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AID, INVESTMENT, AND ECONOMIC GROWTH IN DEVELOPING COUNTRIES

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Aid, Investment, and Economic Growth In Developing Countries

by

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I. INTRODUCTION

A basic economic and political fact of the post-War era has been the extensive economic assistance granted by a number of industrial countries to the less developed countries. One justification for this assistance (henceforth simply "aid") is that it accelerates the process of economic development by increasing economic growth. This study seeks to determine whether there is an effect of aid on the economic growth of the recipient countries and if so, what is the channel through which the effect operates.

The importance of such questions is magnified by the recent findings of Baumol [1986, 1987] concerning the cross-country structure of the process of economic growth. For a broad group of developing and already developed countries, Baumol found what he termed a Convergence Property, manifest as a negative relation between per capita income and economic growth. Under such a relation lower income countries tend, in growing relatively faster, to converge in terms of per capita incomes to higher income countries. However, for the least developed subset of his sample, Baumol found no such tendency to converge to the main group. The importance of aid in this context emerges if aid can either directly or indirectly enable a country to achieve a higher rate of economic growth, thereby serving as a vehicle by which the least developed countries can join the broad group of countries in the Convergent subset.

The literature on the relation between aid and growth has yielded conflicting results. Griffin & Enos [1970], using a sample of 12 Latin American countries with admittedly unreliable data, found a negative correlation between aid and growth. Papanek [1973], using a larger sample and richer theoretical and empirical specifications, found a positive effect of aid larger than that of either domestic savings or private capital inflows. Mosley's [1980] using data from 83 countries over the period 1969-1977, found that aid had a negative effect on growth. This conclusion, however, was reversed for the 30 poorest countries in his sample, ranked by 1977 GNP per capita.

In this study, using a panel of 62 developing countries for the period 1968-81, we analyze the incremental effect of aid on growth, by means of an equation system that systematically controls for the effect of other relevant macro variables and enables a more detailed exploration of the channels for the effects of aid. Four features of our analysis facilitate this analysis. First, since aid will generally be negatively related to income per capita, we employ a recursive system that accounts for this relation. Second, the countries in our sample differ fairly widely in income per capita, amount of aid received, degree of industrialization, and so on, suggesting potential structural differences within the sample. Thus we partition the sample into two subsamples based on per capita income, and estimate separate systems for each subsample, but ultimately uncover an interactive specification that unifies the results across the subsamples. Third, we distinguish between technical assistance (subsidies to human capital formation) and other forms of aid, and their differential impact on growth. Fourth, we structure a two equation system for growth and investment that allows us to distinguish between the effects of aid that operate through capital accumulation and through other channels.

In Section II, we develop some theoretical consideration that lead to the empirical design that forms the basis for our study. In Section III, we present and discuss our empirical results. Section IV concludes the paper.

II. THEORY AND EMPIRICAL DESIGN

1. The Effects of Aid on Economic Growth.

This study seeks to determine the effects of aid on the economic growth of recipient countries. These effects come under three basic headings: 1) capital augmentation, 2) resource mobilization and (3) rent seeking. Consider first the capital augmentation effect. In theory, if aid is fungible then aid would be treated by the recipient as a pure income transfer. Like any increment to income, the recipient can devote aid either to current consumption or to the accumulation of physical and human capital.[1] Under the Permanent Income or Life Cycle Hypotheses, if aid is permanent then it will largely consumed with little impact on economic growth.[2] However, if aid is effectively tied to net public or private capital accumulation, so that it serves as a subsidy to investment,[3] then one would expect, ceteris paribus, a positive association between the level of aid (relative to domestic product) and the growth rate of real domestic output, as long as the projects undertaken yield a positive return. As it turns out, the proviso that projects yield a positive return will play an important role in understanding the role of aid in the empirical results.

The increase in a recipient country's productive inputs brought about by aid may not be confined to a country's stock of physical capital. First, to the extent that aid increases the demand for domestic output, the supply of cooperating domestic factors of production may also increase. Second, the recipient government could use aid to reduce the (distortionary) taxes, (thereby reducing the disincentives for supplying inputs) or to provide inputs

complementary to private production. Finally, if aid were used to raise the average diet or to supply medical services, thereby reducing the morbidity and mortality of the population, labor inputs would increase. Thus, by mobilizing resources, the level of aid can have a positive effect on the level of output.

The existence of "rent seeking" behavior discussed in Tullock [1967] and Krueger [1974] constitutes a countervaling factor to the mobilization effect. Under this scenario, aid accrues to certain individuals as an economic rent. As a consequence, agents will dissipate resources that have productive alternative uses to compete for access to these rents. Unlike resource mobilization, rent seeking will manifest itself by a negative effect of the level aid on output the level of output. Thus, in terms of the effect on economic growth, rent seeking (resource mobilization) implies a negative (positive) effect of the growth of aid on output growth.[4]

2. The Empirical Design

We seek to develop evidence concerning the above issues in the context of a multivariate cross-country system of equations for economic growth. The system is designed to estimate the direction and magnitude of the effect of official development assistance on the rate of growth of real GDP and to explore the role of investment in any such effect. For expositional purposes only, we shall temporarily focus on the capital augmentation effect, i.e., the effect of the level of aid on economic growth.

Our basic specification will be a regression equation of the form

$$(1) \quad MDY_j = a_o + MAID_j a_2 + X_j a_2 + \varepsilon_j \qquad j=1,\ldots,N.$$

where MDY is the mean rate of growth of real GDP, MAID is the mean level of aid as a fraction of GDP, X_j is a vector of explanatory variables, a_o is a scalar intercept, a_1 is a scalar coefficient, a_2 is a vector of coefficients conformable to X_j, ε_j is an error term, and j indexes the N countries in the

sample. The variables to be included in X, which we draw from a previous cross-country macro study (Kormendi & Meguire [1985]), will be discussed shortly. We interpret (1) as a reduced form, not as a structural relation.

In assessing the effects on growth of either MAID or of the variables in X_j, it will be important to determine whether those effects operate through capital accumulation (the "investment channel"), or through some other channel(s), e.g., the rate of return on existing capital or government policy modification. To address this issue, we will examine in addition to (1) the following two equation system:

$$(2a)\quad MDY_j = b_o + MIX_j b_1 + MAID_j b_2 + X_j b_3 + \mu_{1j};$$

$$(2b)\quad MIX_j = c_o + MAID_j c_1 + X_j c_2 + \mu_{2j},$$

where MIX is the mean investment as a fraction of GDP, and μ_{1j} and μ_{2j} are error terms, uncorrelated with any of the regressors and with each other. The MIX coefficient, b_1, can be interpreted as the marginal rate of return on investment, holding X constant. If MAID or any of the X variables affect growth solely through the investment channel, then its coefficient in (2b) will be nonzero and the corresponding coefficient in (2a) will be zero. If any of these variables affect growth solely through some other channel, such as through the rate of return, then its coefficient will be zero in (2b) and nonzero in (2a). To the extent that both the investment and other channels are operative, the corresponding coefficients in both equations may be nonzero.[5]

3. The Relation between Aid and Recipient's Income per Capita.

A country's real per capita income, considered as an indicator of its level of development, is typically assumed to be a prime determinant of the amount of aid it receives. We propose to call this the means-testing hypothesis. The question then arises as to the consequences of this hypothesis for the estimation of (1) and (2).

To address this matter, we posit the following relation:

(3) $MAID_j = d_o + YPC_j d_1 + Z_j d_2 + \phi_j \qquad j=1,...N,$

where YPC_j is real per capita income, Z_j is a vector of controlling variables (with Z_j and d_2 conformable), and ϕ_j is an error term. Under the means-testing hypothesis $d_1 < 0$. Comparing (3) with either (1) or (2), if YPC is included in X_j, and Z_j does not include MDY_j, then OLS estimates of a_1 and b_1 will be consistent. This is because a system made up of (1) (or(2)) and (3) is recursive.[6]

4. Factors Affecting Economic Growth.

We now turn to a brief discussion of the controlling variables we propose to include in the vector X_j in (1) and (2). We draw here from Kormendi & Meguire [1985], which contains a more complete discussion of the variables that should be taken into account when seeking to explain cross-country differences in rates of economic growth.

a) Real per capita income at the start of the sample period (YPC:). If a country is in transition to, rather than in, the neoclassical steady state, the lower the initial real per capita income, the faster the rate of growth. The same relation would obtain if technology diffuses from more developed to less developed countries. This is the same relation stressed by Baumol [1986, 1987] in his analysis of convergent growth processes. Note that including YPC: in X_j also deals with the problems associated with the mean testing hypothesis discussed in II.3. above.

b) The mean growth rate of labor input (MDPOP). In the neoclassical steady state derived from one sector models, this is the fundamental determinant of growth, and its effect is one-for-one. In the transition to the steady state, it remains important, but its effect may be less than one-for-one.

c) The standard deviation of the rate of growth (SDY). Black [1979], drawing on received theory on the pricing of financial assets, hypothesized a positive risk-return trade-off in aggregate technology, whereby agents in making project and policy choices, either individually or collectively, can effect a higher average rate of growth by accepting a more variable rate of economic growth. This yields a positive relation between SDY and growth. Alternatively, the theory of saving under uncertainty (Sandmo [1971], Mirman [1971]) implies that more variable income stream leads to higher savings and therefore a positive relation between SDY and economic growth.

d) The variability of innovations to the money supply (SDM). Barro [1976, 1980] has argued that monetary variability adds noise to the ex ante real returns and yields contained in the nominal ex post returns and ex ante yields on financial assets. The resulting increased uncertainty about the real returns on investment projects may cause the marginal propensity to invest, and hence the rate of growth, to decline.[7]

e) The mean change in the rate of inflation (MDINF). Tobin [1965] and Mundell [1963] have argued that an increase in the anticipated rate of inflation leads to a reallocation of total wealth away from real balances and towards physical capital, and hence to an increase in growth. Stockman [1981], however, has shown the contrary, using a model that invokes a Clower-type "cash-in-advance" constraint.

f) The extent to which a country is "outward looking" in terms of its trade policies. Trade restrictions, including encouraging domestic industry to produce for import substitution rather than for export, may lead to failure to exploit comparative advantage. Under this scenario, a higher mean export ratio (MEXX) or greater mean growth in the export ratio (MDEXX) should be associated with greater economic growth.[8]

III. EMPIRICAL RESULTS

1. Definition of Variables, Sample Construction, and Data Sources.

Table 1, in four parts, lists the variables used in this study, followed by the data series from which each was computed. The first part lists those variables computed as mean annual exponential growth rates. The second part lists variables computed as exponential growth rates net of the growth rate of nominal GDP. The third part lists those variables that are sample means of their respective series as fractions of GDP. The final part lists those variables that are computed as the standard deviation of the (annual) growth rates of the respective series. Unless otherwise stated, all input series are in units of local currency at current prices, and all variables are measured either in fractional shares or in percent growth rates per year.

YPC, annual real income per capita in units of $1000 US at 1975 international prices, is RGDP* from Summers & Heston [1984], as computed by the International Comparison Project (ICP) sponsored by the World Bank.[9] The 1968 value of this series, henceforth referred to as YPC:, is the variable we use to measure initial per capita real income, factor (a) in II.3. In spite of the extensive care and research that have gone into the production of these data, we suspect that the values of YPC for a few countries in our sample (to be discussed later) are not fully plausible.

The criteria for including a country as an observation in this study are:

- inclusion in the developing countries section of the World Tables;
- published data for the years 1968 to 1981 inclusive, with minor exceptions;
- annual real income per capita in $US of at most $4100 (Israel) in 1980;
- a 1968 population of at least 1 million.

Excluded a priori were

- European countries;

- countries with planned economies;
- the city-states of Hong Kong and Singapore;
- Nicaragua, because its real GDP declined by 37% over the period 1978-81.
- Jordan because its national accounts include the West Bank during the earlier part of the sample period.

These criteria yield a sample of 62 countries whose names can be found in the Table 2. With very few exceptions, the data were taken from the World Bank computer tape, the 1983 World Tables of the World Bank, or the 1984 International Financial Statistics Yearbook of the International Monetary Fund. Additional details pertaining to sources and computations are given in a Data Appendix.

2. Partitioning the Sample

Mosley [1980] found the effects of aid to be different for those countries in his sample with lower incomes per capita. Since this finding may hold for our sample and specifications as well, and because the lowest income countries generally receive the most aid relative to their domestic products, we partition our sample ranked on 1980 values of income per capita (henceforth YPC80) as follows.[10] The empirical distribution of YPC80 suggests that the countries in the sample can be clustered into three groups: a modal cluster of 25 countries with YPC80 between $250 and $700, 33 countries scattered fairly evenly between $800 and $2600, and four outliers ranging from $3150 up to $4100 (Israel). Since there were no countries with values of $750, and only 3 countries had values of $800 or $850, we initially partition the ranked sample into 2 groups, with $750 as a cutoff. The 37 countries with YPC80 > $750 will be known as the "Developing" countries, and the remaining 25 countries will be called the "Least Developed" countries. From this initial partition, a few modification are necessary. Because India and Pakistan each

possess much larger total income and stocks of human and physical capital than is characteristic of the other Least Developed countries (or even of some of the Developing ones), we reclassify them as Developing Countries. In addition, because YPC80 for Kenya is implausibly low, we also reclassified it as a Developing country.[11]

The net result of the above is to partition the total sample of 62 countries into 22 Least Developed and 40 Developing countries. As an illustration of the effects of this partition, we present the simple correlations between MAID and MDY for the whole sample and the subsamples just defined (with t statistics in parentheses).

Countries	Correlation Coefficient
All 62	-.24 (-1.9)
Developing	.14 (.7)
Least Developed	.59 (3.2)

First note the large and significant positive correlation for the Least Developed countries, in contrast to the negative (marginally significant) correlation estimated from the entire sample. This finding, which is consistent with Mosely's (1980), bears out the potential value of stratifying the sample on per capita income, and forms a striking instance of the pitfalls of aggregation. It also appears to indicate that for the Least Developed countries aid may positively affect growth. It will therefore be interesting to see whether similar result hold the more detailed analysis to be presented below.

3. Setting up Some Benchmark Results

The starting point of our empirical analysis is equation 3.1,[12] taken from Kormendi & Meguire [1985]. The sample included all of the industrialized countries, plus most of Latin America and the Pacific Rim. The variables were computed over a sample period starting typically around 1950 (differing slightly across countries) and ending in 1977. This specification explained about three-fifths of the cross-country variation of MDY with no clear evidence of misspecification, such as heteroskedasticity or outliers. Monetary factors were important as SRM had the largest marginal explanatory power, while the negative coefficient on MDINF was consistent with Stockman's [1981] model, but not with the Tobin-Mundell effect. The sign and significance of the SDY coefficient bore out Black's [1979] hypothesis concerning a positive mean-variance tradeoff in real output. The coefficient of MDPOP is clearly less than one, which is consistent with population growth being either an upward biased or noisy measure of labor force growth, or both. The coefficient of initial per capita income was significantly negative meaning lower income countries tend to grow faster.

Regressions 3.2 and 3.3 for the set of 40 Developing countries tell a story similar to that of 3.1, the major exception being that MDINF no longer has any effect. Even in Kormendi & Meguire [1985], this variable was not particularly robust so we do not consider it further in this study. Since 23 of the 40 countries in this sample were included in the earlier study, an F test to determine whether this subset of 23 countries is drawn from the same population as the remaining 18 Developing ones, can shed light on whether the earlier results of Kormendi & Meguire can be validated out of sample. The F statistic is 1.02, with a p value under the null of .43, given 6 numerator and 29 denominat r degress of freedom, which is consistent with the two subsample being drawn from the same population.

Turning to the corresponding regression for the Least Developed countries, 3.4, it is perhaps surprising that the r^2 is higher and the standard deviation of residuals is lower than in 3.3. We suspect these results obtain because the Least Developed countries form a more homogeneous subsample than the Developing countries, as the latter group is in a sense a residual category. Note also that the variance of MDY across the Developing countries is higher than that for the Kormendi & Meguire sample.

The story told by the coefficients in 3.4 and 3.3 are similar except that SDM and SDY essentially vanish and the coefficient and t statistic for MDEXX become smaller.[13] Note also the relatively large coefficient for YPC: and that first degree homogeneity of output growth in population growth MDPOP, cannot be rejected. Finally note that the intercepts in 3.3 and 3.4 imply that ceteris paribus, the Developing countries have experienced 3% greater growth than the Least Developed countries. This is related to Baumol's [1986, 1987] finding that Least Developed countries are not in the same convergent set as other Developing countries.

To determine whether the two subsamples can be considered as having been drawn from the same population, we present 3.5, the analogue of 3.3 and 3.4 for the total sample of 62 countries, except for the addition of an intercept dummy. The coefficients (and t statistics) essentially lie between those of 3.3 and 3.4. The intercept dummy LDEV22 for the Least Developed subset of countries is large and significantly negative. An F test for whether an intercept dummy captures the entire heterogeneity between the two subsamples yields a statistic of 1.93, whose p value, given 5 numerator and 51 denominator degrees of freedom, is .11. Hence, we can interpret the difference between the Developing and Least Developed countries as being in considerable part embodied in the intercept.

4. Aid and Growth--Initial Pass

Table 4 presents the main results on the effects of aid on MDY. Aid is defined as Official Development Assistance (ODAT) measured in dollars. These dollar flows are converted into local currency using the average value of the exchange rate over the year,[14] and then divided by GDP. The mean of the resulting series is the value of MAID for a country.[15]

As a first attempt, we simply add MAID to 3.4 and obtain 4.1. Aid appears to have little effect.[16] Equation 4.2 deletes SDM and SDY, since they seem to play no important role. Equation 4.3 shows that only if we also delete MDPOP and MDEXX, does MAID become positive and marginally significant. The main point here is that we do not find the same strong effect of aid on growth in the partial correlations that we find in the simple correlation of III.1. This is mainly because we are controlling for YPC:, as required to account for means-testing of aid. Equation 4.4 is presented mainly for the record and should be contrasted with 3.3. Any interpretation of the negative MAID coefficient in this equation should at this point be tempered by an awareness that few of the Developing countries receive material amounts of aid (Israel is the only major exception).[17]

5. Aid-Growth-Income Nexus--An Interactive Specification

In light of our finding in section III.1 that the simple aid-growth correlation varies over our two subsamples, which were partitioned based on YPC:, we now allow the coefficient of MAID to vary continuously with YPC:. 4.5 and 4.6 reflect this major shift in strategy--MAID not only enters these regressions directly, but also through an interaction term with YPC:, labeled YPCA. The coefficient of YPCA indicates whether the effect of aid on growth depends upon the level of income YPC:. Looking at 4.5, the negative coefficient of YPCA with its t statistic of -2.3, is evidence in support of

aid having an effect on growth that is linear and declining in YPC:.[18] The positive and significant effect of MAID alone is evidence that for the lowest levels of YPC:, aid does have strong positive effects on growth.

Turning to 4.6, the interactive specification for the Developing countries, the coefficients for MAID and YPCA are quite similar to the analogous ones estimated over the Least Developed countries in 4.5. A test of homogeneity across the two subsamples yields an F statistic of 1.80, with a p value under the null of .12. Although the r^2 are not much different from 4.3 and 4.4, the striking numerical similarity of the aid-related coefficients in 4.5 and 4.6 constitutes evidence in favor of the interactive specification.

The coefficients estimated from an interactive specification can be used to compute both the rate of return to aid at given income levels and the value of YPC: at which aid ceases to have a positive effect. We call this latter value the "breakeven level" of YPC:. The point estimates in 4.5 and 4.6 imply breakeven levels of approximately $600 and $800 respectively. It is interestng to note that these value are in the neighborhood of the $750 boundary that separates our two subsamples. To see what the rate of return of aid is for the Least Developed countries, we can use 4.5 to calculate the implied coefficient for aid conditional upon particular values of YPC:. For example, for YPC: equal to $300 the implied rate of return for aid is 12%. Finally, the similarity between 4.5 and 4.6 also implies that the linear aid-YPC: relationship estimated from the Developing countries can be extrapolated to the Least Developed countries and vice versa. These results also help explain the negative effect of aid on growth found in 4.4 for the sample of Developing countries (and by Mosley [1980]), once we see that the $800 breakeven level for the Developing countries implies that aid is associated with adverse effects on growth in these countries.

6. The Differential Effects of Technical Assistance

Besides data on total aid received by country, data also exists that allow us to decompose total aid into a technical assistance component and a remainder. Though this classification scheme is far from perfect, technical assistance attempts to measure in-kind aid in the form of technically skilled personnel and knowledge. The average value of these components (divided by GDP) over the sample period are called MAIDTA and MAIDNTA respectively. Equation 4.7 shows the effects of decomposing, MAID in 4.5 into its MAIDTA and MAIDNTA components. The collinearity between these two variables tends to inflate the standard errors of their coefficients. However, the point mates and t-statistics suggest that the effect of technical assistance is stronger than that of the remainder, but one connot reject the hypothesis that these both forms of aid yield positive returns.

The above result lends support to the importance accorded by Shultz [1964] to human capital formation in the development process. It is also consistent with the hypothesis that transfers of technical skills and other knowledge are less likely to be diverted to unproductive uses than transfers of funds and material resources. However, because such data are subject to classification error, as well as because of the collinearity previously mentioned, we consider these results to be suggestive rather than definitive.

7. Effects of the Growth Rate of Aid--Rent-Seeking and Resource-Mobilization

In section II.1 above, two scenarios for the effect of aid on growth, "rent seeking" and "resource mobilization", linked the growth of aid, in contrast to its level, to the growth of economic activity. If the resource mobilization (rent-seeking) scenario dominates, then the effect of the growth of aid on the growth of real product should be positive (negative). To distinguish between these scenarios, we add to 4.5 the variable MDODAT, measur-

ing the mean growth rate of aid, measured in $US. The result is 4.8, where the coefficient and t statistic of MDODAT are both trivial. We conclude that, when averaging over the Least Developed countries, aid has on net been neither "resource mobilizing" nor an inducement to "rent seeking". Note however, that both of these scenarios could obtain, and yet offset each other either within countries or across countries.

7. The Aid-Investment-Growth Nexus

So far we have uncovered evidence of (1) positive effects of aid on growth for the Least Developed countries, (2) effects which diminish as the level of per capita income increases and (3) effects which seem to derive predominately from technical assistance, which may be interpreted as linked to human capital formation. We now wish to explore further the mechanism through which aid affects growth. To do this we now estimate the two equation system (2a) and (2b) using specifications related to those presented in Table 4. Our goal here is to determine whether the effects of aid on growth is also related to capital accumulation.

Table 5 and 6 present regressions corresponding to (2a) and (2b), respectively. Equation 5.1 and 6.1 report the results for the set of 40 Developing countries. Equations 5.2 and 6.2-6.3 report the results for the set of Least Developed countries. To the extent a variable such as aid has effects on growth through encouraging capital accumulation (the investment channel) it should have a strong effect in Table 6 directly in the MIX equation. If investment induced by aid is more productive then other sources of investment then the aid variable in Table 5 should be positive and the return on other sources of investment will be smaller than the return on aid.

The results in 5.1 and 6.1 for the Developing countries are presented mainly as a benchmark. Since aid is not important for those countries, we

have omitted MAID from these results for simplicity. The key result to focus on is the coefficient for MIX in 5.1, which is .10 and significant, indicating that over these countries investment has approximately a 10% return at the margin. A similar 12% return was found in Kormendi and Meguire [1985] for their sample of countries.

Now turn to 5.2 and 6.2, the first set of results for the Least Developed countries, and focus on the coefficient of MAID, YPCA and MIX in 5.2 and on the MAID coefficient in the MIX equation 6.2. The first and most intriguing result is that the MIX coefficient in 5.2 is negative and insignificant, suggesting that the rate of return on capital is approximately zero in the Least Developed countries. This zero return helps one to understand why the Least Developed countries seem to stagnate even as they undertake substantial investment. In this respect, it also explains Baumol's [1986, 1987] finding of non-covergence for the poorest countries of his sample. It leaves unanswered, however, why such countries invest it all in projects with zero return.

We also observe that the effects of aid as revealed in the MAID and YPCA coefficient in 5.2 are unaltered by the inclusion of MIX and that there is a positive (thought insignificant) effect of MAID on MIX in 6.2. These results suggest that the rate of return on aid is positive whereas the rate of return on other investment is zero. To explore further this point we again decompose MAID into it technical assistance component MTAID and the residual MNTAID and present these results in 6.3.[19] Here we now see that aid not in the form of technical assistance (MNTAID) does augment investment approximately one for one, with a marginally significant coefficient in 6.3. This result lends more support to the interpretation suggested above that investment induced by aid flows has a positive rate of return whereas other investment appears to have a zero return.[20]

Before concluding, one final result emerged that merits mention. In our explorations of the investment equation (2b), we included the mean ratio of exports to income, MEXX, among the regressors. For the set of 40 Developing countries (and for the Kormendi-Meguire sample), including MEXX reveals a marginal positive effect on MIX with some important changes for the other coefficients. For the Least Developed countries, however, a surprising result emerged. We report in equation 6.4, the results of adding MEXX to the MIX equation for the set of Least Developed countries. MEXX shows itself to be by far the dominant determinate of MIX. Its inclusion raises the r^2 to 80%. Moreover, the effect of non-technical assistance becomes more significant as it remains approximately one-for-one. However, a negative relation between technical assistance and investment emerges.

IV. CONCLUSION

In this study we have addressed a variety of issues relating to aid, economic growth, and investment in LDCs. Positing a recursive system for aid, investment, and growth that accounts for the endogeneity of aid with respect to income per capita we explored both the effect of aid on growth and the mechanism through which the effect operates.

The first key finding was that aid as a fraction of GDP has positive effects on the growth of output only for the Least Developed countries in the sample. This result emerged from a single specification with interaction effects that could be applied to both the Developing and Least Developed subsets of countries. This specification, which allows the coefficient of aid in the growth equation to vary with per capita income, shows that the effects of aid or growth will be positive only for countries with 1980 per capita incomes less than about $700. Since these are precisely the countries most in need of growth and also those that have tended to receive more aid, this suggests that aid policy is having the effect intended by donors.

We next found evidence that aid in the form technical assistance has larger effects on growth than other forms of aid. This is consistent with Schultz's [1964] stress on the importance of human capital accumulation and transfers of knowledge in the development process. We also explored whether the growth of aid mobilizes productive resources in the recipient country thereby increasing economic growth, or whether it promotes the dissipation of resources through rent seeking thereby reducing growth. We found no significant effect and concluded that neither the rent seeking effect nor the resource mobilization effect dominates the other.

Finally, we investigated the extent to which the effects of aid on economic growth operate through measured capital accumulation. The marginal rate of return on investment is positive for the Developing Countries, for the least developed countries we obtain mixed results. The rate of return on aid-related investment appears to be positive though not very significant, but other investment appears to have zero return. This latter result helps explain the stagnation of the Least Developed countries, even as they undertake substantial investment. In this regard, it also explains Baumol's [1986, 1987] findings of non-convergence for the poorest countries in his sample.

FOOTNOTES

[1]Significant attention has been given in the past to the question weather the recipient country reduces its own savings as a response to the flow of aid. Several studies attempted to test this hypothesis and concluded that aid leads to a negative offset of domestic savings (about 20-30 percent) so that not all of it is invested. (See Krueger [1986] for reference to the rather extensive earlier empirical work on this point). However, the methodological and data shortcomings of these studies are well documented. (See de Melo [1987] for an extensive survey on these shortcomings.)

[2]Under the PIH-LCH, exogenous transitory aid may be partially diverted to capital accumulation in order to smooth out the intertemporal consumption impact of the aid, hence resulting in some temporary increase in economic growth. Conversely, temporary aid as a policy response to temporarily adverse income events would, under the PIH-LCH, tend to be fully consumed (see Levy [1987]). The extent to which our results reflect such transitory factors depends upon the extent to which they fail to average out over the course of the time span under consideration (1968-81).

[3]The measure of aid used in this study includes the net proceeds from borrowing at concessionary terms representing a discount from market rates of interest of at least one fourth. Such aid can be viewed as a subsidy to the cost of capital. Aid can be viewed as an alternative to tapping the external or the (possibly nonexistant) domestic capital markets. The possible drawbacks of such aid include a lessened incentive to develop the institutions needed to tap domestic savings such as domestic financial intermediaries and limited liability corporations, which would allow for self-financed growth via personal saving and retained earnings. Aid also allows countries to indulge in hostility to direct foreign investment by foreign corporations. For more on these points, see Bauer [1971] and Shaw [1973].

[4]Recently a broader view of foreign assistance has emerged in which it is viewed in terms of an overall policy "bundle" rather than in terms of financial flows only (see Kruger 1986). Aid, it is claimed, can affect growth by enhancing (or weakening) the quality of policies in the recipient country (e.g., adoption of more market-oriented pricing, exchange rate, and interest rate policies) since in practice, it has carried out policy leverage. In appraising this broader view, the problem lies isolating the effects of aid on the growth of total factor productivity.

[5]Note that the coefficients in (1) can be expressed as linear combinations of those in (2a) and (2b).

[6]Mosley [1980] recognized that the means-testing of aid may bias estimates of the aid coefficient in his growth equation. However, because of the recursive nature of the aid-growth relation, his use of 2SLS is unnecessary once one controls for YPC in the growth equation. Note that if aid depends (negatively) on the recipient's (recent) rate of growth, then the error term in (1) or (2a) may be correlated with MAID, and the OLS estimates of a_1 (b_1) may be inconsistent. While recognizing this possibility, we do not address it directly, since the main concern of the literature has been the means-testing hypothesis, which does not impair the consistency of OLS estimates of the MAID coefficient once YPC is included in the growth equation.

[7]See Mirman [1971] and Sandmo [1970].

[8]See Balassa [1978], Tyler [1981] and Feder [1982].

[9]RGDP* deflates Total Resources using national price indices derived from the ICP, but leaves the Net Export component of GDP measured in international prices. This is effectively an adjustment for changes in the real terms of trade.

[10]We chose the classification based on ranked 1980 data because we believe this to be the best per capita income data presently available. When ranked on 1968 values of income per capita, we found few "cross-over" countries, and similar results obtain.

[11]Our suspicions about Kenya emerged when we discovered that its YPC80, $450, ranks Kenya slightly behind Tanzania and Uganda. Furthermore, YPC:, also $450, implies that there was no growth in real per capita income in Kenya over the period 1968 to 1981. Both these observations strongly violate all casual empiricism about Kenya and its relation to East Africa. Our suspicions were confirmed by inquiries addressed to the World Bank staff.

[12]Regression estimates in this article will referenced by two integers separated by a period. The first number refers to a table, while the second one refers to a particular equation within that table.

[13]3.2 and 3.5 were also estimated with the mean growth rate of money included as in Kormendi & Meguire [1985]. Its coefficient was insignificant for both sets of countries. This is consistent with the neutrality of anticipated money, and suggests that the printing press is not a promising way to finance development.

[14]This is normally IFS line rf, the exchange rate used to convert trade flows and balance of payments accounts from local currencies into dollars.

[15]This measure of the value of aid to the recipient country only partially accounts for differences in the degree of concessionary elements of aid received by different countries. It also does not take into account any offsetting economic and noneconomic quid pro quo. For example if aid is "tied" to purchases from the donating country, then its economic value will be reduced by the excess of the price of tied purhcases over the international price.

[16]Aid flows frequently finance investment projects with long gestation period. It may well take several years for projects to be implemented and to show effects on the growth rate. However, using averages of variables over a 15 year period, as we do, would fail to pick up the effects of only the longest gestation lag projects.

[17]Starting in the late '70s, some of these countries received negative amounts of aid because they were net repayors of concessionary borrowing.

[18]Estimating an equation that includes both YPC: and YPCA yields similar estimated coefficients, in particular for aid, but with large standard errors because YPC: and YPCA are highly collinear. Moreover, within the Least Developed sample, we find no significant correlation between aid and income per capita. Thus, failing to include YPC: does not result in simultaneity bias due to the means-testing of aid.

[19]Decomposing MAID into MAIDTA and MAIDNTA in (5.2) produces results virtually the same as (4.7) with MIX negative and insignificant.

[20]Of course, the zero return for category of other investment way the result of a dominant measurement error, whereas the level of new-technical aid may be much more precisely measured.

TABLE 1

Definitions of Variables

Variable	Related Factor in II.4	Series From Which Variable Was Computed
Mean Growth Rates		
MDINF	e	Rate of inflation computed from the Consumer Price Index.
MDODAT		Official Development Assistance (ODAT).
MDPOP	b	Population
MDY		Real Gross Domestic Product (RGDP) in local currency and 1975 prices; the fundamental dependent variable in this study.
Standard Deviation of Growth Rates		
SDM	d	M1
SDY	c	RGDP
Mean Growth Rate Relative to GDP		
MDEXX	f	Exports, national income definition.
Mean Level as Fraction of GDP		
MAID		ODAT
MAIDNTA		ODAT net of ODATA, i.e., net of technical assistance
MAIDNTA		MAID - MAIDNTA
MEXX		Exports
MIX		Gross Domestic Investment

TABLE 2

Countries included in this study.

DEVELOPING	LEAST DEVELOPED
Algeria	Benin
Argentina	Burkina Faso
Bolivia	Burundi
Brazil	Central African Republic
Burma	Ethiopia
Cameron	Ghana
Chile	Haiti
Colombia	Madagascar
Congo	Malawi
Costa Rica	Mali
Dominican Republic	Mauritania
Ecuador	Nepal
Egypt	Niger
El Salvador	Rwanda
Guatemala	Senegal
Honduras	Sierra Leone
India	Somalia
Indonesia	Tanzania
Israel	Togo
Ivory Coast	Uganda
Jamaica	Zaire
Kenya	Zambia
Korea	
Malaysia	
Mexico	
Morocco	
Nigeria	
Pakistan	
Panama	
Paraguay	
Peru	
Philippines	
Sri Lanka	
Sudan	
Syria	
Thailand	
Tunisia	
Turkey	
Uruguay	
Venezuela	

TABLE 3

Estimates of Growth Regressions Without Aid or Investment

Eq. #	Sample	N	Con-stant	YPC:	MDPOP	SDY	SDM1	MDEXX	MDINF	R^2	r^2	s.d.r.
(1)	Kormendi-Meguire [1985]	47	.048 (6.8)	-.0068 (-3.5)	.57 (3.4)	.51 (3.1)	-.20* (-4.9)	.15 (2.7)	-.57 (-2.2)	.64	.59	.0100
(2)	Developing Countries	40	.056 (4.0)	-.0086 (-1.9)	.45 (1.3)	.18 (1.4)	-.11 (-2.2)	.30 (2.9)	.11 (.7)	.47	.38	.0155
(3)		40	.054 (4.0)	-.008 (-1.8)	.45 (1.3)	.18 (1.4)	-.10 (-2.2)	.30 (2.9)	--	.48	.41	0.146
(4)		22	.019 (1.1)	-.032 (-2.7)	.74 (1.3)	.01 (.1)	.03 (.5)	.07 (2.0)	--	.55	.41	.0108
(5)	All Countries**	62	.061 (5.5)	-.011 (-2.7)	.52 (1.4)	.09 (.9)	-.08 (2.0)	.11 (2.8)	--	.57	.52	.0146

*Coefficient of SRM, the standard deviation of M1 (percentage growth) innovations. SRM is identical to SDM1 whenever the best univariate representation of M1 is the geometric random walk, which is the case for about half of the countries in the sample. [See Kormendi & Meguire [1984] for a more complete discussion of this variable.] This equation is [4] in Kormendi & Meguire [1985].

**The coefficient (t statistic) of the intercept dummy, LDEV22, is -.027(-5.3).

NOTE: MDY is the dependent variable. N is the sample size, r^2 is R^2 adjusted for degrees of freedom, and s.d.r. is the standard deviation of the regression residuals.

TABLE 4

Estimates of Growth Regressions Augmented by AID

Eq. #	N	Constant	MAID	MAIDTA	MAIDNTA	MDODAT	YPC:	YPCA	MDPOP	SDY	SDM1	MDEXX	R^2	r^2	s.d.r.
							Total Aid Added Directly								
(1)	22	.016	.08	--	--	--	-.027	--	.3	-.04	.04	.05	.57	.40	.0109
		(.8)	(.8)				(-1.9)		(1.1)	(-.3)	(.6)	(1.3)			
(2)	22	.021	.07	--	--	--	-.028	--	.56	--	--	.05	.56	.45	.0104
		(1.4)	(.8)				(-2.2)		(1.0)			(1.4)			
(3)	22	.031	.13	--	--	--	-.029	--	--	--	--	--	.49	.43	.0105
		(3.0)	(1.7)				(-2.4)								
(4)	40	.057	-.07	--	--	--	-.009	--	.40	.18	-.10	.30	.49	.40	.0148
		(4.0)	(-.4)				(-1.9)		(1.3)	(1.5)	(-2.1)	(2.9)			
							Total Aid and YPC: Interacting								
(5)	22	.011	.24	--	--	--	--	-.41	.45	--	--	.07	.57	.47	.0103
		(.8)	(2.9)					(-2.3)	(.8)			(2.1)			
(6)	40	.045	.24	--	--	--	--	-.26	.52	.18	-.12	.31	.46	.39	.0150
		(3.6)	(1.1)					(-1.4)	(1.4)	(1.4)	(2.7)	(3.0)			
							Technical Assistance Separated from Total Aid								
(7)	22	.008	--	.49	0.12	--	--	-.44	.57	--	--	.08	.59	.47	.0103
		(0.6)		(1.8)	(0.8)			(-2.5)	(1.0)			(2.2)			
							Including the Rate of Growth of Aid as well as its Mean Level								
(8)	22	.004	.22	--	--	.04	--	-.41	.51	--	--	.07	.578	.475	.0105
		(.2)	(2.4)			(.6)		(-2.2)	(.9)			(2.0)			

NOTE: MDY is the dependent variable. YPCA is the product of YPC: and whatever aid variable is included in the regression. N is the sample size, r^2 is R^2 adjusted for degrees of freedom, and s.d.r. is the standard deviation of the regression residuals.

TABLE 5

Estimates of Growth Regressions Augmented by Aid and Investment

Eq. #	N	Con-stant	MAID	MAIDTA	MAIDNTA	YPC:	YPCA	MIX	MDPOP	SDY	SDM1	MDEXX	R^2	r^2	s.d.r.
						Developing Countries									
(1)	40	.025	--	--	--	-.010	--	.10	.25	.11	-.08	.20	.54	.45	.0145
		(1.7)				(-2.3)		(1.9)	(0.7)	(0.9)	(-1.7)	(1.8)			
						Least Developed Countries									
(2)	22	.011	.24	--	--	--	-.37	-.03	.61	--	--	.08	.58	.45	.0105
		(.8)	(2.7)				(-1.8)	(-.6)	(1.0)			(2.2)			

NOTE: MDY is the dependent variable. YPCA is the product of YPC: and MAID. N is the sample size, r^2 is R^2 adjusted for degrees of freedom, and s.d.r. is the standard deviation of the regression residuals.

TABLE 6

Investment (MIX) Regressions

Eq. #	N	Constant	MAID	MAIDTA	MAIDNTA	YPC:	MDPOP	SDY	SDM1	MDEXX	MEXX	R^2	r2	s.d.r.
						Developing Countries								
(1)	40	.124	--	--	--	.027	2.06	.65	-.20	.94	--	.34	.25	.0460
		(3.2)				(1.9)	(1.7)	(1.6)	(-1.4)	(2.9)				
						Least Developed Countries								
(2)	22	-.040	.28	--	--	.10	5.7	--	--	.35	--	.39	.24	.0560
		(-.5)	(.8)			(1.4)	(1.9)			(1.9)				
(3)	22	- .02	--	-.78	1.0	.10	5.1	--	--	.34	--	.41	.23	.564
		(.3)		(-.5)	(1.4)	(-1.4)	(1.7)			(1.8)				
(4)	22	.012	--	-1.45	.89	-.062	3.39	--	--	.01	.52	.85	.80	.0285
		(.03)		(-2.0)	(2.1)	(-1.6)	(2.3)			(0.1)	(6.6)			

NOTE: MIX is the dependent variable. N is the sample size, r^2 is R^2 adjusted or degrees of freedom, and s.d.r. is the standard deviation of the regression residuals.

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