988, 1989), I discussed recent theories of endogenous economic growth. Particularly in the second paper I analyzed empirical evidence about per capita growth, investment, secondary school enrollment, and population growth for a cross section of countries in the post-World War II period. I related the evidence to the theories, particularly in terms of the effects of initial income and of government expenditures on consumption and public investment. In this paper I extend this empirical analysis, giving special attention to the role of human capital as it interacts with the level of per capita income.

I. Effects of Initial Income and Human Capital

In models with diminishing returns to capital, the prediction is that per capita growth will be inversely related to the starting level of income or product per person. However, this convergence-type hypothesis seems to be inconsistent with the cross-country evidence, which indicates that per capita growth rates are uncorrelated with the starting level of per capita product. Figure 1 shows this type of relationship. For 94 countries, using the data from the Summers-Heston (1988) international comparison project, the average growth rate of per capita real GDP from 1960 to 1985 is unrelated to the 1960 value of real per capita GDP (the correlation is +.08).[1] This finding seems to be consistent with models that assume constant returns to a broad concept of capital, such as Rebelo (1987) and Lucas (1988).

[1] I use throughout the values of GDP expressed in terms of prices for the base year, 1980. Results using chain-weighted values of GDP were not very different.

Models with constant returns to physical and human capital together also allow for transitional dynamics. In the frameworks of Rebelo (1987) and Lucas (1988), the initial ratio of human to physical capital can depart from its steady-state value. For example, if human capital is high initially relative to physical capital (as in post-war situations where the main wartime destruction applied to physical capital), the subsequent path may feature high rates of physical investment and per capita growth. The general prediction is that rates of physical investment and per capita growth would be increasing in the starting ratio of human to physical capital.

Becker and Murphy (1988) allow for transitional dynamics related to the level of human capital per person. If rates of return on human capital are increasing over some range, increases in the quantity of human capital per person tend to lead to higher rates of investment in human and physical capital, and hence, to higher per capita growth. (This conclusion applies if the initial level of human capital per person is high enough to escape the underdevelopment trap.) A supporting force is that more human capital per person reduces fertility rates (because human capital is more productive in producing goods or additional human capital, rather than more children).

The existing theories suggest that growth rates and ratios of investment to GDP may relate to the starting value of human capital differently from the starting value of physical capital (which includes natural resources as well as reproducible capital). In practice, I use a proxy for human capital that is based on school enrollment rates, and use initial real per capita GDP to measure the starting value of physical capital. That is, given the human capital proxy, I view differences in per capita GDP as reflecting differences in reproducible capital or natural resources.

Table 1 shows regressions for annual growth rates of per capita real GDP. Most of the results apply from 1960 to 1985 for 94 countries (the largest sample on which I have been able to assemble data on the variables employed). The GDP data come Summers and Heston (1988), while other variables (to be detailed in a forthcoming appendix) are from the United Nations, the World Bank, the Banks (1979) data set, and some other sources. Means and standard deviations for all variables appear in Table 5. For the moment, I will concentrate on results related to the initial (1960) values of per capita GDP and the human capital proxies. The other variables, discussed later, are not strongly correlated with the initial values of GDP and human capital.

The two human capital proxies are the 1960 values of school-enrollment rates at the secondary (SEC60) and primary levels (PRIM60).[2] These variables measure number of students enrolled in the designated grade levels relative to the total population of a corresponding age group. (Because of this definition it is possible for the computed values to exceed 1.0.) With these school-enrollment rates (and, less importantly, the other explanatory variables) held constant, the estimated coefficient on starting income, GDP60, in regression 1 of Table 1 is negative and highly significant: -.0075, s.e. = .0012. Figure 2 plots the per capita growth rate, net of the value predicted by all explanatory variables except GDP60, versus GDP60. That is, the figure shows the partial correlation between the per capita growth rate and GDP60. In contrast with Figure 1, there is now a strong

[2]It would be better to use proxies for the initial stock of human capital per person, rather than variables that relate to the flow of investment in human capital per person. It may be possible to obtain a time series on school enrollments prior to 1960, and use a cumulation of this series to get better measures of initial stocks of human capital.

negative relationship (correlation = -.77). Thus, taken at face value, the results say that--holding constant a set of variables which includes proxies for human capital per person--higher initial per capita income is substantially negatively related to subsequent per capita growth. The sample range of variation in GDP60 (in 1980 U.S. dollars) from $237 to $7380 "explains" a spread in average per capita growth rates of about 5 percentage points. (The sample range in per capita growth rates is -1.6% to 7.2%, with a mean of 2.2%.)

The other strong finding is that per capita growth is positively related to initial human capital, holding fixed initial per capita GDP and the other variables shown in regression 1. The estimated coefficients of SEC60 and PRIM60 are individually significantly different from zero, with t-values of 2.7 and 3.1, respectively. A joint test for the significance of the two school-enrollment variables leads to the statistic, $F^2_{85} = 13.7$.

Figure 3 shows the relationship between the per capita growth rate, net of the value predicted by the regressors other than the school enrollment variables, and a linear combination of the 1960 values for the secondary and primary school enrollment rates. (The variable on the horizontal axis is .028*SEC60 + .019*PRIM60, corresponding to the coefficients estimated in regression 1 of Table 1.) The partial correlation of per capita growth with the human capital proxy is .69, as opposed to a simple correlation of .40. (The simple relation between per capita growth and the human capital measure is shown in Figure 4.)

Note from Figure 3 that the sample range of the human capital proxy "explains" a range of variation in per capita growth rates of about 5 percentage points; that is, roughly the same range as that related to GDP60

in Figure 2. Thus, given the strong positive correlation (.78) between GDP60 and the human capital measure, the results turn out to be consistent with the lack of a simple correlation between per capita growth and starting GDP, as shown in Figure 1. Increases in initial GDP per capita that are accompanied by the typical increase in human capital per person are not systematically related to subsequent growth. But increases in initial GDP per capita with human capital held fixed are strongly negatively related to subsequent growth. Similarly, increases in human capital with GDP60 held fixed are strongly positively related to subsequent growth.

The results can be highlighted by noting three kinds of situations (Harvard-style "case studies") where an imbalance between GDP per capita and human capital leads to significant effects on subsequent growth rates. For a country like Japan, the 1960 figures on the school-enrollment variables--especially the secondary school rate--are high relative to those typically associated with the 1960 value of GDP per capita. (The value for SEC60 is .74, compared to the value of .26 that would be predicted for Japan from a regression of SEC60 on a quadratic function of GDP60.) To some extent, this pattern likely reflects the residual influence from the destruction of physical capital during World War II. According to the regression, the relatively high value for initial school enrollment in Japan raised the estimated growth rate by .013, so that the fitted value of .057 is close to the actual of .055. Somewhat similar behavior applies to Korea, where the high values for school enrollment, relative to GDP60, raise the estimated growth rate by .011 (but the fitted value of .039 is still below the actual of .057).

The typical country in sub-Saharan Africa has 1960 school-enrollment rates that are low relative to the value associated with 1960 per capita GDP in the full sample of countries. This pattern likely reflects physical capital from the colonial era that is high in relation to the amount of initial human capital, as well as relatively high quantities of natural resources. For example, for Senegal, the relatively low values for school enrollment reduce the estimated growth rate by .009 (fitted value is .008 with an actual of .000), and for Ivory Coast by .006 (fitted value is .015 versus an actual of .008). Given the remaining explanatory power of an Africa dummy variable (as discussed below), it may be that the present functional form does not yet capture this effect fully.

Finally, the oil-exporting countries have high values of GDP60 relative to their 1960 school-enrollment rates. The sample of 94 countries includes five members of OPEC: Algeria, Gabon, Nigeria, Iran, and Venezuela.[3] Aside from Gabon, the relatively low values of school enrollment reduce the estimated growth rates by an average of .010. (This adjustment improves the fit for Nigeria and Venezuela, but worsens it for Algeria and Iran.) For Gabon, 1960 school enrollment is actually above normal, and this effect raises the estimated growth rate by .005 (so that the fitted value, .039, comes closer to the actual of .052).

Romer (1989) notes that a result such as that shown in Figure 2 would be sensitive to measurement error in GDP. If there is temporary measurement

[3]My earlier (1989) study deleted the oil countries. However, with initial measures of human capital included along with initial per capita GDP, these countries can be satisfactorily incoporated into the sample. Without the human capital variables, the oil countries particularly look like outliers with respect to fertility behavior (see below).

error, future growth rates of GDP will automatically have a negative correlation with the starting level. However, for this effect to account for much of the results, measurement error has to be very large, as well as temporary. For example, a 10% error in GDP, which is corrected over the subsequent 25 years, affects the computed average growth rate over the 25-year period by only -.004. This value contrasts with the range of variation of about .05 that GDP60 appears to explain.

If measurement error in GDP were short lived, no estimation problem would arise in the relation between the 1960 level of per capita GDP and, say, the average growth rate of per capita GDP from 1970 to 1985. Regression 3 in Table 1 shows that the estimated coefficients for GDP60, SECRAT60, and PRIM60 are not much affected by this change in the averaging period for the dependent variable. Thus, measurement error can be important for the results only if it is large and also persistent over periods longer than ten years. (In interpreting these results, one has to think that the convergence period associated with imbalances between the starting values of human and physical capital or with the starting level of human capital per person are much longer than that related to the persistence of measurement error. Since the values of GDP60 differ by a factor of 31, it is plausible that the intervals related to convergence would be much longer than ten years.)

Presumably, measurement error in GDP would be proportionately more important for the low-income countries. In fact, the squared residuals from regression 1 of Table 1 have a correlation of -.24 with GDP60. Regression 5 shows that the estimated coefficient on GDP60 changes little if the sample is restricted to the 54 countries for which GDP60 exceeds $1000 per capita. Regression 6 shows that the results also do not change greatly if the 94

observations are weighted by the square root of GDP60 (which is appropriate if the variance of the error term is proportional to the reciprocal of GDP60). Regression 7 indicates similar findings if the weight is the square root of population (where population is measured at the midpoint of the sample for each country). This standard weighting scheme is appropriate if the variance of the error term is proportional to the reciprocal of population.[4] However, the correlation of the square of the residuals from regression 1 with population is only -.12.

Regression 8 in Table 1 uses the human capital proxy employed by Romer (1989); the 1960 adult literacy rate. With the school enrollment rates entered, this variable is insignificant (and actually has a negative point estimate in the growth equation). The literacy rate is attractive in that it relates to the initial stock of human capital, rather than to the flow of investment. My conjecture is that the variable is insignificant because it is measured in an inconsistent way across countries, and is particularly inaccurate for the less-developed countries. The school enrollment rates, although not immune from measurement problems, are likely to be more accurate and more consistent cross-sectionally.

The theories where the initial values of human capital and per capita GDP matter for subsequent growth also suggest relations with fertility rates and investment ratios. Table 2 shows results for fertility. The variable FERT

[4]This weighting scheme arises if we think of a growth rate of per capita GDP as an average of independent values for each person in the population. Probably this view is an uninteresting theory of the error term, since the error would likely vanish in the mean of several million observations. If the error term relates to common aggregate forces or to model specification, there is no reason that population would be closely related to the error variance.

is the average of the 1965 and 1985 values of the World Bank's estimate of the total fertility rate (the projected average number of live births for the typical woman over her lifetime). FERTNET is FERT*(1 - MORTINF), where MORTINF is the average of the 1965 and 1985 values for the World Bank's figures on infant mortality rates. Thus, FERTNET is the per woman number of children who will live beyond the age of one. (Results are similar if child mortality between ages one and four is also considered--generally, the infant mortality rate is the dominant influence on pre-adult mortality.)

Figures 5 and 6 show the strongly negative simple correlations between FERTNET and GDP60 (-.72) and between FERTNET and the human capital proxy (-.85). (The human capital measure is 3.15*SEC60 + 1.40*PRIM60, based on regression 9 in Table 2). With GDP60 and the human capital variable entered simultaneously, as in regression 9 of Table 2, the two school-enrollment rates have significantly negative coefficients, while the coefficient of GDP60 is insignificant. Thus, for given income, more human capital is associated with lower fertility, as would be suggested by Becker and Murphy (1988), among others. For given human capital, higher income (which means more physical capital or natural resources) has an insignificant relation with fertility.

Regression 11 shows that, with no correction for infant mortality, FERT is positively related to infant mortality, MORTINF. But regression 12 indicates that MORTINF is no longer important when FERTNET is the dependent variable. That is, the adjustment of fertility rates to reflect the fraction of children that do not survive past the age of one is sufficient to account for most of the positive relation between fertility and child mortality.

Regression 13 shows that the literacy rate (LIT60) is insignificant for fertility, once the school-enrollment variables are included. Regression 14 indicates that population growth (averaged for each country from 1960 to 1985) relates to GDP60 and the human capital variables in a way consistent with the findings for fertility rates.

Table 3 shows results for ratios of real physical investment to real GDP. Regressions 15 and 16 refer to private investment, and regressions 17 and 18 to the total of private and public investment. The figures on the total investment ratio come from Summers and Heston (1988); note that these values reflect variations across countries in the ratio of the investment deflator to the GDP deflator. The numbers on the private investment ratios are the Summers-Heston figures less estimates of the ratio of real public investment to real GDP. The data on public investment are described in Barro (1989). (Figures on nominal public investment were divided by the Summers-Heston deflators for total investment, and were then divided by real GDP; this procedure is appropriate if deflators for total investment are good approximations to the deflators for public investment.) Values for public investment at the level of consolidated general government were found only for the 1970-85 period, and only for 75 countries. Therefore, the results for private investment apply to this limited sample.

The simple correlations of the private investment ratio are +.43 with GDP60 and +.64 with a human capital proxy (.14*SEC60 + .06*PRIM60, based on regression 15 of Table 3)--see Figures 7 and 8. With GDP60 and the school-enrollment variables entered together, as in regression 15 of Table 3, the estimated coefficients of SEC60 and PRIM60 are significantly positive, but that on GDP60 is significantly negative. Thus, for given human capital,

one way in which a higher value of GDP60 leads to lower per capita growth is through a lower ratio of physical investment to GDP.

Regression 17 shows results for the total investment ratio. (This variable is measured over the period 1960 to 1985, but the main difference from regression 15 is the shift from private to total investment, and not the change in the averaging interval for the dependent variable.) The results for total investment are broadly similar to those for private investment, but the estimated coefficient on GDP60 is smaller in magnitude.

II. Effects of Other Variables

A. Government Expenditures

In previous analysis I found that the ratio of real government consumption expenditure to real GDP (g^c/y) had a negative association with growth and investment. The argument was that government consumption had no direct effect on private productivity (or private property rights), but would reduce saving and growth through the distorting effects from taxation (or government expenditure programs). Government consumption is measured by the Summers-Heston (1988) figures on the ratio of real purchases to real GDP, less estimates of the ratio of nominal government spending on education and defense to nominal GDP. The idea is that spending for education and defense are more like public investment than public consumption; in particular, these expenditures are likely to affect private-sector productivity or property rights, which matter for private investment. I used nominal ratios for education and defense because deflators were unavailable, and because I thought that the Summers-Heston figures for the total government "consumption" deflator would not be appropriate for these components. (That

is, the deflator for GDP is probably as good as the deflator for government consumption.) Since the numbers on educational and defense expenditures were compiled for the 1970-85 period, the data on g^c/y also apply to this period.

The results in Table 1 indicate a significantly negative association between g^c/y and growth; for example, in regression 1 the estimated coefficient is -.14, s.e. = .03.[5] Figure 9 shows the nature of this relationship--the variable on the vertical axis is the per capita growth rate net of the fitted value obtained from all regressors other than g^c/y. Table 3 shows that g^c/y also has a negative association with private investment; the estimated coefficient in regression 15 is -.34, s.e. = .12. However, regression 17 shows that the relation with total investment is insignificant (-.12, s.e. = .11).

A negative effect of g^c/y on investment is one route whereby more government could reduce growth. However, even with the investment ratio held constant, the relation between g^c/y and growth is significantly negative. For example, in regression 19 of Table 4, which holds constant the total investment ratio (i/y), the estimated coefficient on g^c/y is -.13, s.e. = .03.

Regression 21 of Table 4 includes the public investment ratio, g^i/y, as an explanatory variable. The estimated coefficient, .16, s.e. = .08, is significantly positive. I discussed this variable in my earlier study (Barro, 1989), and mentioned some difficulties in interpreting this result in terms of the marginal product of public services. In any event, regression

[5] If entered separately, the ratios to GDP of government expenditures on education and defense are each insignificant in the regressions. These types of results were discussed in Barro (1989).

23 shows that public investment plays no special role once total investment, i/y, is also included as a regressor. Given i/y (which includes public investment one-to-one with private investment), the estimated coefficient on g^i/y is insignificant.

With the investment ratio, i/y, included in a growth equation--as in regression 19 of Table 4--the school-enrollment variables are less important than before. My interpretation is that one way that initial human capital affects growth is by influencing physical investment (regressions 15 and 17 of Table 3). That is, i/y is an endogenous variable that is determined jointly with growth by, among other things, the initial quantity of human capital.

B. War and Revolution

The variable WAR is a dummy, where a one indicates that the country participated in a "war" sometime over the period from 1960 to 1985 (see Barro, 1989, for a discussion). The variable REV, from Banks (1979), is the number of revolutions and coups per year over the sample, which is 1960-85 or a subset of these years when data were unavailable. Each of the variables WAR and REV are significantly negative for growth in Tables 1 and 4, and significantly negative for the investment ratio in some cases in Table 3. I interpret these variables as influences on property rights and thereby on investment and growth. However, regression 19 of Table 4 shows that the coefficients on WAR and REV are still negative for growth when the investment ratio, i/y, is held constant.

C. Economic System

Gastil (1987) divided countries into economic systems. I used this breakdown to construct a three-way division of countries into primarily socialist, mixed, and primarily free enterprise. The dummy variable for socialist (SOC = 1) is significantly negative on growth in Tables 1 and 4, but not for investment in Table 3. The dummy variable for mixed systems (MIXED) turned out to be insignificant for growth and investment. Since there are only 8 "socialist" countries in the 94-country sample, the results here are not very reliable. Also, regression 7 shows that the findings are sensitive to weighting by population.

D. Investment prices

It is often argued that distortions of market prices impact negatively on economic growth (see, for example, Agarwala, 1983.). Because of the intimate connection between investment and growth, such market interferences would be especially important if they apply to capital goods. As an attempt to quantify these types of market distortions for a large sample of countries, I considered the purchasing-power-parity numbers for investment goods that were computed by Summers and Heston (1988). It is well known (for example, from Balassa, 1964) that PPP ratios calculated with broad price indices (such as GDP deflators or consumer price indices) are systematically related to the level of economic development and perhaps to the presence of natural resources and other variables. Figure 10 shows the significantly positive relation for the 94 countries between the 1960 PPP ratio based on the GDP deflator (PPPY60) and GDP60. This relation presumably reflects the relatively low prices of services and some other non-traded goods in

low-income countries. On the other hand, Figure 11 indicates the absence of a regular relationship between the 1960 PPP ratio based on the investment deflator (PPPI60) and GDP60. To proxy for market distortions, I would have filtered out the normal relation of PPPI60 to variables such as the level of income. But, given the absence of a systematic relation in Figure 11, I calculated just the magnitude of the deviation of PPPI60 from the sample mean. In this view, either unusually high investment prices or unusually low investment prices proxy for distortions.

The regressions in Table 1 indicate a significantly negative relation between growth and the magnitude of the PPPI60 deviation (denoted PPI60DEV); the estimated coefficient in regression 1 is -.015, s.e. = .005. This result implies that a one-standard-error (.26) increase in the magnitude of PPPI60 is associated with a reduction in the per capita growth rate by 4-tenths of a percentage point. On the other hand, the sign of the deviation does not seem to matter; if the algebraic value for PPPI60 is added to the equation, its estimated coefficient is insignificant (.000, s.e. = .005), while that on PPI60DEV remains significant (-.015, s.e. = .007). Not surprisingly, the results in Table 3 indicate that the algebraic value for PPPI60 matters negatively for the investment ratios. (However, this relationship could be induced from measurement error in the investment price deflators.) These results on the relation of growth and investment to investment prices are preliminary, and I plan to look further into alternative measures of price distortions.

E. Africa and Latin America

A common view is that countries in Africa or Latin America have poorer

growth performances than other countries. Of course, if the nature of being in Africa or Latin America is already held constant by the other explanatory variables, continent dummies would be insignificant in equations for growth, fertility, or investment. Thus, the finding of significant coefficients on these dummies would indicate that some regularities are missing from the model.

The dummy variable AFRICA receives the value one for countries in sub-Saharan Africa (not including the island Mauritius, for which the majority of the population is of Indian descent). The dummy variable LAT. AMER. equals one for countries in South and Central America, including Mexico.

The results for growth rates in Table 1 (regressions 1 and 3) indicate that the estimated coefficient on AFRICA is significantly negative, with a magnitude of about one percentage point per year. The variable AFRICA is significantly positive for fertility (regression 10 of Table 2), and insignificant for the investment ratio (regressions 16 and 18 of Table 3). Holding fixed the investment ratio in regression 20 of Table 4, the estimated coefficient of AFRICA in a growth equation is still significantly negative, with a value of about -.01. (With FERTNET also held constant, the estimated coefficient of AFRICA is -.009, s.e. = .004.) Thus, there appear to be remaining effects on growth from being in sub-Saharan Africa, and these effects do not seem to result from the unexplained behavior of investment ratios or fertility.

The variable LAT. AMER. is also significantly negative for growth (regressions 1 and 3 of Table 1), significantly positive for fertility (regression 10 of Table 2), and insignificant for the investment ratio

(regressions 16 and 18 of Table 3). Again (Table 4, regression 20), the negative effects on growth appear even when the investment ratio (or fertility) is held constant. The magnitudes of the effects for LAT. AMER. are similar to those for AFRICA. Thus, it appears that something is also missing to explain the typically weak growth performance in Latin America.

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Table 1: Regressions for Per Capita Growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
const.	.0391 (.0065)	.0430 (.0067)	.0371 (.0084)	.0437 (.0081)	.0475 (.0086)	.0393 (.0063)	.0366 (.0055)	.0377 (.0066)
GDP60	-.0075 (.0012)	-.0071 (.0011)	-.0085 (.0015)	-.0079 (.0014)	-.0067 (.0012)	-.0061 (.0008)	-.0070 (.0009)	-.0070 (.0012)
SEC60	.0278 (.0104)	.0143 (.0106)	.0319 (.0134)	.0089 (.0128)	.0228 (.0102)	.0248 (.0068)	.0271 (.0072)	.0333 (.0113)
PRIM60	.0188 (.0061)	.0198 (.0061)	.0189 (.0078)	.0207 (.0074)	.0118 (.0081)	.0141 (.0059)	.0223 (.0053)	.0259 (.0085)
g^c/y	-.137 (.027)	-.116 (.026)	-.157 (.035)	-.122 (.032)	-.134 (.029)	-.111 (.023)	-.160 (.026)	-.135 (.027)
WAR	-.0059 (.0030)	-.0065 (.0029)	-.0070 (.0038)	-.0080 (.0035)	-.0094 (.0037)	-.0053 (.0027)	-.0054 (.0023)	-.0057 (.0030)
REV	-.0168 (.0067)	-.0129 (.0065)	-.0221 (.0086)	-.0154 (.0079)	-.0165 (.0092)	-.0183 (.0066)	-.0164 (.0055)	-.0158 (.0067)
SOC	-.0152 (.0047)	-.0147 (.0045)	-.0161 (.0061)	-.0151 (.0054)	-.0177 (.0079)	-.0185 (.0064)	-.0018 (.0048)	-.0150 (.0047)
PPI60DEV	-.0147 (.0053)	-.0143 (.0051)	-.0157 (.0068)	-.0151 (.0062)	-.0247 (.0114)	-.0224 (.0067)	-.0147 (.0044)	-.0150 (.0053)
AFRICA	--	-.0098 (.0039)	--	-.0168 (.0047)	--	--	--	--
LAT.AMER.	--	-.0105 (.0032)	--	-.0180 (.0039)	--	--	--	--
LIT60	--	--	--	--	--	--	--	-.0118 (.0100)
weight	--	--	--	--	--	$\sqrt{GDP60}$	$\sqrt{POP}$	--
R^2	.59	.64	.52	.63	.66	.56 (.73)	.54 (.85)	.59
$\hat{\sigma}$	.0120	.0113	.0154	.0137	.0102	.0123 (.0108)	.0126 (.0113)	.0119

Notes to Table 1: All samples have 94 observations, except for regression 5, which has 54 observations. Standard errors of coefficient estimates appear in parentheses.

For columns 1, 2, 5-8, the dependent variable is the growth rate of per capita GDP from 1960 to 1985. For columns 3 and 4, the growth rate is from 1970 to 1985.

GDP60 is the 1960 value of real per capita GDP (1980 base year), SEC60 is the 1960 value of the secondary-school enrollment rate, PRIM60 is the 1960 value of the primary school enrollment rate, g^c/y is an average from 1970 to 1985 for the ratio of real government consumption to real GDP, WAR is a dummy for the presence of war, REV is the number of revolutions and coups per year, SOC is a dummy for socialistic economic system, PPI60DEV is the magnitude of the deviation from the sample mean of the 1960 PPP value based on the investment deflator, AFRICA is a dummy for sub-Saharan Africa, LAT.AMER. is a dummy for Latin America, LIT60 is the 1960 adult literacy rate.

For regression 5, only the 54 observations with GDP60 above $1000 per capita were used. For regression 6, the observations are weighted by $\sqrt{GDP60}$, and for regression 7 by $\sqrt{POP}$, where POP is population at the midpoint of the sample. In these cases the statistics for R^2 and $\hat{\sigma}$ shown in parentheses are the weighted values.

Table 2: Regre[illegible] for Fertility

	(9)	(10)	(11)	(12)	(13)	(14)
dep. var.	FERTNET	FERTNET	FE[illegible]	FERTNET	FERTNET	POPGR
const.	6.00 (0.40)	5.75 (0.42)	5.[illegible] (0.[illegible])	5.06 (0.71)	5.91 (0.41)	.0322 (.0035)
GDPGO	-.101 (.074)	-.120 (.072)	-.0[illegible] ([illegible])	-.095 (.073)	-.073 (.077)	-.0007 (.0006)
SECGO	-3.15 (0.64)	-2.43 (0.67)	-2.[illegible] (0.[illegible])	-2.63 (0.71)	-2.79 (0.70)	-.0228 (.0056)
PRIMGO	-1.49 (0.37)	-1.51 (0.38)	-1.[illegible] (0.[illegible])	-1.96 (0.50)	-1.02 (0.52)	-.0062 (.0033)
g^c/y	1.7 (1.7)	0.6 (1.7)	1.3 (1.8)	1.3 (1.7)	1.8 (1.7)	-.015 (.015)
WAR	.27 (.18)	.31 (.18)	.[illegible] ([illegible])	.25 (.18)	.29 (.18)	.0011 (.0016)
REV	-.15 (.41)	-.34 (.41)	-.[illegible] ([illegible])	-.28 (.42)	-.09 (.42)	-.0007 (.0036)
SOC	.25 (.29)	.21 (.28)	.[illegible] (.[illegible])	.28 (.29)	.27 (.29)	-.0001 (.0025)
PPIGODEV	.36 (.33)	.32 (.32)	.[illegible] ([illegible])	.40 (.32)	.34 (.33)	.0023 (.0028)
AFRICA	--	.57 (.24)	--	--	--	--
LAT.AMER.	--	.53 (.20)	--	--	--	--
LITGO	--	--	--	--	-.79 (.61)	--
MORTINF	--	--	.0[illegible] (.0[illegible])	.0061 (.0038)	--	--
R^2	.77	.80	.8[illegible]	.78	.78	.60
$\hat{\sigma}$	.74	.71	.7[illegible]	.73	.74	.0064

Notes: 94 observations apply to each regression. FERT is the total fertility rate (average for 1965 and [illegible]), FERTNET is FERT adjusted for infant mortality (averaged for 1965 [illegible] 1985), POPGR is population growth from 1960 to 1985, MORTINF is the infant mortality rate (average for 1965 and 1985). See the notes to Table 1 for additional information.

Table 3: Regressions for Investment Ratios

	(15)	(16)	(17)	(18)
dep. var.	i^{priv}/y	i^{priv}/y	i/y	i/y
const.	.200 (.034)	.184 (.040)	.183 (.031)	.170 (.031)
GDP60	-.0108 (.0049)	-.0105 (.0049)	-.0063 (.0050)	-.0057 (.0049)
SEC60	.140 (.043)	.126 (.046)	.148 (.043)	.150 (.046)
PRIM60	.065 (.030)	.091 (.033)	.089 (.025)	.108 (.026)
g^c/y	-.34 (.12)	-.33 (.12)	-.12 (.11)	-.12 (.11)
WAR	-.028 (.013)	-.025 (.013)	-.014 (.012)	-.009 (.012)
REV	-.048 (.028)	-.027 (.030)	-.058 (.028)	-.046 (.028)
SOC	.020 (.029)	.020 (.029)	.020 (.020)	.015 (.019)
PPI60DEV	.030 (.030)	.026 (.030)	.061 (.028)	.063 (.028)
PPPI60	-.063 (.021)	-.072 (.021)	-.095 (.020)	-.108 (.021)
AFRICA	--	.017 (.021)	--	.023 (.017)
LAT.AMER.	--	-.021 (.015)	--	-.018 (.014)
R^2	.61	.63	.65	.67
$\hat{\sigma}$	.046	.046	.050	.048

Notes: i^{priv}/y is the average from 1970 to 1985 of the ratio of real private investment to real GDP, i/y is the average from 1960 to 1985 of the ratio of real total investment (private plus public) to real GDP, PPPI60 is the 1960 value of the PPP ratio based on the investment deflator.

Regressions 15 and 16 have 75 observations, regressions 17 and 18 have 94 observations. See the notes to Table 1 for additional information.

Table 4: Interactions between Growth and Investment

	(19)	(20)	(21)	(22)	(23)	(24)
const.	.0312	.0359	.0402	.0454	.0296	.0363
	(.0067)	(.0067)	(.0079)	(.0080)	(.0083)	(.0082)
GDP60	-.0071	-.0067	-.0073	-.0071	-.0066	-.0064
	(.0011)	(.0011)	(.0011)	(.0011)	(.0066)	(.0010)
SEC60	.0188	.0067	.0292	.0163	.0208	.0096
	(.0103)	(.0103)	(.0100)	(.0099)	(.0098)	(.0096)
PRIM60	.0109	.0119	.0112	.0121	.0052	.0057
	(.0063)	(.0063)	(.0069)	(.0071)	(.0068)	(.0071)
g^c/y	-.112	-.111	-.130	-.115	-.102	-.091
	(.026)	(.025)	(.029)	(.027)	(.029)	(.027)
WAR	-.0051	-.0058	-.0050	-.0069	-.0027	-.0049
	(.0029)	(.0027)	(.0030)	(.0029)	(.0029)	(.0028)
REV	-.0130	-.0098	-.0172	-.0122	-.0146	-.0106
	(.0065)	(.0062)	(.0066)	(.0065)	(.0063)	(.0062)
SOC	-.0170	-.0163	-.0191	-.0183	-.0214	-.0205
	(.0045)	(.0043)	(.0067)	(.0062)	(.0063)	(.0059)
PPI60DEV	-.0129	-.0125	-.0165	-.0152	-.0141	-.0128
	(.0050)	(.0049)	(.0051)	(.0050)	(.0048)	(.0048)
i/y	.072	.067	--	--	.081	.073
	(.022)	(.021)			(.027)	(.025)
g^i/y	--	--	.157	.145	-.002	.006
			(.077)	(.072)	(.090)	(.084)
AFRICA	--	-.0099	--	-.0105	--	-.0106
		(.0037)		(.0044)		(.0041)
LAT.AMER.	--	-.0095		-.0110	--	-.0099
		(.0031)		(.0032)		(.0031)
R^2	.63	.68	.64	.70	.68	.74
$\hat{\sigma}$	.0114	.0107	.0108	.0099	.0102	.0094

Notes: The dependent variable is the growth rate of real per capita GDP from 1960 to 1985. Regressions 19 and 20 have 94 observations, regressions 21-24 have 75 observations. g^i/y is the average from 1970 to 1985 of the ratio of real public investment to real GDP. In regressions 19 and 20, i/y is the average from 1960 to 1985 of the ratio of real total investment to real GDP. In regressions 23 and 24, i/y is an average from 1970 to 1985. See the notes to Table 1 for additional information.

Table 5: Means and Standard Deviations of Variables

Variable	94-country sample Mean	94-country sample σ	75-country sample Mean	75-country sample σ
growth [illegible] (70-85)	.022	.018	.023	.017
growth [illegible] (70-85)	.015	.021	.017	.021
i/[illegible]	.191	.079	.205	.077
i/y (70-85)	.196	.079	.208	.076
i[illegible]	--	--	.175	.069
FE[illegible]	4.24	1.49	4.04	1.49
FE[illegible]T	4.67	1.81	4.41	1.80
M[illegible]INP	.075	.051	.066	.048
P[illegible]	.020	.010	.018	.009
P[illegible])	23.9	64.3	26.3	71.0
G[illegible] (1000)	1.97	1.83	2.23	1.90
G[illegible] (1000)	3.75	3.51	4.23	3.61
S[illegible]	.23	.22	.27	.22
S[illegible]	.53	.29	.59	.28
P[illegible]	.80	.31	.85	.28
PRIM85	.96	.18	.98	.16
g[illegible]/y	.105	.052	.106	.054
g[illegible]/y	--	--	.033	.017
WAR (dummy)	.37	.49	.36	.48
REV	.17	.23	.16	.23
S[illegible] (dummy)	.09	.28	.04	.20
M[illegible] (dummy)	.47	.50	.49	.50
P[illegible]	.23	.26	.25	.28
PPP60	.76	.34	.74	.37
PPPY60	.58	.19	.60	.18
L[illegible]	.57	.33	.63	.31
AF[illegible] (dummy)	.26	.44	.19	.39
LA[illegible] (dummy)	.24	.43	.25	.44

List of Countries in Samples

ID number	Country	Missing from 75-country sample (*)
1.	Algeria	*
4.	Botswana	
5.	Burundi	*
6.	Cameroon	
7.	Central African Repub.	*
10.	Egypt	
11.	Ethiopia	*
12.	Gabon	*
14.	Ghana	
16.	Ivory Coast	*
17.	Kenya	
19.	Liberia	
20.	Madagascar	*
21.	Malawi	
24.	Mauritius	
25.	Morocco	
28.	Nigeria	*
29.	Rwanda	*
30.	Senegal	
31.	Sierra Leone	
33.	South Africa	
35.	Swaziland	
37.	Togo	*
38.	Tunisia	
39.	Uganda	
40.	Zaire	
41.	Zambia	
42.	Zimbabwe	*
43.	Bangladesh	*
44.	Burma	
45.	Hong Kong	*
46.	India	
47.	Iran	
49.	Israel	
50.	Japan	
51.	Jordan	
52.	Korea (South)	
54.	Malaysia	
55.	Nepal	*
56.	Pakistan	

ID number	Country	Missing from 75-country sample (*)
57.	Philippines	
59.	Singapore	
60.	Sri Lanka	
63.	Thailand	
64.	Austria	
65.	Belgium	
66.	Cyprus	
67.	Denmark	
68.	Finland	
69.	France	
70.	Germany (West)	
71.	Greece	
72.	Iceland	
73.	Ireland	
74.	Italy	
75.	Luxembourg	
76.	Malta	
77.	Netherlands	
78.	Norway	
79.	Portugal	*
80.	Spain	
81.	Sweden	
82.	Switzerland	
83.	Turkey	
84.	United Kingdom	
85.	Barbados	
86.	Canada	
87.	Costa Rica	
88.	Dominican Republic	
89.	El Salvador	
90.	Guatemala	
91.	Haiti	*
92.	Honduras	*
93.	Jamaica	*
94.	Mexico	
95.	Nicaragua	
96.	Panama	
97.	Trinidad and Tobago	*
98.	United States	
99.	Argentina	

ID number	Country	Missing from 75-country sample (*)
100.	Bolivia	
101.	Brazil	
102.	Chile	
103.	Colombia	
104.	Ecuador	
105.	Guyana	
106.	Paraguay	
107.	Peru	
109.	Uruguay	
110.	Venezuela	
111.	Australia	
112.	Fiji	
113.	New Zealand	
114.	Papua New Guinea	

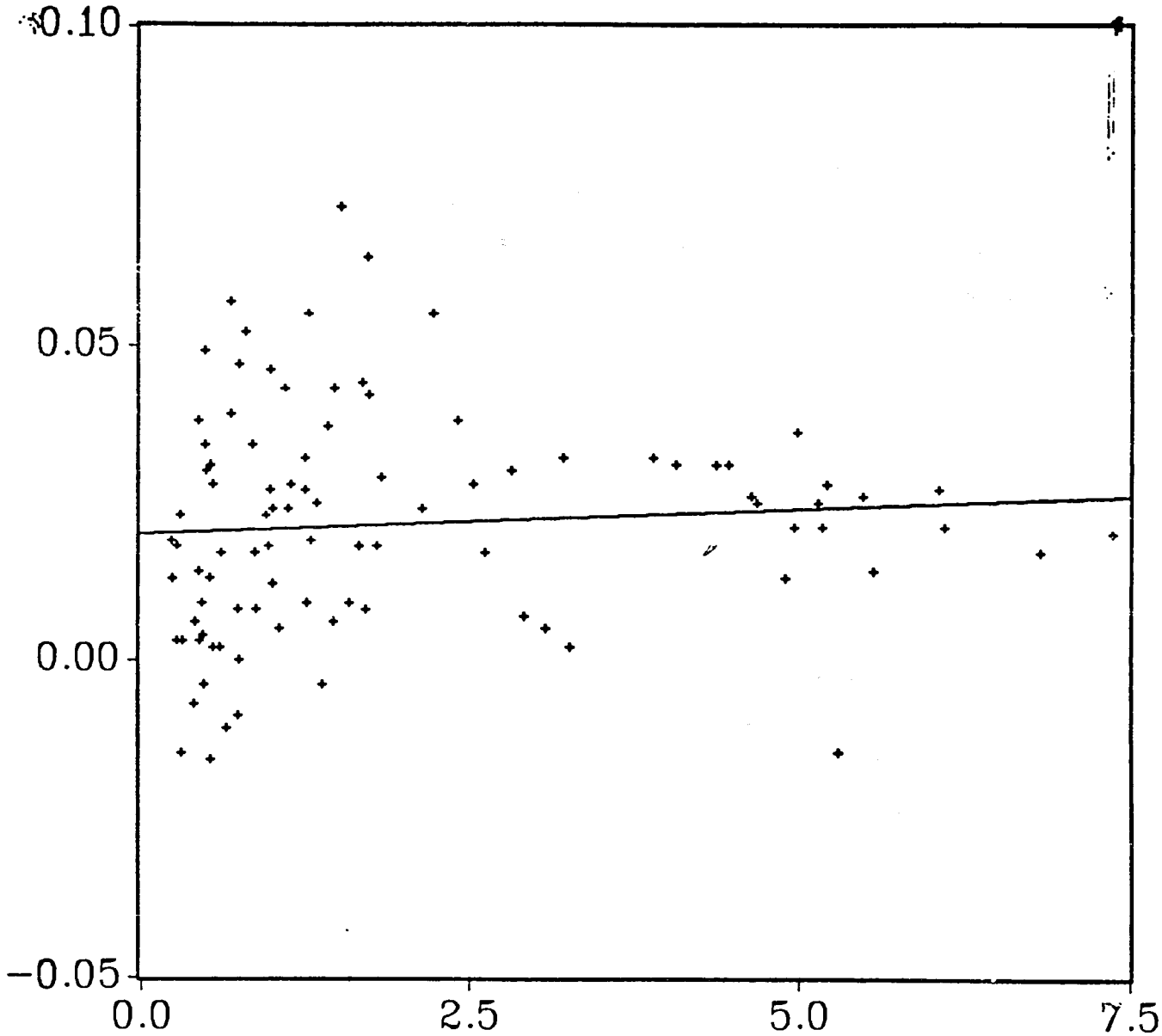

Figure 1 Per Capita Growth Rate versus 1960 GDP per capita

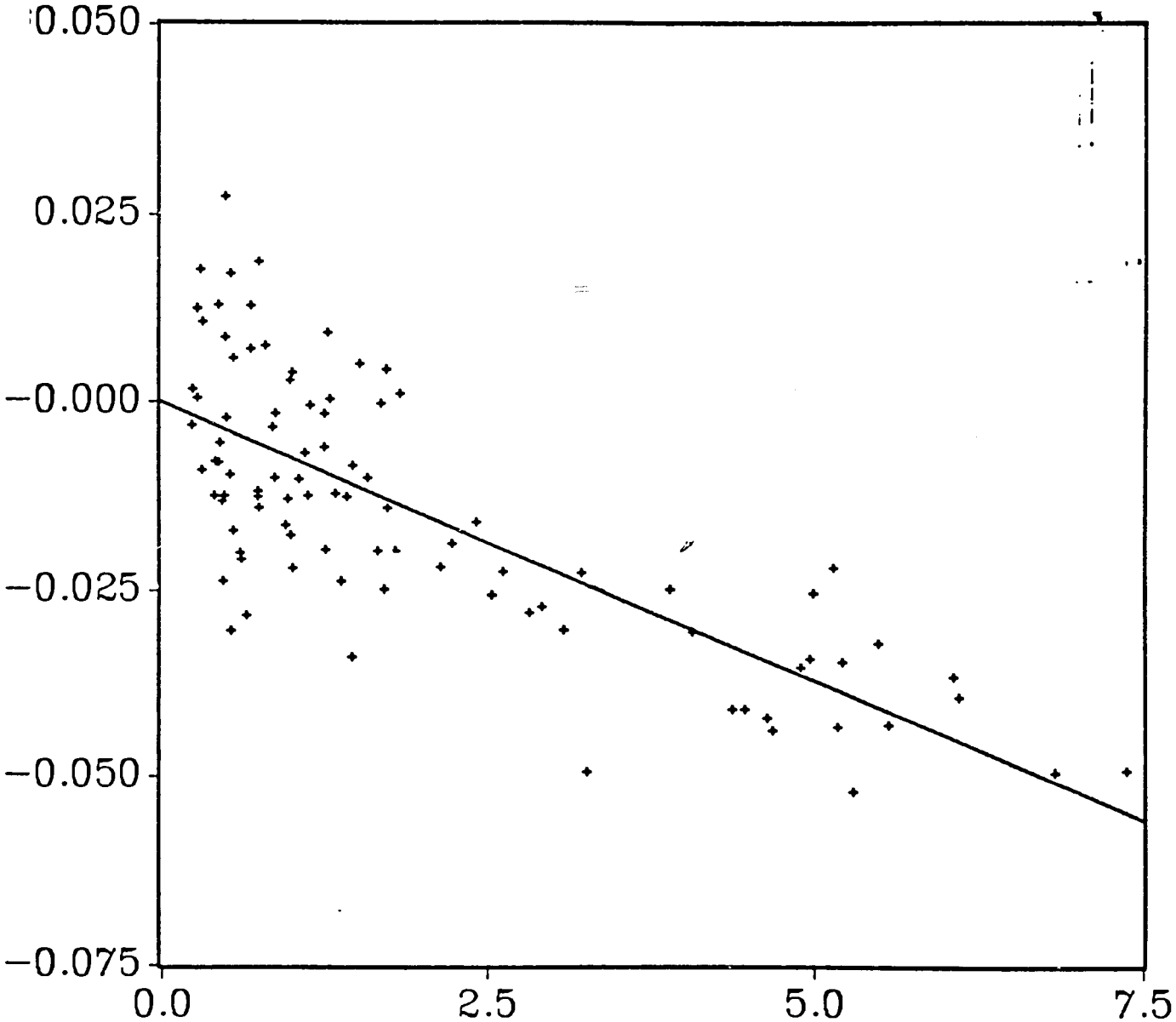

Figure 2 Partial Association between per capita Growth and 1960 GDP per capita (from Regression 1 of Table 1)

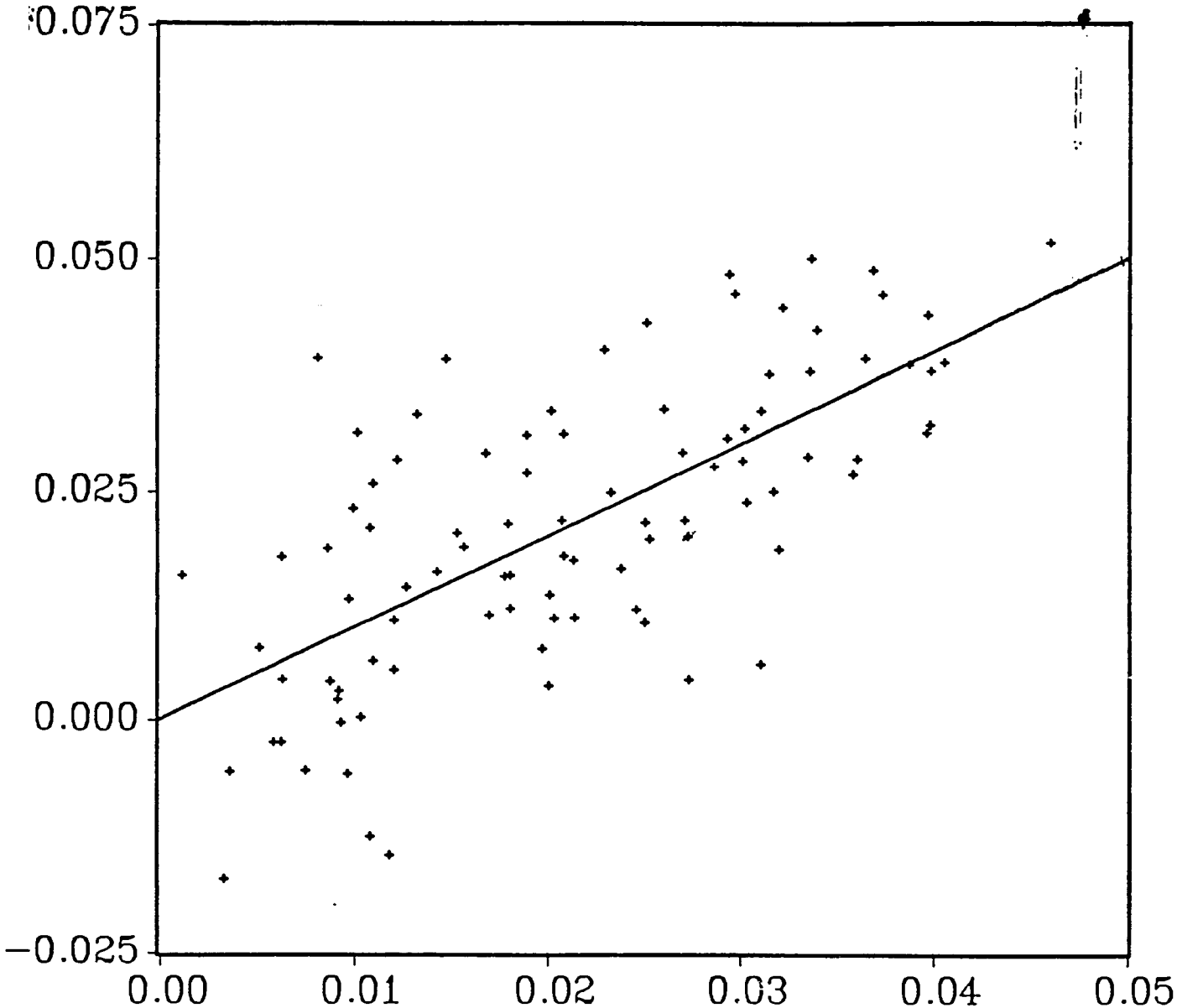

Figure 3 Partial Association between per capita Growth and School–Enrollment Variables (from Regression 1 of Table 1)

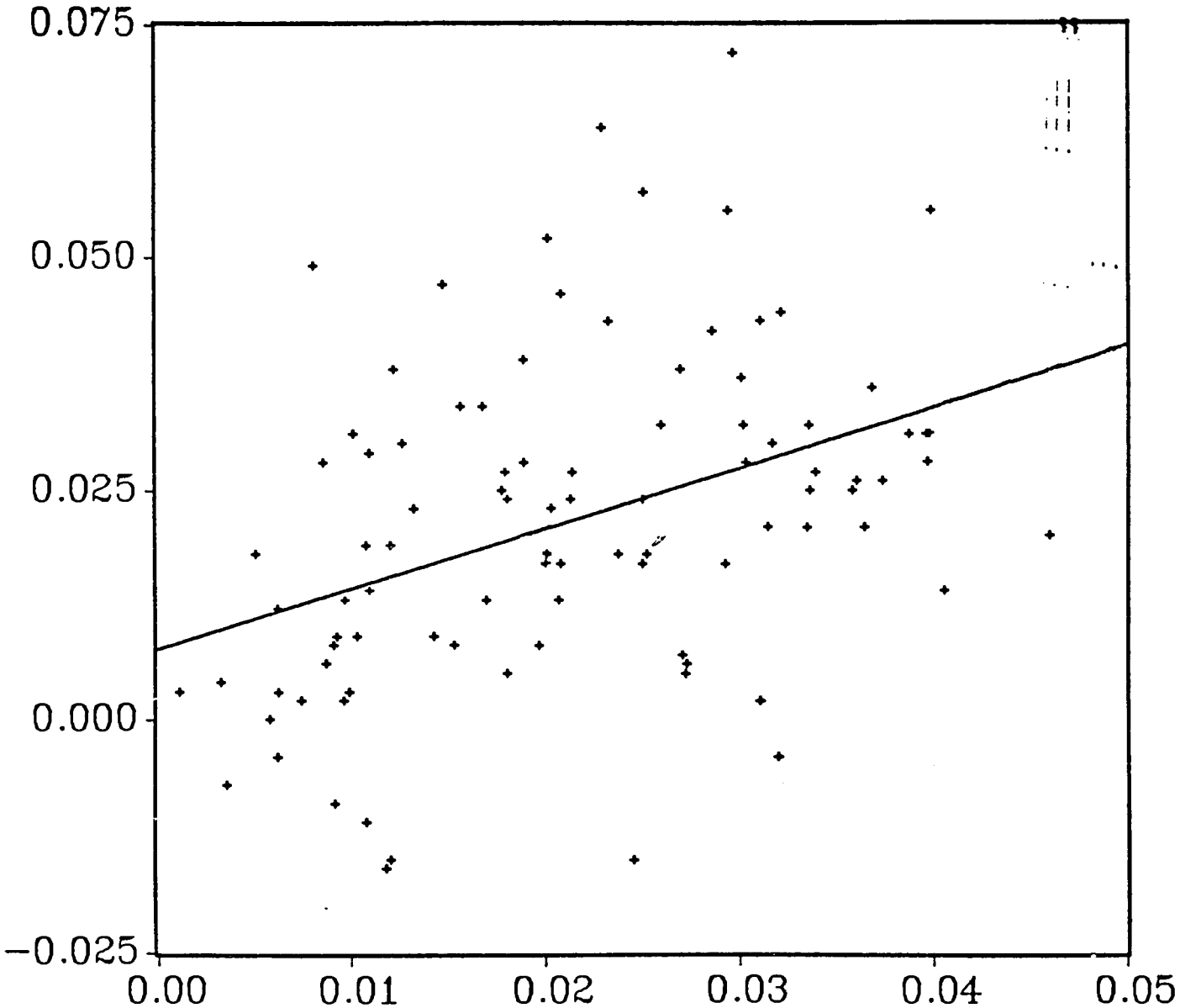

Figure 4 Per capita Growth versus School–Enrollment Variables (.0278*SEC60 + .0188*PRIM60)

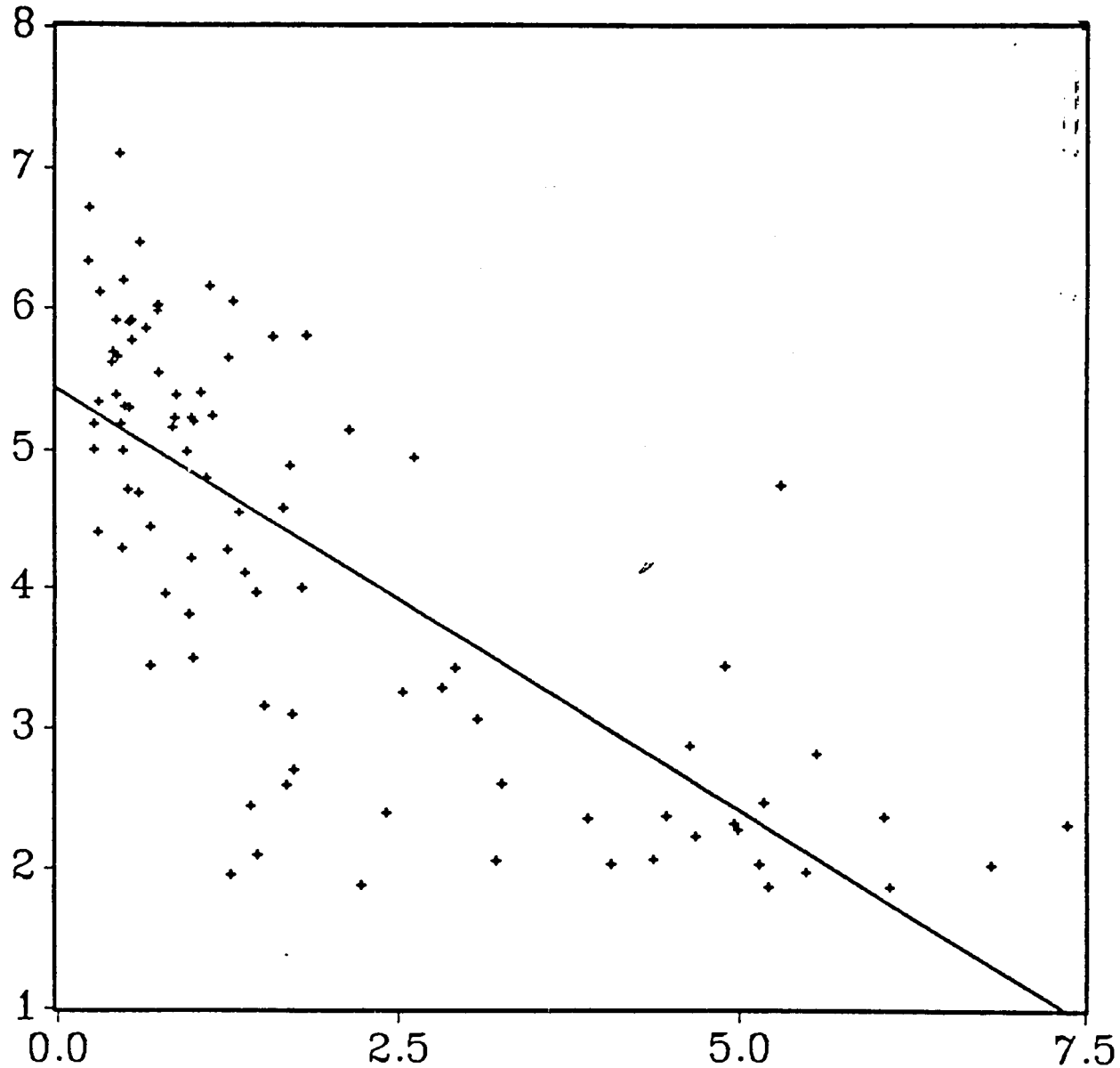

Figure 5 Net Fertility (FERTNET) versus 1960 GDP per capita

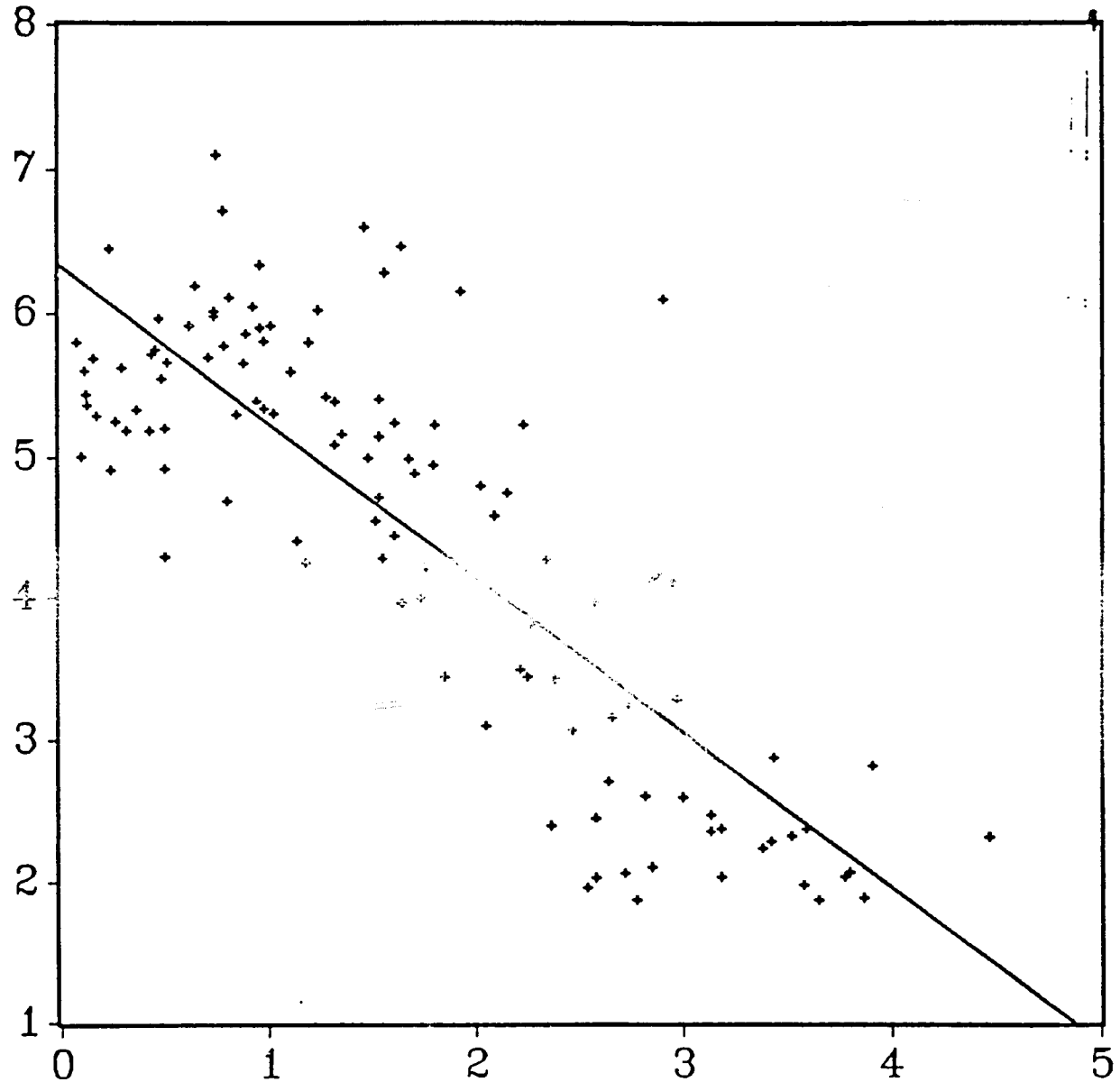

Figure 6 Net Fertility (FERTNET) versus School-Enrollment Variables (3.150*SEC60 + 1.495*PRIM60)

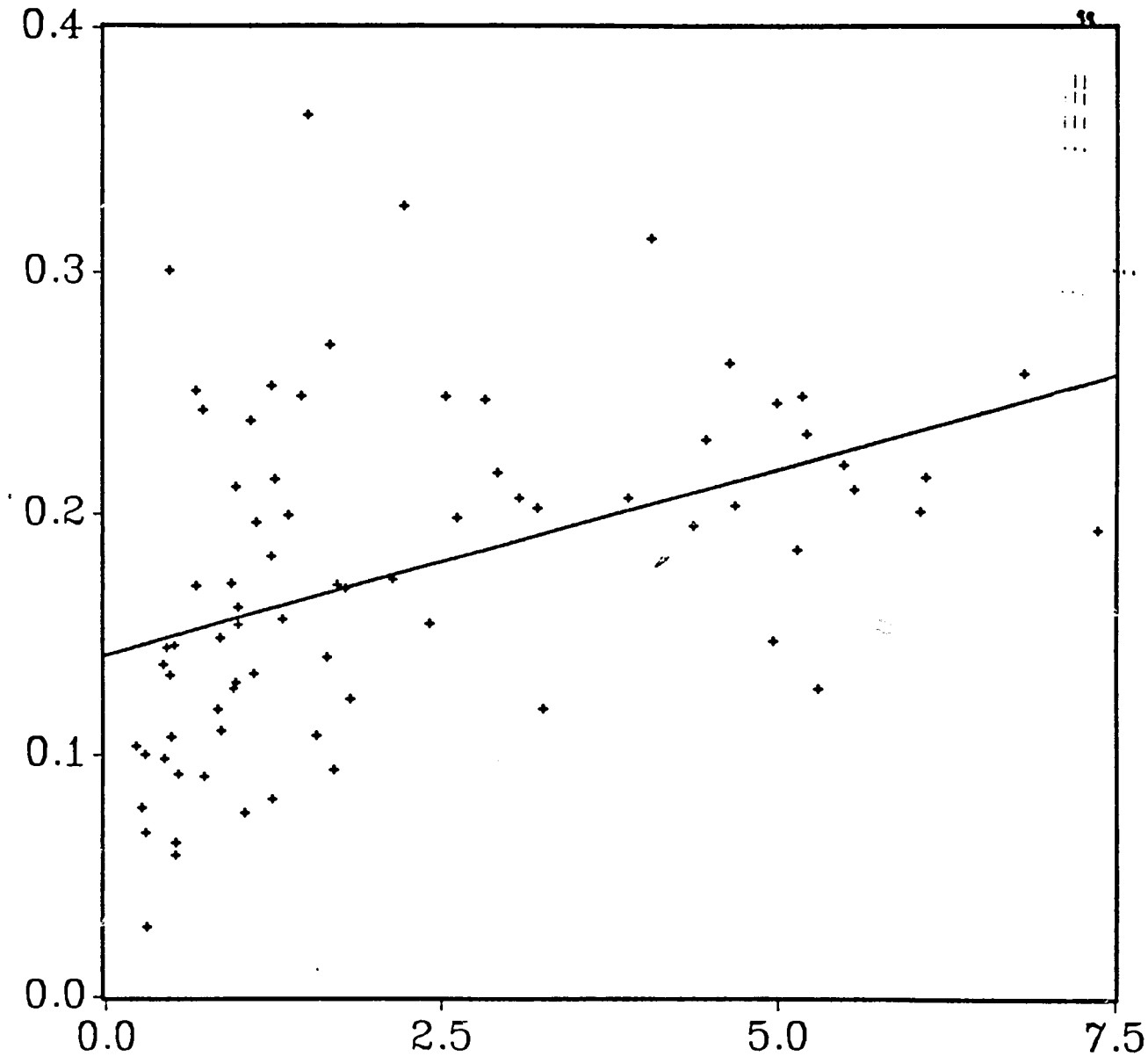

Figure 7 Ratio of Private Investment to GDP versus 1960 GDP per capita

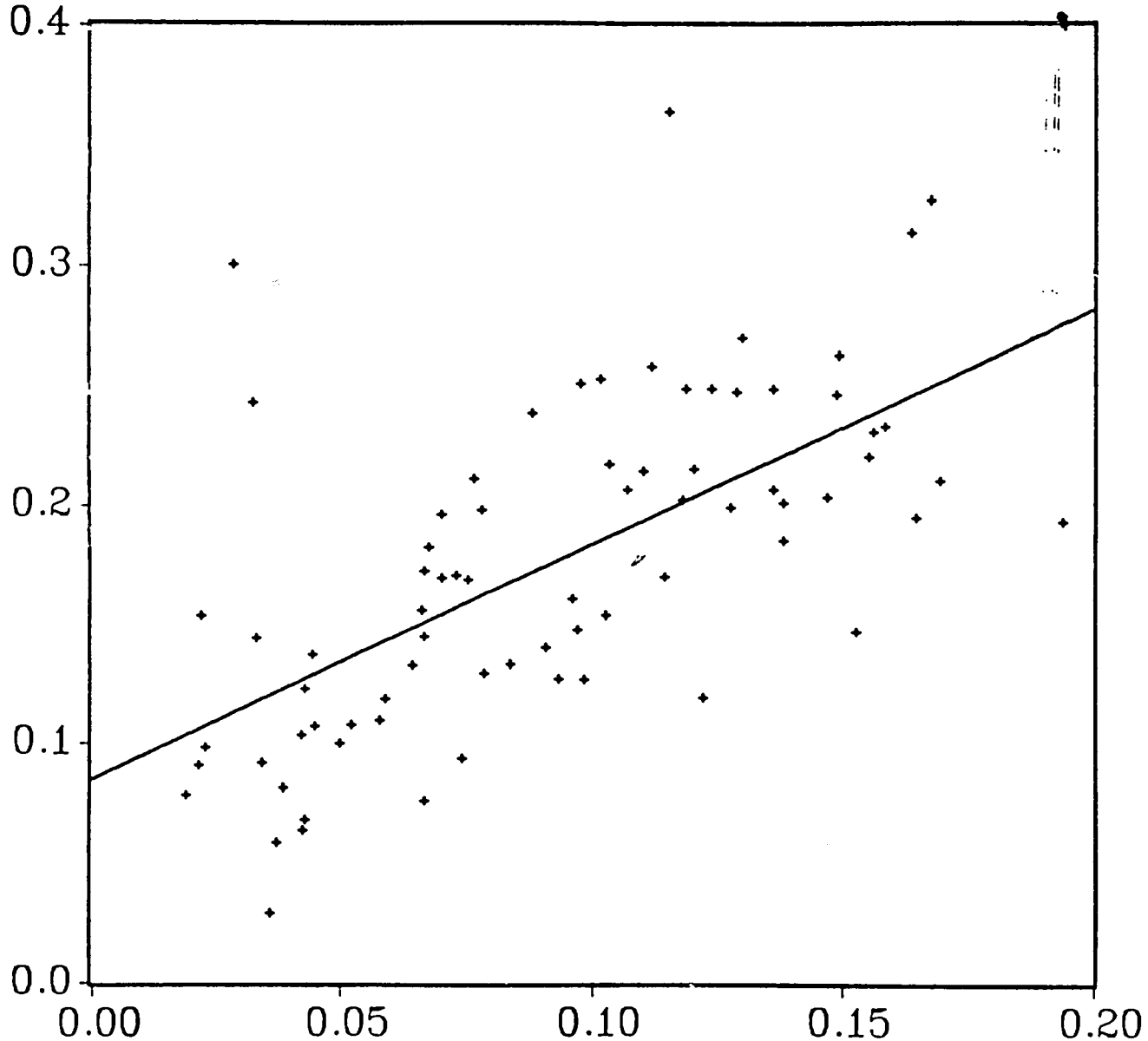

Figure 8 Ratio of Private Investment to GDP versus School–Enrollment Variables (.136*SEC60 + .065*PRIM60)

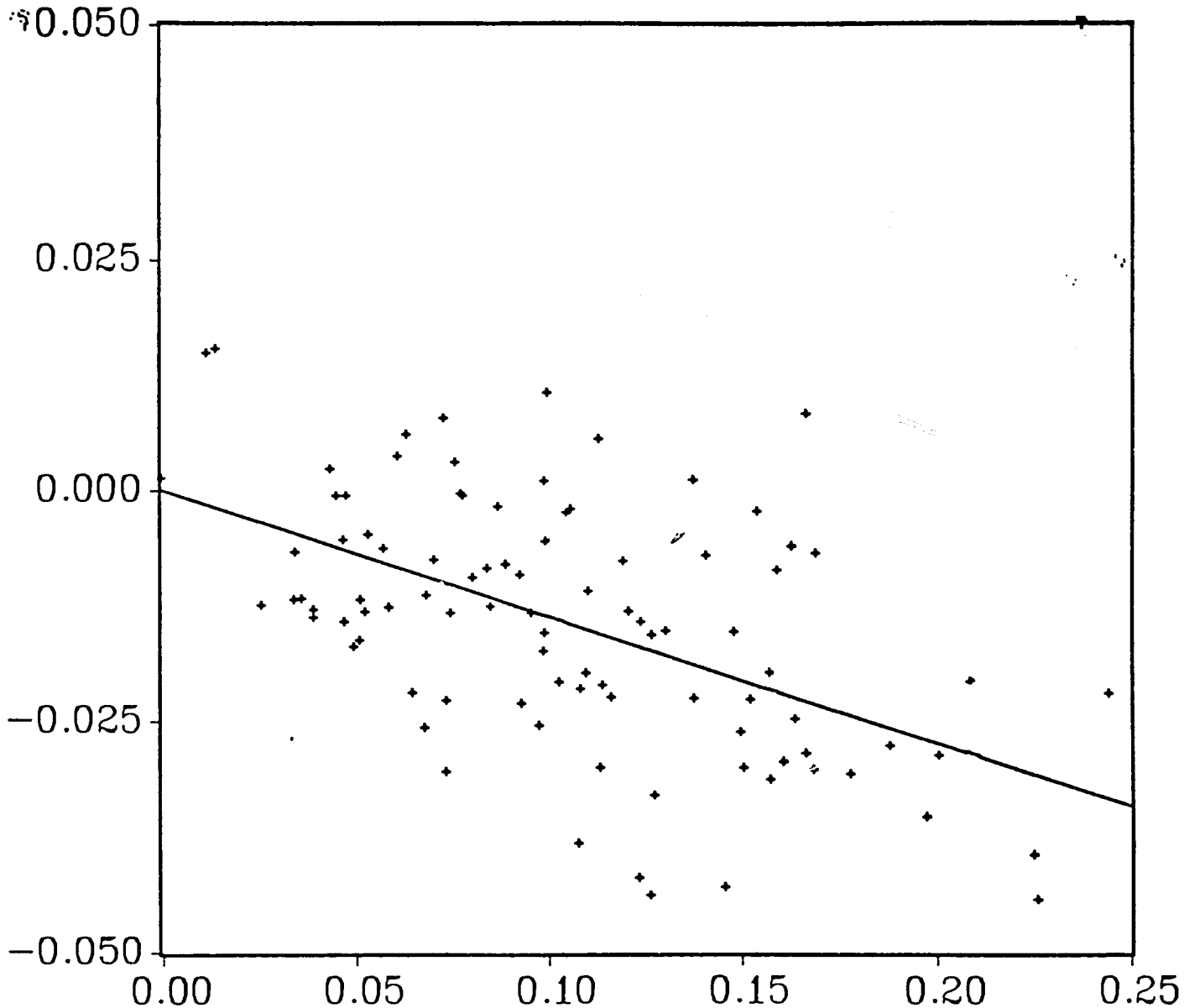

Figure 9 Partial Association between per capita Growth and g^c/y (from Regression 1 of Table 1)

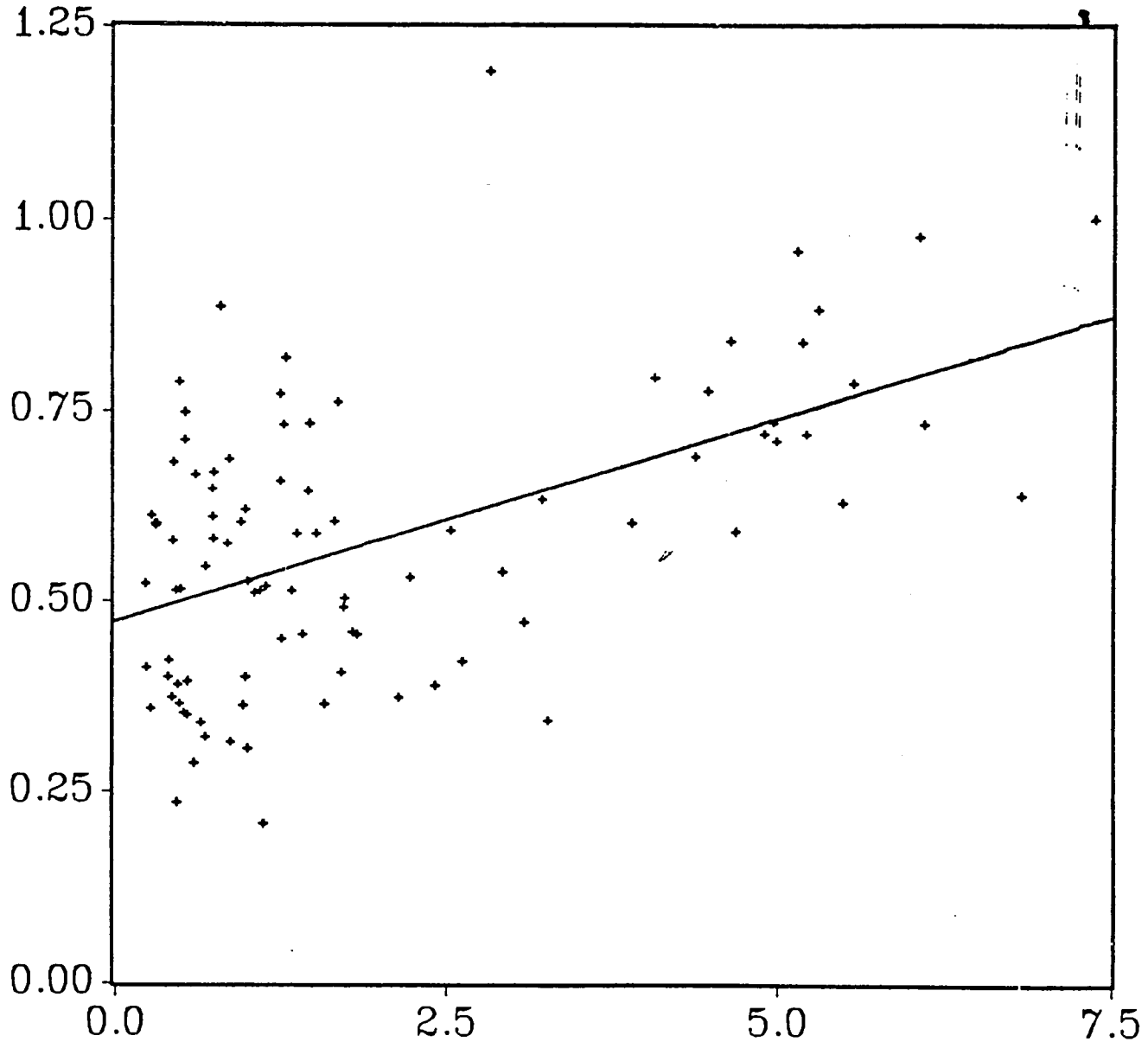

Figure 10 1960 PPP Ratio for GDP Deflator (U.S. = 1.0) versus 1960 GDP per capita

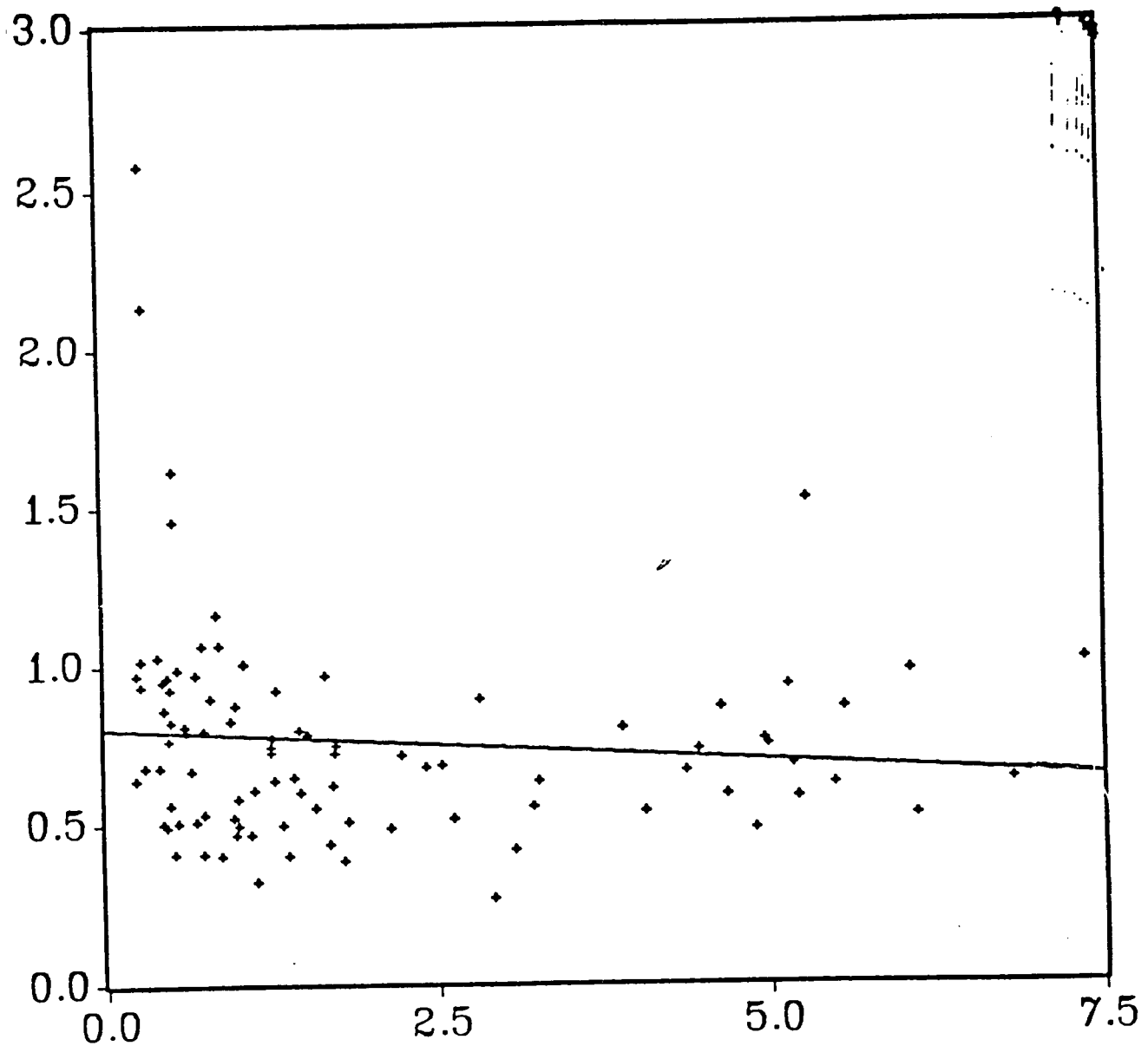

Figure 11 1960 PPP Ratio for Investment Deflator (U.S. = 1.0) versus 1960 GDP per capita