**CREDIT Research Paper**

**No. 99/6**

# Is there an Aid Laffer Curve?

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## ABSTRACT

Comparing aid flows in the 1990s with those from the 1970s make it clear that there are now many more countries receiving what may be termed "high aid" (say in excess of 30 per cent of GNP) and that there has emerged a group of countries receiving very high aid. Whilst never formally considered in the literature, there is a feeling that such high aid may do more harm than good, a notion which may be captured in an aid Laffer curve. This paper presents an endogenous growth model which exhibits negative returns to aid at high aid levels, and offer some additional reasons as to why such a phenomenon may exist. Finally, empirical evidence is provided from cross-country regressions which confirms the existence of an aid Laffer curve.

## 1. INTRODUCTION

During the last two decades aid to some developing countries has grown to very high levels. Whereas in the late 1970s only eight countries had aid to GNP ratios in excess of 20 per cent, and none higher than 50 per cent, by the first half of the 1990s 26 countries had aid ratios of 20 per cent or more, with four countries having ratios greater than 50 per cent. Aid per capita has shown a similar trend, with the number of countries receiving over US$100 per person rising from 19 to 32 from the late 1970s to the early 1990s, 12 countries receiving in excess of $250 per person in the later period compared to five in the earlier.[1] The highest aid recipient in both periods, New Caledonia, saw its aid inflow rise from an average of $670 each year for each person in the 1970s to over US$2,000 a person in the first half of the 1990s. Aid donors worry that such high levels of aid may signify, or induce, aid dependence, rather than lay the basis for self-reliant development as aid is intended to. Several commentators in the aid effectiveness literature have suggested that a country can receive "too much" aid, though this notion has been neither formalised nor empirically tested.

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In this paper we first document the phenomenon of rising aid levels (Part 2), before going on in Part 3 to present both an endogenous growth model and additional arguments to illustrate why high levels of aid can be bad for the recipient. The latter notion can be captured in the idea of the aid Laffer curve: that is, the benefits from aid increase with initial inflows but after a certain level begin to decline, so that the country would actually be better off with less aid. In Part 4 we attempt empirical estimation of the aid laffer curve. Part 5 concludes.

## 2. THE EMERGENCE OF HIGH AID INFLOWS

Tables 1 and 2 lists those countries having over certain threshold values of aid flows, where aid flows are normalised by both GNP and population. Table 3(a) reports the cumulative distributions from these data. Two features are notable from these data. First, the number of countries receiving aid in excess of the threshold values shown has been increasing over time, with a doubling in the number of countries receiving aid of $50 or more per capita and a more than threefold increase in those receiving aid equivalent to at least 20 oer cent of GNP. Second, there has emerged a group of "very high aid" recipients, receiving more aid per capita than the income per capita levels of many developing countries. For several countries aid is 30 per cent or more of GNP. Whilst none of these countries are large ones, the phenomenon of high aid is by no means restricted to micro-states: countries such as Israel, Mozambique and Nicaragua also feature in the tables.

An alternative presentation of these data is given by the box plots shown in Figures 1 and 2, for which summary statistics are provided in Table 3(b). Figure 1 clearly shows the emergence of a group of very high recipients (the two highest are off the graph for the latest period). At the same time the median aid per capita has drifted up over time (from US$ 11 per person in 1975-79 to US$ 38 in 1990-95): by the later period the upper quartile had reached $80, so that a quarter of developing countries were in receipt

of aid in excess of this amount. Whilst the median aid to GNP ratio has not risen in the same way (Figure 2), the upper quartile has moved up, so that over one quarter of countries have aid ratios greater than 15 per cent in the 1990s. Figure 2 shows a clearly lengthening upper tail as countries emerge with aid ratios well in excess of those experienced in the 1970s.

These data thus clearly support both the proposition that a greater number of countries can be classified as high aid recipients in the 1990s than was the case in the 1970s, and that there has emerged a class of very high aid recipients. But do these trends represent a problem? Or will extraordinary aid flows allow their recipients to achieve their development objectives the sooner?

## 3. THE AID LAFFER CURVE

Aid has always had its critics who maintain that it does more harm than good. Milton Friedman supported military aid to defend the "free world", but argued that the case for economic aid was based on three basic propositions that are "at best misleading half-truths" (1958, reprinted in 1970: 67). He objected in particular to the idea that development required comprehensive planning and control by government. Indeed, the contrary was the case - that is, "what is required in the underdeveloped countries is the release of the energies of millions of able, active, and vigorous people, ... [who] only require a favourable economic environment to transform the face of their countries" (*ibid*: 71). Hence aid will "almost surely retard economic development and promote the triumph of Communism" (*ibid*: 64). This line of argument has been persistently pursued by Peter Bauer over the years; for example:

> .. aid does not descend indiscriminately on the population at large, but goes directly to the government. Because aid accrues to the government it increases its resources, patronage, and power in relation to the rest of society. The resulting politicization of life enhances the hold of government over their subjects and increases the stakes in the struggle for power. This result in turn encourages or even forces people to divert attention, energy and resources from productive economic activities... Foreign aid has also enabled many governments to pursue policies that plainly retard economic growth and exacerbate poverty... (Bauer, 1991: 45-46).

Writers from the left, especially those employing a dependency theory framework, have also been

critical. In Andre Gunder Frank's paper entitled Aid or Exploitation? he argued that US assistance was "definitely prejudicial to Brazil" (1963, reprinted in 1969: 160), since it facilitated a net outflow out of the country and allowed the US to direct Brazilian development in a direction beneficial to US interests. Starting with *Aid as Imperialism* (Hayter, 1971), Teresa Hayter has published a series of works examining how aid harms the poor and the environment to the benefit of Western interests and a small minority in developing countries (e.g., Hayter, 1989). Finally, Keith Griffin (1970, and Griffin and Enos, 1970) argued that aid can harm growth, an effect which is produced by a combination of savings displacement and an increase in the incremental capital-output ratio (ICOR) as a result of the lower productivity of aid-financed investment.

We do not pursue these arguments here, although some of them may play some role in explaining why aid's net benefits may become negative at high levels of inflows. Rather we are concerned to explore the possibility that aid may have not merely decreasing returns (a proposition which everyone would surely accept) but that, after a certain level, the returns to further aid inflows are negative. This idea, i.e. that a country can get "too much aid", can be shown by an aid Laffer curve, as shown in Figure 3. The horizontal axis measures aid (say A/Y or A/P) and the vertical "beneficial effects". The curve is an inverted U; that is, after a certain threshold ($A^*$) more aid is detrimental rather than beneficial, and the country would be better off with less aid.

Beneficial effects may of course refer to any of aid's intended beneficial impacts. A review of donor policy statements (see Lensink and White, 1997) shows five themes common to many donors: (1) self-sustaining growth; (2) poverty reduction; (3) environmental sustainability; (4) improving the position of women;[2] and (5) good governance (democratisation etc.). Examination of the aid Laffer curve would require estimation of the link between aid and some output measure related to each of these objectives. However, in practice we move rapidly into uncharted territory if we attempt an overall assessment of aid's

impact in relation to any of these objectives. The most effort has been put into the growth objective, and our empirical estimates in Part 3 relate to this objective. But first we consider reasons as to why an aid Laffer curve may exist.

*The model*

We use a simple endogenous growth model to illustrate the possible existence of an aid laffer curve. The model is of a decentralised economy consisting of three sectors: households, firms and a government. Households have perfect foresight, live infinitely and maximize a constant intertemporal elasticity of substitution utility function:

$$U = \int_{0}^{infinity} e^{\sigma t}\left(\frac{c^{1\theta}\,1}{1\theta}\right)dt \qquad (1)$$

subject to the budget constraint,

$$\frac{d\,z_t}{dt} = w_t + r_t\,a_t \;\; c_t \qquad (2)$$

where $c$ is consumption; $\sigma$ the rate of time preference; $\theta$ the inverse of the elasticity of substitution; $z$ net assets per person (holdings of domestic capital minus domestic family debt), $w$ is the real wage rate (wage income per person) and $r$ is the rental price of capital. Households are assumed to be indifferent as to the composition of their wealth, so that $r$ equals the interest rate on debt. It is assumed that households do not borrow or lend internationally. Moreover, population growth is ignored for reasons of convenience.

The optimization problem leads to the well known intertemporal Euler condition:

$$\frac{dc}{c} = \frac{1}{\theta}(r\sigma) \qquad (3)$$

Firms are assumed to produce goods with a Cobb-Douglas production function of the form:

$$Y = T\,L^{1\alpha}\,K^{\alpha}\,G^{1\alpha} \qquad (4)$$

where $\alpha$<1;*Y* is production, *L* is the labour force; *K* the capital stock, Ggovernment purchases and T the technological shift factor which is may be interprested as a measure of total factor productivity. This production function is similar to the production function used in the public goods model of Barro (1990) (see also Barro and Sala-i-Martin, 1995: Chapter 4). The assumption is that the government does not engage in public-sector production. The government buys private goods, which are used for providing free public services (infrastructure, education etc.) to private producers. The form of the production function implies endogenous growth in the case where the capital stock and government purchases increase simultaneously.

Profits of firms ($\pi$) at any point in time equal:

$$\pi = T L^{1\alpha} K^{\alpha} G^{1\alpha} (r + \delta) K \quad wL \qquad (5)$$

where $\delta$ is a depreciation rate. For a competitive firm, the wage rate and the rental price of capital are given, so that profits are maximized in the case where the marginal productivity of capital equals the rental rate of capital and the marginal productivity of labour equals the real wage rate. For our analysis only the first condition is relevant:

$$\alpha T L^{1\alpha} K^{\alpha 1} G^{1\alpha} = (r + \delta) \qquad (6)$$

We assume that foreign aid is channelled through the economy via the government. For simplicity, it is assumed that government purchases are only financed by foreign aid,[3] hence:

$$G = A \qquad (7)$$

where *A* is foreign aid. Since foreign lending, or borrowing by the private sector is ignored, government purchases are always equal to the trade balance deficit. If foreign aid equals a fixed percentage, *a*, of production of the recipient countries, the expression becomes:

$$G = aY \qquad (8)$$

By using the production function and the expression for foreign aid, government purchases can be

rewritten as:

$$G = (aT)^{1/\alpha} L^{(1-\alpha)/\alpha} K \tag{9}$$

The relevant first-order condition of firms can now be rewritten as:

$$\alpha T^{1/\alpha} (La)^{(1-\alpha)/\alpha} = r + \delta \tag{10}$$

Note that, by inserting the expression for government expenditures in the first-order conditions, we have implicitly assumed that firms optimize for given government expenditures, and hence that firms take aid inflows as given.

The first-order condition shows that the marginal product of capital is determined by exogenous factors, and hence does not depend on the capital stock. It can be shown that there are no transitional dynamics and that the growth rates of consumption, the capital stock and income are equal. The growth rates can be obtained by inserting the equality of the marginal product of capital and the rental rate in the intertemporal Euler condition for consumers, which gives:

$$\frac{dc}{c} = g = \frac{1}{\theta}(\alpha T^{1/\alpha} (La)^{(1-\alpha)/\alpha} \delta \sigma) \tag{11}$$

where *g* is the growth rate. The effect of an increase in foreign aid is given by the first derivative with respect to *a*:

$$\frac{dg}{da} = \frac{1-\alpha}{\theta a} T^{1/\alpha} (La)^{(1-\alpha)/\alpha} > 0 \tag{12}$$

An increase in foreign aid, by stimulating government purchases of goods, and hence the provision of public services, unambiguously affects the growth rates positively.

However, in the literature on the effectiveness of aid many authors have pointed at the possible negative effects of foreign aid on the productivity of capital (e.g. Griffin, 1970), especially when aid inflows become substantial. The reason might be that aid is used to finance too capital intensive projects, which is empirically supported by Rana and Dowling (1988 and 1990) for a group of Asian countries or that government capacity is undermined by the shear volume of aid. In addition, Bauer (1981, 1984 and 1991) has criticised the effectiveness of foreign aid by arguing that aid hinders development since it stimulates recipient governments to reduce their efforts to enhance growth since the costs of leisure *vis a vis* the cost of effort decline in the case where aid flows increase. It may also be the case that aid encourages "inward- looking" polices, or even encourages corrupt government policies. The upshot of this is that aid inflows may have a negative effect on productivity, and below we summarise a number of empirical studies which give some credence to this position. In our simple model this can be taken into account by endogenizing the level of technology as follows:

$$T = (1 \ \beta a) T_0 \qquad (13)$$

where $T_0$ is the level of technology without aid and $\beta$ is a coefficient, assumed to be smaller than 1 and above zero.

The level of technology is no longer constant. Instead, it is negatively affected by inflows of aid. Taking this effect into account, the impact of an increase in *a* on the growth rate becomes:

$$\frac{dg}{da} = \left(\frac{1\alpha}{a}\frac{\beta}{1\beta a}\right)\left[\frac{1}{\theta}((1\beta)T_0)^{1/\alpha}(La)^{(1\alpha)/\alpha}\right] \qquad (14)$$

The sign of the multiplier depends on the first term between brackets on the right hand side. Rearranging this term gives:

$$\frac{1\beta a(2\alpha)\alpha}{(1\beta a)a} \qquad (15)$$

The denominator of this expression is always positive. Hence, for small values of *a*, the multiplier is always positive. However, if *a* increases above a certain level, the effect of an increase in *a* on growth becomes negative. The optimum value of the growth rate is obtained when:

$$a = \frac{1 \alpha}{\beta (2 \alpha)} \qquad (16)$$

For higher levels of *a* the growth rate declines when *a* increases. The implication of this analysis is that there may exist an aid laffer curve: for small levels of aid, aid has a positive effect on economic growth rates, while for high levels of aid, aid negatively affects growth (i.e. as shown in Figure 3 above).

The reasoning behind our result is somewhat similar to that of Griffin (1970), in that Griffin argued that aid would reduce the productivity of investment so that, if this effect were sufficiently large, then aid would reduce growth. However, our model introduces a non-linearity absent from his model. The diminishing returns to aid-financed government expenditure in the production function mean that the negative effect only becomes present after some threshold value.

*The absorptive capacity constraint and institutional destruction*

In addition to our development of Griffin's argument, contributions to the aid effectiveness literature have also pointed to problems of absorptive capacity, which may suggest the inverse relationship bewteen aid and productivity which underlies the theoretical rationale for an aid laffer curve. Examples of studies finding this phenomenon include:

X Lavy and Sheffer (1991) examine the cases of Egypt, Syria and Jordan which are now worse off, after years of very high aid inflows, than they were in the early 1970s. The story of why this is so is as follow. High aid inflows exceed those which can feasibly be used in profitable investment and so some aid must be consumed. This consumption usually takes the form of consumer subsidies (and

perhaps highly subsidised government services). When aid slackens these policies are not readily reversible (a notion economists call hysteresis). If possible, the government will borrow to maintain consumption - which postpones, but exacerbates, the eventual fiscal adjustment. Alternatively, government may print money. These problems are intensified by the fact that aid-financed investments may not have been particularly profitable, and may have discouraged private sector activity.

X Zejan and Kokko's analysis of aid to Guinea-Bissau finds that aid has financed investment, but that "the total investment volume reflects levels of investment which are too high with respect to the country's management capability" (1998: 134).

X Morton draws a similar conclusion from his analysis of Sudan, arguing that donors are unwilling to accept that the poorest developing countries only have the capacity to successfully implement a very limited number of development projects; hence, he says, "the volume of aid just grows and grows without regard for its chances of being put to productive use" (1994: 16).

X Sobhan (e.g. 1996) argues that aid is too high as the recipient government is swamped by donors and so unable to direct its own development effort, to the long run detriment of that development.

X A review by ODC of *Strengthening Aid in Africa* argues that aid has been allocated without regard for absorptive capacity:

> The absorptive capacity of the recipient state, not some arbitrary proportion of GNP of donor countries should determine the level of aid a country receives... Given the low levels of development in most African countries, low domestic savings, low government capacity, and the levels of aid already often well above 10 per cent of GNP, such estimates suggest that many African countries could not absorb much more aid without further drops in long-term effectiveness. (van de Walle and Johnston, 1996: 98).

X Morss (1984) observed what he called "donor proliferation" and how this phenomenon diverted government officials into "pleasing donors" rather than pursuing their country's development objectives.

From these studies a story emerges. There is a limit to how much aid a country can "absorb" (i.e. have the capacity to manage).[4] That fact alone would suggest rapidly diminishing returns to aid. But the situation is worse since the institutional destruction of government's proper functioning as its resources are diverted to managing the burgeoning aid programme means that no aid is used effectively so that the return on aid falls. This argument motivates the basis for our model in which higher aid is linked to lower productivity. Moreover, longer-run growth prospects are undermined as government becomes embroiled in a network of aid-financed subsidies.

In summary, this part has presented a theoretical model, with motivation from some empirical studies for some of its key features, which suggests that an aid Laffer curve may exist. We now turn to empirical investigation of this possibility.

## 4. ESTIMATION RESULTS

Here we examine the aid laffer curve empirically in relation to the growth objective. Growth is chosen since it is a readily available output measure and we can draw on a well-established approach to conduct our analysis. We present the estimation results from growth regressions using the per capita growth of real GDP as the dependent variable. The regression is a pooled cross-section time series analyses, using period averages calculated from three five year periods (1975-79, 1980-84 and 1985-89) and one three year period (1990-92). The main data source is World Bank (1997), though the dependent variable comes from the Penn World Tables, with our time periods determined by data availability from these sources. The basic panel consists of 138 countries (the countries used in Barro and Lee, 1994), from which we have included

only those countries which are aid recipients (see Appendix 1 for a list of countries).[5]

Following the seminal work of Barro (1991), many studies have analysed the determinants of economic growth. These studies report a large number of variables to be correlated with growth. In principle, they could all be taken into account. However, using extreme bound analysis (EBA), Levine and Renelt (1992), show that most of these variables are not robust (i.e. their coefficients and significance can change substantially depending which other variables are included in the estimated equation). Therefore, we use EBA.

In the analysis the following cross-section regression is used:

$$g = \alpha_j + \beta_{ij} I + \beta_{mj} M + \beta_{zj} Z + \mu \qquad (17)$$

where $g$ is the per capita growth rate of GDP, $I$ is a set of variables always included in the regressions. $M$ are the variables of interest. In our case, $M$ is the aid/GDP ratio and the aid/GDP ratio squared. $Z$ is a subset of a vector of domestic and international macroeconomic variables identified by past studies as being potentially important explanatory variables of capital flight.

The estimation procedure starts by determining a reasonable base model in which the quadratic term for the aid/GDP ratio is not yet taken into account. First, we have to decide on the vector of variables $I$. We take as $I$ variables the initial level of per capita income (*GDPPC*), the initial secondary-school enrollment rate (*SENROLM*), the debt to GDP ratio (*DEBTGDP*), intercept dummies for Sub-Saharan Africa (*DUMSSH*), Latin America (*DUMLA*), Asia (*DUMASIE*) and the different sub-periods (*DUM7579, DUM8084, DUM8589 and DUM9094*, respectively). *GDPPC* is included to account for the conditional convergence effect. The sign is expected to be negative. *SENROLM* proxies for the initial stock of human

development. The sign is expected to be positive. *GDPPC* and *SENROLM* are standard variables in recent growth regressions. While *DEBTGDP* is not often included in growth regressions, it is very often a variable of interest in studies on developing countries. Therefore, we have included *DEBTGDP* in the set of *I* variables. The region dummies are often found to be significant in growth regressions (see Sala-i-Martin, 1997) and are thus included. The intercept dummies for Sub-Saharan Africa and Latin America, unlike Asia, are expected to be negative.[6] The time dummies are taken into account to correct for possible fixed effects caused by the different sub-periods.

A word is in order with respect to the investment share (*INVGDP*). Most growth regressions show that *INVGDP* significantly affects economic growth. However, if the investment to GDP ratio is introduced, the interpretation of a significant coefficient for variable x differs from a significant coefficient for variable x when the investment rate is not introduced. In the first case, the variable is said to affect growth via the "level of efficiency" whereas in the latter case it is unclear whether it affects growth via investment or via efficiency (see also Sala-i-Martin, 1997b). For this reason, we have calculated a set of estimates in which *INVGDP* is not included and a set of estimates in which *INVGDP* is included in the vector of *I* variables.

The first estimate we present contains all above mentioned *I* variables as well as the the Aid to GNP ratio (*AIDGDP*). The results are given by equation 1 (without the investment share) and equation 2 (with the investment share) in Table 4. Both equations confirm the relevance of the initial level of GDP, the Debt to GDP ratio, quite a few dummies and the secondary enrollment rate for economic growth. This result is in line with theory and hence quite satisfactory. Most importantly, the aid variable is significant and has the expected sign. However, the Jarque-Bera (JB) test shows that the residuals of equations 1 and 2 are not normally distributed.[7]Therefore, we reestimated the equations by deleting extreme outliers. The results are given in the equations 3 and 4 in Table 4. The Jarque-Bera now suggests that the residuals are normally distributed. In the other estimates presented in this paper, we use the data set without the extreme outliers.

Before we add a quadratic term for the aid/GDP ratio we consider two issues which are emphasized in recent growth regressions with aid. First, some studies by Boone (1994, 1996) and a recent study by Burnside and Dollar (1997) suggest that one should instrument the aid/GDP ratio in order to account for the possible endogeneity of aid. Second, Burnside and Dollar (1997) show that foreign aid only significantly affects aid in good policy environments, implying that the aid term should be interacted with a policy variable. We consider both issues in turn.

We first examined whether the aid variable should be instrumented as follows. We estimated different equations for *AIDGNP,* which are presented in Table 5. We regressed *AIDGNP* on all exogenous variables from the base regression (equation 3 in Table 4) in addition to some combination of the size of the population (*POP*), the mortality rate (*MORTAL*), a variable for political rights (*PRIGHTS*), the debt service ratio (*DEBTSERV*) and a variable denoting civil liberties (*CIVIL*). These variables are suggested by other studies as good instruments for AID.[8] [9] Since *FITAIDGNP* is insignificant in all cases, the null is accepted, and hence *AIDGNP* may be considered exogenous. Based on these results we decided not to instrument for *AIDGNP* and perform the rest of the analysis by using the base models without instruments as presented in Table 4.[10,11]

The next issue we considered is the efficiency of aid in a good policy environment. It has recently been argued in the World Bank report *Assessing Aid* (World Bank, 1998) that aid only works when the policy environment is right: this finding being based on a growth regresssion in which aid is insignificant but the interactive variable, aid times policy, significant.[12] Burnside and Dollar (1997) (which is the background paper from which the growth regressions in *Assessing Aid* are taken) construct a combined policy variable consisting of a variable proxiing for trade openness (*TRADE*), inflation (*INFL*) and the budget surplus (*BUDSURP*). We follow their approach. The first column in Table 7 presents the results

when *TRADE, INFL* and *BUDSURP* are added to the base model without *INVGDP*.[13] We used the coefficients for *TRADE, INFL* and *BUDSURP* as given in equation 1 of Table 7 to construct a combined policy index. In equation 2 of Table 7 we reestimate the base model with *AIDGNP* and *AIDGNP* interacted with the policy index (*POL*). We also ran regressions in which *AIDGNP* is only interacted with one of the policy variables. Results are given by equations 3 and 4 in Table 7. These results give a consistent picture: he policy variables *TRADE* and *INFL* are significant, in general *AIDGNP* is significant, but the interaction term with *AIDGNP* is never significant. Whilst *Assessing Aid* does find this interactive term to be significant, it is not found to be so here, neither is it in the model of Henrik and Tarp, who attempted to replicate the *Assessing Aid* results, or in estimates for sub-Saharan Africa by White (1997). Hence the significant interactive policy term is a far from robust finding, and so, based on these results we do not interact *AIDGNP* with a policy index, or one of the policy variables, in the remainder of the paper.

After this short digression, we come back to the main issue of this paper and that is to examine whether there exist an aid laffer curve. In order to do this we extend our 2 base models (with and without *INVGDP*) with a quadratic term for *AIDGNP* (*AIDGNP2*).[14] The results are given in Table 8. The results presented in Table 8 confirm the existence of an aid-laffer curve. These results suggest a threshold value of the Aid to GNP ratio between 41% (with INVGDP) and 58% (without INVGDP).

The estimates presented in Table 8 may suffer from omitted variable bias since some relevant variables may not be taken into account. To test the reliability of the above results, the estimations as presented by equation 1 and 2 in Table 8 are extended by adding a group of domestic and international macroeconomic variables. The selection of the set of domestic and international macroeconomic variables - the *Z*-variables - is based on those identified by Sala-i-Martin (1997) as being important for economic growth. The following variables were included in the various models estimated:

1. Political variables: we consider an index for civil liberties (*CIVIL)* and index of political rights (*PRIGHTS)*.
2. In accordance with other recent studies (e.g. Burnside and Dollar, 1996), we include policy variables to measure market distortions. We used the black market premium (*BMP*), the inflation rate (*INFL*), the standard deviation of inflation (*STDINFL*) and the ratio of the budget surplus to GDP (*BUDSURP*).

3. Measure of Openness. We have included the trade to GDP ratio (*TRADE)*.

4. Financial development indicators. We include two proxies for financial development: the money and quasi money to GDP ratio (*MONGDP*) and credit to the private sector as % of GDP (*CREDITPR)*.

5. Capital flows. In the analysis we have also taken into account a linear and a quadratic term for total private capital flows (% of GDP) averaged over 5 year periods (*CAPFLO* and *CAPFLO2*).

6. We also consider the Life expectancy at birth (*LIFEE*), the primary enrollment rate (*PRENROLM*), the debt service ratio (*DEBTSERV*) and the mortality rate (*MORTAL*).

This means that in total 15 variables are included in the *Z* vector. In the regressions, all combinations of three of the above presented set of 15 variables are taken into account. This implies that 455 estimates have been done per base model. It also means that 15 (for model without *INVGDP*) and 16 (with *INVGDP*) independent variables are taken into account in all regressions.

The procedure of the EBA is as follows. For each regression *j*, we find an estimate $\beta_{mj}$ and a standard

deviation $\sigma_{mj}$. The lower extreme bound is the lowest value of $\beta_{mj} - 2\sigma_{mj}$, whereas the upper bound is $\beta_{mj} + 2\sigma_{mj}$. If the upper extreme bound for variable *M* is positive and the lower extreme bound is negative (*i.e.* the sign of the coefficient $\beta_{mj}$ changes), then variable *M* is not robust. Results are presented in Table 9.

The above results show that according to the extreme bound analysis test, both the linear term for aid and the quadratic term is fragile in the two groups of estimates.

Sala-i-Martin (1997) criticizes the *EBA* analysis of Levine and Renelt (1992) for using too strict a test and presents an alternative stability analysis. His analysis comes down to looking at the entire distribution of the coefficient $\beta$, instead of a zero-one (robust-fragile) decision and calculating the fraction of the cumulative distribution function lying on each side of zero. By assuming that the distribution of the estimates of the coefficients is normal and calculating the mean and the standard deviation of this distribution, the cumulative distribution function (*CDF*) can be calculated. His methodology starts by computing the point-estimates of $\beta$ and the standard deviation $\sigma$. Next, the mean estimate of $\beta$ and the average variance are calculated as:[15]

$$\overline{\beta_z} = \frac{\Sigma \beta_{zj}}{n} \qquad (18)$$

$$\overline{\sigma_z^2} = \frac{\Sigma \sigma_{zj}^2}{n} \qquad (19)$$

The mean estimate of $\beta$ and the average standard error are the mean and the standard deviation of the assumed normal distribution. Finally, by using a table for the (cumulative) NORMAL distribution, it can be calculated which fraction of the cumulative distribution function is on the right or left hand side of zero. In Table 10 CDF denotes the Largest of the two areas. For this it does not matter whether this area is below or above zero.

Table 10 shows that the linear and quadratic term are robust according to this stability test. It also appears that in more than 90 % of all regressions *AIDGNP* is significant at the 5% level. The quadratic term is significantant at the 5% level in 40-60 percent of all the regressions.

Based on the average coefficients for the entire set of estimates the optimal value of the aid to GNP ratio ranges between 40 % (with *INVGDP*) and 50 % (without *INVGDP*).

## 5. CONCLUSIONS

The paper begins by illustrating that the number of countries receiving high aid inflows (measured in relation to either their GNP or their population) has increased over time. Moreover, some countries are now quite clearly "very high aid recipients", which was not so clear in the 1970s. Is all this aid a good thing? More specifically, is it possible that there is a point at which a country would be better off with less aid rather than more? That this may be so is a notion we embody in the aid Laffer curve. Moreover, both the incorporation of aid flows into an endogenous growth model, and an examination of existing literature on aid effectiveness, give grounds for thinking that mechanisms may well exist which would cause an aid Laffer curve to be observed in practice. Our empirical estimation bears this out.

The policy conclusions of our analysis may seem very clear: place a ceiling at aid around the top of the aid Laffer curve. Any country receiving more should lose this excess, which should be redistributed to countries in which aid will be effective. However, whilst we have sympathy with this conclusion, we would urge some caution in that attention should also be paid to special circumstances (e.g. short periods of high emergency aid or debt relief), the type of aid, and the possibilities of increasing aid effectiveness at all levels of aid.

**NOTES**

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**Appendix 1 Countries in data set**

| | | | | | |
|---|---|---|---|---|---|
| Algeria | Kenya | Tanzania | Panama | Hong Kong | Cyprus |
| Angola | Lesotho | Togo | St. Lucia | India | Greece |
| Benin | Liberia | Tunisia | St. Vincent | Indonesia | Hungary |
| Botswana | Madagascar | Uganda | Trinidad | Iran | Malta |
| Burkina Faso | Malawi | Zaire | Argentina | Iraq | Poland |
| Burundi | Mali | Zambia | Bolivia | Israel | Fiji |
| Cameroon | Mauritania | Zimbabwe | Brazil | Jordan | PNG |
| Cape Verde | Mauritius | Bahamas, The | Chile | South Korea | Solomon Islands |
| CAR | Morocco | Barbados | Colombia | Kuwait | Tonga |
| Chad | Mozambique | Costa Rica | Ecuador | Malaysia | Vanuatu |
| Comoros | Niger | Dominica | Guyana | Nepal | Western Samoa |
| Congo | Nigeria | Dom. Republic | Paraguay | Oman | |
| Egypt | Rwanda | El Salvador | Peru | Pakistan | |
| Ethiopia | Senegal | Grenada | Suriname | Philippines | |
| Gabon | Seychelles | Guatemala | Uruguay | Saudi Arabia | |
| The Gambia | Sierra Leone | Haiti | Venezuela | Singapore | |
| Ghana | Somalia | Honduras | Afghanistan | Sri Lanka | |
| Guinea | South Africa | Jamaica | Bahrain | Syrian Arab Republic | |
| Guinea-Bissau | Sudan | Mexico | Bangladesh | Thailand | |
| Cote d'Ivoire | Swaziland | Nicaragua | China | United Arab Emirates | |

**Appendix 2 List of variables and sources**

| | |
|---|---|
| GDPPC | Real GDP per capita (1985 international prices) from Summers and Heston, the Penn World Tables (Mark 5.5 and Mark 5.6). Data for 1970-1989 (Mark 5.5) are taken from Barro and Lee (1994). Data for 1990-1992 (Mark 5.6) are taken from Penn World Tables, 1994. For estimation starting values for each 5 years' sub-period are used. |
| PCGROWTH | Per Capita Growth Rate of Real GDP. In the estimates, average growth rates over sub-periods of 5 years are used (except for the last period, which refers to 3 years). The growth rates are calculated from Real GDP per capita figures of the Summers and Heston (Penn World Table) datset. For sources see GDPPC. |
| PRIGHTS | Index of political rights (from 1 to 7; 1=most freedom). Taken from Barro and Lee (1994). The figures used refer to five year averages. Since latest data available refer to 1985-1990, we have lagged the variable with 5 years. |
| SENROLM | Gross enrolment ratio for secondary education. Taken from World Bank (1997). |
| CREDITPR | Credit to private sector (% of GDP). Taken from World Bank (1997). |
| DEBTGDP | Total external debt (% of GDP). Calculated by using figures for DEBT and GDP, both in current US$. Taken from World Bank (1997). |
| STDINFL | Standard deviation of inflation (calculated from GDP deflators) for each five years' sub-period. Inflation figures are taken from World Bank (1997) |
| CAPFLO | Total net private capital flows (% of GDP). The figures refer to averages for five years' sub-periods. Figures for total private capital flows and GDP (both denominated in current US$) are from World Bank (1997). |
| CAPFLO2 | Squared value of CAPFLO |
| AIDGNP | Foreign aid (% of GNP). We have used starting values for each five years' sub-period. Taken from World Bank (1997) |
| AIDGNP2 | Squared value of AIDGNP |
| TRADE | Trade (exports plus imports) (% of GDP). Taken from World Bank (1997) |
| INVGDP | Gross domestic investments (% of GDP). Taken from World Bank (1997). |
| DUM7579 | Dummy for first five years' sub-period |
| DUM8084 | Dummy for second five years' sub-period |
| DUM8589 | Dummy for third five years' sub-period |
| DUM9094 | Dummy for last five years' sub-period |
| DUMASIE | Dummy for Asian countries |
| DUMLA | Dummy for Latin American countries |
| DUMSSH | Dummy for Sub-Saharan African countries |

**Table 1 Aid levels classified by aid by per capita**

| | 1975-79 | 1980-84 | 1985-89 | 1990-95 |
|---|---|---|---|---|
| A/P>$250 | New Caledonia (670), French Polynesia (641), Jordan (303), Antilles (270), Bahrain (264) | New Caledonia (1150), French Polynesia (1018),Bahrain (433), Netherlands Antilles (411), Jordan (397), Seychelles (273), Kiribati(258), Israel (254), Vanuatu (253) | New Caledonia (1487), French Polynesia (1457), Grenada (381), Israel (349), Seychelles (348), Netherlands Antilles (326), Cape Verde (276), Vanuatu (257) | New Caledonia (2090), French Polynesia (1614), Sao Tome and Principe (472), Netherlands Antilles (386), Micronesia (352), Cape Verde (321), Western Somoa (310), Tonga (304), Seychelles (294), Vanuatu (281), Israel (263), Kiribati (254) |
| A/P>$100 | Suriname (225), Israel (219), Seychelles (218), Vanuatu (217), Dijbouti (198), Kiribati (129), Western Somoa (126), Oman (1998), Mauritania (116), Syria (112), Solomon Islands (107), Malta (106), Tonga (104), Belize (100) | Dijbouti (225), Dominica (207), Cape Verde (198), Tonga (180), Suriname (161), Western Somoa (153), Solomon Islands (123), Syria (123), Comoros (119), Mauritania (114), Oman (113), Botswana (106), Papua New Guinea(101) | Kiribati (228), Dominica (224), Dijbouti (220), St Kitts and Nevis (209), Sao Tome and Principe (205), Tonga (202), Western Somoa (176), Jordan (169), Solomon Islands (146), Belize (140), Comoros (122), St. Vincent (119), Equatorial Guinea (116), Botswana (114), Mauritania (113), Gabon (108), The Gambia (105), Maldives (100) | Dijbouti (236), Dominica (224), St. Lucia (174), St Kitts and Nevis (165), Suriname (165), St. Vincent (165), Jordan (159), Grenada (151), Maldives (148), Nicaragua (141), Bahrain (138), Equatorial Guinea (137), Guyana (137), Solomon Islands (131), Gabon (127), Belize (124), Guinea-Bissau (123), Zambia (118), Mauritania (116), Namibia (107), Comoros (106) |
| A/P>$50 | Papua New Guinea (96) Dominica (93), Cape Verde (91), Cyprus (86), Botswana (77), Gabon (64), Swaziland (59), Antigua and Barbuda (56) Egypt (55), Sao Tome and Principe (52), St. Vincent (52), Guinea-Bissau (52) | Belize (87), St Kitts and Nevis (87), Sao Tome and Principe(86), Gabon (82) Antigua and Barbuda (81), Malta (81), The Gambia (78), Lebanon (75), Guinea-Bissau (74), Jamaica (74), St. Vincent (72), Lesotho (69), Maldives (68), St. Lucia (62), Swaziland (60), Barbados (57), Liberia (56), Senegal (56), Somalia (55), Yemen (55), Costa Rica (54), Fiji (54), Congo (53) Guyana (52), Cyprus (52), Grenada (51) | Guinea-Bissau (99), St. Lucia (91), Papua New Guinea (87), Antigua and Barbuda (84), Jamaica (83), El Salvador (81), Costa Rica (80), Senegal (80), Bahrain (77), Bhutan (67), Lesotho (64), Honduras (60), Central African Republic (59), Suriname (58), Cyprus (58), Fiji (58), Zambia (58), Somalia (56), Bolivia (54), Mauritius (52), Mali (51) | Bhutan (98), Papua New Guinea (93), Botswana (88), The Gambia (86), Bolivia (86), Yugoslavia (84), Senegal (83), Mozambique (78), Congo (73), Cote d'Ivoire (71), Lesotho (70), Albania (69), Rwanda (68), Fiji (67), Antigua and Barbuda (67), Honduras (66), El Salvador (65), Egypt (65), Swaziland (64), Guinea (62), Jamaica (60), Central African Republic (60), Somalia (57), Malawi (55), Benin (53), Poland (52), Mongolia (51), Mali (50) |
| Source: World Bank *World Development Indicators 1997* | | | | |

**Table 2 Aid levels classified by ratio of aid to GNP**

| | 1975-79 | 1980-84 | 1985-89 | 1990-95 |
|---|---|---|---|---|
| A/Y> 0.5 | - | Cape Verde (57), Somalia (56) | Guinea-Bissau (57), Cape Verde (56), Somalia (50) | Sao Tome and Principe (132), Mozambique (98), Somalia (59), Guinea-Bissau (52) |
| A/Y> 0.3 | Cape Verde (41), Vanuatu (38), Solomon Islands (35), Mauritania (33), Guinea-Bissau (33) | Guinea-Bissau (44), Comoros (37), Kiribati (36), Vanuatu (32) | Mozambique (48), Sao Tome and Principe (48), The Gambia (39), Equatorial Guinea (37), Kiribati (33) | Nicaragua (43), Equatorial Guinea (38), Cape Verde (37), Guyana (37), Rwanda (36), Western Somoa (31), Zambia (30), Kiribati (30) |
| A/Y> 0.2 | Somalia (29), Comoros (28), Kiribati (20) | The Gambia (28), Mauritania (26), Tonga (26), Sao Tome and Principe (25), Solomon Islands (25), Western Somoa (22), Dominica (22), Mali (20) | Comoros (29), Vanuatu (28), Mauritania (27), Chad (26), Western Somoa (25), Mali (25), Solomon Islands (24), Maldives (23), Malawi (22), Tonga (21) | Malawi (29), Tanzania (29), Dijbouti (26), The Gambia (25), Mauritania (25), Vanuatu (25), Burundi (25), Bhutan (24), Sierra Leone (23), Marshall Islands (23), Micronesia (23), Chad (22), Albania (21), Tonga (20) |
| Source: World Bank *World Development Indicators 1997* | | | | |

**Table 3(a) Cumulative distributions of aid per capita and aid as a per cent of GNP**

| | 1975-79 | 1980-84 | 1985-89 | 1990-92 |
|---|---|---|---|---|
| *Aid per capita* | | | | |
| A/P > $50 | 31 | 47 | 47 | 60 |
| A/P > $100 | 19 | 21 | 26 | 32 |
| A/P > $250 | 5 | 9 | 8 | 12 |
| | | | | |
| *Aid as a per cent of GNP* | | | | |
| A/Y > 20 % | 8 | 14 | 18 | 26 |
| A/Y > 30 % | 5 | 6 | 8 | 12 |
| A/Y > 50 % | 0 | 2 | 3 | 4 |

Source: World Bank World Development Indicators 1997

**Table 3(b) Summary statistics of aid per capita and aid as a per cent of GNP**

| | 1975-79 | 1980-84 | 1985-89 | 1990-92 |
|---|---|---|---|---|
| *Aid per capita* | | | | |
| Lower quartile | 2.0 | 1.8 | 2.4 | 10.5 |
| Median | 11.0 | 19.2 | 22.5 | 38.3 |
| Upper quartile | 34.5 | 55.5 | 58.3 | 79.5 |
| Inter-quartile range | 32.5 | 53.7 | 55.9 | 69 |
| n | 152 | 160 | 159 | 162 |
| | | | | |
| *Aid as a per cent of GNP* | | | | |
| Lower quartile | 0.7 | 0.6 | 0.1 | 0.6 |
| Median | 3.8 | 4.9 | 3.3 | 4.0 |
| Upper quartile | 10.6 | 10.2 | 10.6 | 16.2 |
| Inter-quartile range | 9.9 | 9.6 | 10.5 | 15.6 |
| n | 109 | 126 | 148 | 152 |

Source: World Bank World Development Indicators 1997

**Table 4 Base model estimates**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| GDPPC | -0.000311 (-2.63) | -0.00034 (-2.93) | -0.00023 (-1.97) | -0.00029 (-2.63) |
| SECENROL | 0.0305 (2.39) | 0.0235 (1.87) | 0.0280 (2.17) | 0.0212 (1.72) |
| DEBTGDP | -0.0214 (-3.72) | -0.0228 (-4.06) | -0.0195 (-3.32) | -0.0199 (-3.74) |
| DUM7579 | 2.3589 (3.00) | 0.2613 (0.26) | 2.3212 (3.07) | 0.1518 (0.15) |
| DUM8084 | -0.5468 (-0.67) | -2.2079 (-2.25) | -0.8590 (-1.08) | -2.7899 (-2.89) |
| DUM8589 | 1.7977 (1.80) | 0.2509 (0.22) | 1.2224 (1.40) | -0.4693 (-0.47) |
| DUM9094 | 1.1186 (1.08) | -0.5358 (-0.47) | 0.8884 (0.92) | -0.8918 (-0.83) |
| DUMA | -1.0574 (-1.58) | -0.7319 (-1.13) | -0.8876 (-1.37) | -0.6276 (-0.99) |
| DUMLA | -0.0324 (-0.06) | 0.2316 (0.43) | -0.1053 (-0.19) | 0.1840 (0.34) |
| DUMASIE | 2.0796 (2.89) | 2.0409 (3.09) | 2.7042 (4.87) | 2.3455 (4.42) |
| AIDGNP | 0.0758 (3.22) | 0.0493 (1.94) | 0.0775 (3.45) | 0.0486 (2.15) |
| INVGDP | | 0.0940 (3.01) | | 0.1048 (3.18) |
| | | | | |
| Adj. $R^2$ | 0.22 | 0.26 | 0.31 | 0.36 |
| SSR | 3468.339 | 3140.805 | 2357.714 | 2170.602 |
| F-statistic | 9.182 | 10.333 | 13.23 | 15.10 |
| SDDV | 3.943 | 3.8955 | 3.5678 | 3.568 |
| MDP | 0.766 | 0.784 | 0.8405 | 0.841 |
| JB | 104.33 | 124.10 | 3.58 | 4.28 |
| Obs. | 296 | 292 | 278 | 278 |

Notes: SSR= Sum squared residuals; SDDV is standard deviation dependent variable; MDP is mean dependent variable; JB = Jarque-Bera test statistic; Obs. = amunt of observations. The estimates are done with white heteroscedastic consistent standard errors. This applies to all tables.

**Table 5 Determination of instruments: dependent variable *AIDGNPS***

| | Inst 1 | Inst 2 | Inst 3 |
|---|---|---|---|
| GDPPC | -0.00017 (-0.73) | -0.00064 (-1.72) | -0.00021 (-0.87) |
| SECENROL | -0.1295 (-3.09) | -0.1563 (-3.42) | -0.1287 (-3.07) |
| DEBTGDP | 0.0486 (2.66) | 0.1036 (3.45) | 0.0485 (2.66) |
| DUM7579 | 10.499 (2.38) | 17.389 (3.48) | 10.591 (2.39) |
| DUM8084 | 12.660 (2.59) | 20.247 (3.62) | 12.696 (2.59) |
| DUM8589 | 11.422 (2.31) | 18.430 (3.44) | 11.186 (2.26) |
| DUM9094 | 11.596 (2.49) | 18.320 (3.64) | 11.478 (2.45) |
| DUMA | 1.633 (0.93) | -0.199 (-0.11) | 1.550 (0.88) |
| DUMLA | -4.746 (-3.60) | -4.571 (-3.23) | -4.747 (-3.58) |
| DUMASIE | -2.905 (-2.22) | -3.852 (-2.53) | -3.310 (-2.51) |
| POP | -4.23E-09 (-2.86) | -5.27E-09 (-3.53) | -4.41E-09 (-2.76) |
| MORTAL | -0.012 (-0.43) | -0.047 (-1.49) | -0.008 (-0.29) |
| CIVIL | -0.018 (-0.04) | -0.051 (-0.12) | 0.811 (1.16) |
| DEBTSERV | | -0.856 (-3.69) | |
| PRIGHTS | | | -0.819 (-1.90) |
| | | | |
| Adj. $R^2$ | 0.33 | 0.40 | 0.33 |
| Obs. | 278 | 254 | 278 |

**Table 6 Estimate with instruments: dependent variable *PCGROWTH***

| | Inst 1 | Inst 2 | Inst 3 |
|---|---|---|---|
| GDPPC | -0.00020 (-1.74) | -2.85E-05 (-0.14) | -0.00021 (-1.85) |
| SECENROL | 0.0697 (1.79) | 0.0212 (1.15) | 0.0531 (1.93) |
| DEBTGDP | -0.0370 (-2.19) | -0.0221 (-3.19) | -0.0300 (-2.34) |
| DUM7579 | -0.7583 (-0.27) | 1.9758 (1.80) | 0.4711 (0.24) |
| DUM8084 | -4.6854 (-1.35) | -1.4459 (-1.15) | -3.1579 (-1.29) |
| DUM8589 | -2.1835 (-0.71) | 0.9845 (0.80) | -0.8238 (-0.38) |
| DUM9094 | -2.5928 (-0.82) | 0.5082 (0.38) | -1.2030 (-0.53) |
| DUMA | -1.4682 (-1.82) | -1.2173 (-1.79) | -1.2364 (-1.76) |
| DUMLA | 1.5315 (0.98) | -0.1008 (-0.14) | 0.8781 (0.75) |
| DUMASIE | 3.9299 (3.44) | 2.6207 (3.73) | 3.4405 (3.78) |
| AIDGNP | 0.0752 (3.36) | 0.0624 (2.53) | 0.0747 (3.33) |
| FITAIDGNP | 0.3563 (1.14) | 0.0809 (0.94) | 0.2155 (0.99) |
| | | | |
| Adj. $R^2$ | 0.31 | 0.28 | 0.31 |
| Obs. | 278 | 254 | 278 |

**Table 7 Estimates with policy interactive term**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| GDPPC | -0.000464 (-4.01) | -0.00043 (-3.76) | -0.00025 (-2.20) | -0.00034 (-3.01) |
| SECENROL | 0.0174 (1.41) | 0.0261 (2.04) | 0.0298 (2.29) | 0.0226 (1.78) |
| DEBTGDP | -0.0288 (-3.81) | -0.0320 (-4.35) | -0.0204 (-3.35) | -0.0216 (-3.72) |
| DUM7579 | 3.6295 (4.55) | 2.9511 (3.57) | 2.3275 (3.05) | 2.0664 (2.69) |
| DUM8084 | 1.0230 (1.21) | 0.2639 (0.30) | -0.8192 (-1.02) | -0.9762 (-1.21) |
| DUM8589 | 3.5132 (3.77) | 2.7818 (2.97) | 1.3402 (1.49) | 1.2504 (1.40) |
| DUM9094 | 2.9143 (2.84) | 2.0829 (1.91) | 1.0998 (1.11) | 0.8893 (0.89) |
| DUMA | -1.4422 (-2.11) | -1.4010 (-1.99) | -0.8605 (-1.32) | -1.1950 (-1.83) |
| DUMLA | -0.1846 (-0.30) | 0.1683 (0.27) | 0.1239 (0.21) | 0.0500 (0.09) |
| DUMASIE | 1.4372 (2.49) | 1.7979 (2.91) | 2.6497 (4.75) | 2.3888 (4.24) |
| INFL | -0.0023 (-3.00) | -0.0022 (-2.85) | -0.0026 (-2.95) | |
| BUDSURP | 0.0738 (1.33) | 0.0113 (3.12) | | |
| TRADE | 0.0134 (3.51) | 0.0858 (1.37) | | 0.0131 (3.43) |
| AIDGNPS | | 0.0929 (2.34) | 0.0741 (2.96) | 0.0830 (1.52) |
| AIDGNP*POL | | -0.0119 (-0.29) | | |
| AIDGNP*INFL | | | 0.0001 (0.20) | |
| AIDGNP*TRADE | | | | -0.0002 (-0.41) |
| Adj. $R^2$ | 0.36 | 0.37 | 0.31 | 0.32 |
| Obs. | 237 | 237 | 278 | 278 |

**Table 8 Aid-laffer curve estimates**

| | (1) | (2) |
|---|---|---|
| GDPPC | -0.00020 (-1.74) | -0.00026 (-2.36) |
| SECENROL | 0.0310 (2.37) | 0.0249 (2.02) |
| DEBTGDP | -0.021 (-3.45) | -0.021 (-3.97) |
| DUM7579 | 1.851 (2.30) | -0.583 (-0.50) |
| DUM8084 | -1.327 (-1.58) | -3.511 (-3.18) |
| DUM8589 | 0.7533 (0.83) | -1.1807 (-1.05) |
| DUM9094 | 0.3482 (0.34) | -1.7034 (-1.41) |
| DUMA | -0.906 (-1.39) | -0.641 (-1.00) |
| DUMLA | 0.0536 (0.10) | 0.4120 (0.75) |
| DUMASIE | 2.870 (5.03) | 2.554 (4.79) |
| AIDGNP | 0.1466 (2.98) | 0.141 (3.05) |
| AIDGNP2 | -0.0013 (-1.82) | -0.0017 (-2.46) |
| INVGDP | | 0.1096 (3.09) |
| | | |
| Adj. $R^2$ | 0.31 | 0.37 |
| SSR | 2339.161 | 2137.019 |
| F-statistic | 12.27 | 14.35 |
| SDDV | 3.5678 | 3.568 |
| MDP | 0.8405 | 0.841 |
| JB | 3.53 | 4.06 |
| Obs. | 278 | 278 |

Notes: SSR= Sum squared residuals; SDDV is standard deviation dependent variable; MDP is mean dependent variable; JB = Jarque-Bera test statistic; Obs. = amunt of observations.

**Table 9 Extreme Bounds Analysis**

| Variable | β | SE | t-value | $R^2$ | AV | Robust/ Fragile |
|---|---|---|---|---|---|---|
| AIDGNP | high: 0.4552<br>low: -0.0402 | 0.086<br>0.080 | 3.32<br>1.50 | 0.36<br>0.38 | BUDDEF, CREDITPR, DEBTSERV<br>BUDDEF, TRADE, MONGDP | Fragile |
| AIDGNP2 | high: 0.0052<br>low: -0.0094 | 0.0026<br>0.0022 | 0.00<br>-2.27 | 0.38<br>0.40 | BUDDEF, PRIGHTS, BMPLAG<br>BUDDEF, CAPFLO, MORTAL | Fragile |
| *With INVGDP* | | | | | | |
| AIDGNP | high: 0.4326<br>low: -0.0264 | 0.0823<br>0.0767 | 3.26<br>1.66 | 0.38<br>0.40 | BUDDEF, CREDITPR, DEBTSERV<br>BUDDEF, PRENROLM, MONGDP | Fragile |
| AIDGNP2 | high: 0.0042<br>low: -0.0092 | 0.0026<br>0.0021 | -0.38<br>-2.38 | 0.42<br>0.38 | BUDDEF, PRIGHTS, BMPLAG<br>BUDDEF, CREDITPR, DEBTSERV | Fragile |

Note: AV= additional variables, SE= standard error. Row 2 and 3 refer to estimates for which *INVGDP* is not included in *I* vector. Row 5 and 6 present the results for estimates where *INVGDP* is included. Note that the amount of observations are not exactly the same in the different estimates due to lacking data. The amount of observations varies between 250 and 278.

**Table 10 An Alternative Stability Test**

| Variable | $R^2$ | $\beta$ | $\sigma$ | CDF | Perc |
|---|---|---|---|---|---|
| AIDGNP | 0.36 | 0.1736 | 0.05729 | 0.999 | 0.96 |
| AIDGNP2 | 0.36 | -0.00175 | 0.001014 | 0.958 | 0.39 |
| *With INVGDP* | | | | | |
| AIDGNP | 0.38 | 0.1639 | 0.0547 | 0.999 | 0.98 |
| AIDGNP2 | 0.38 | -0.002 | 0.000998 | 0.977 | 0.58 |

Note: perc denotes the percentage of regressions that variable is significant at 5% level.

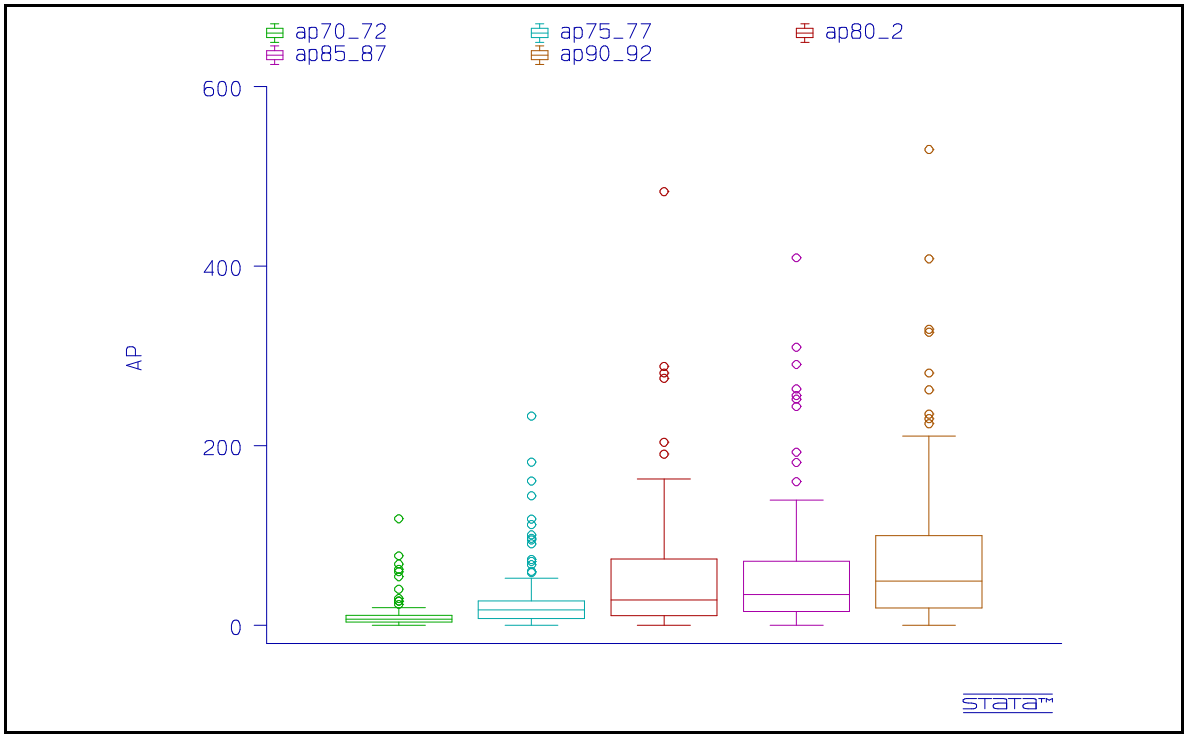


Figure 1

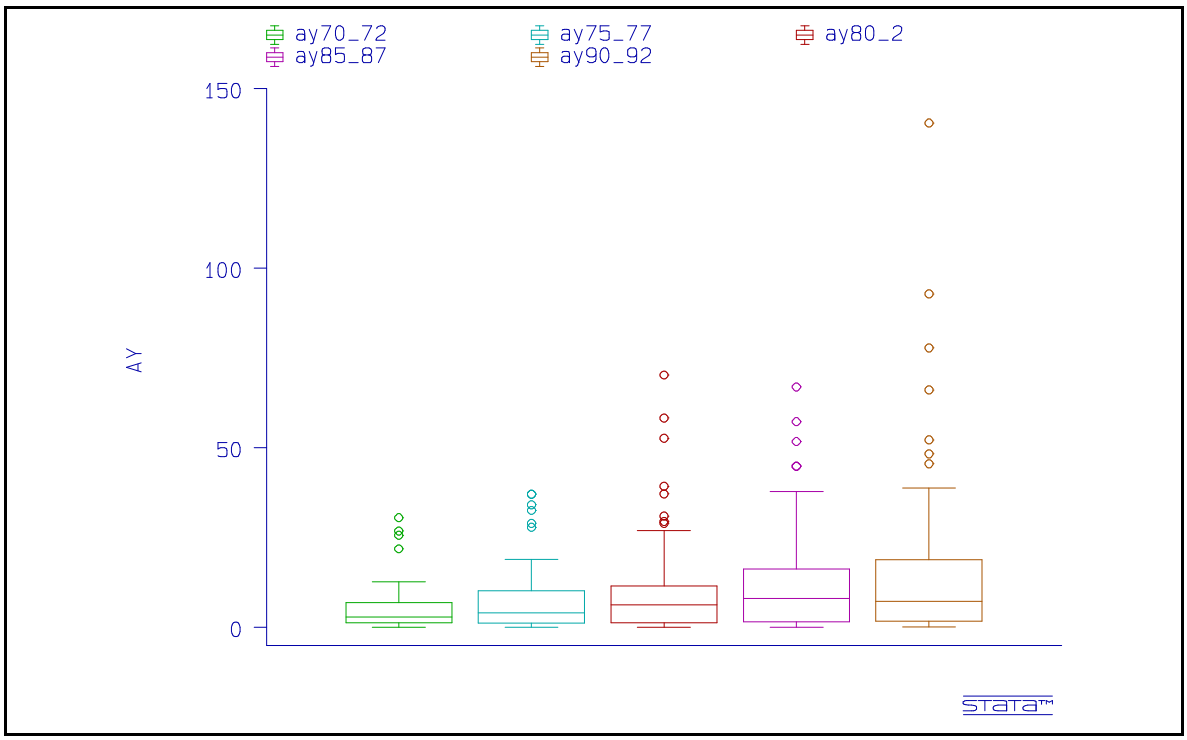


Figure 2

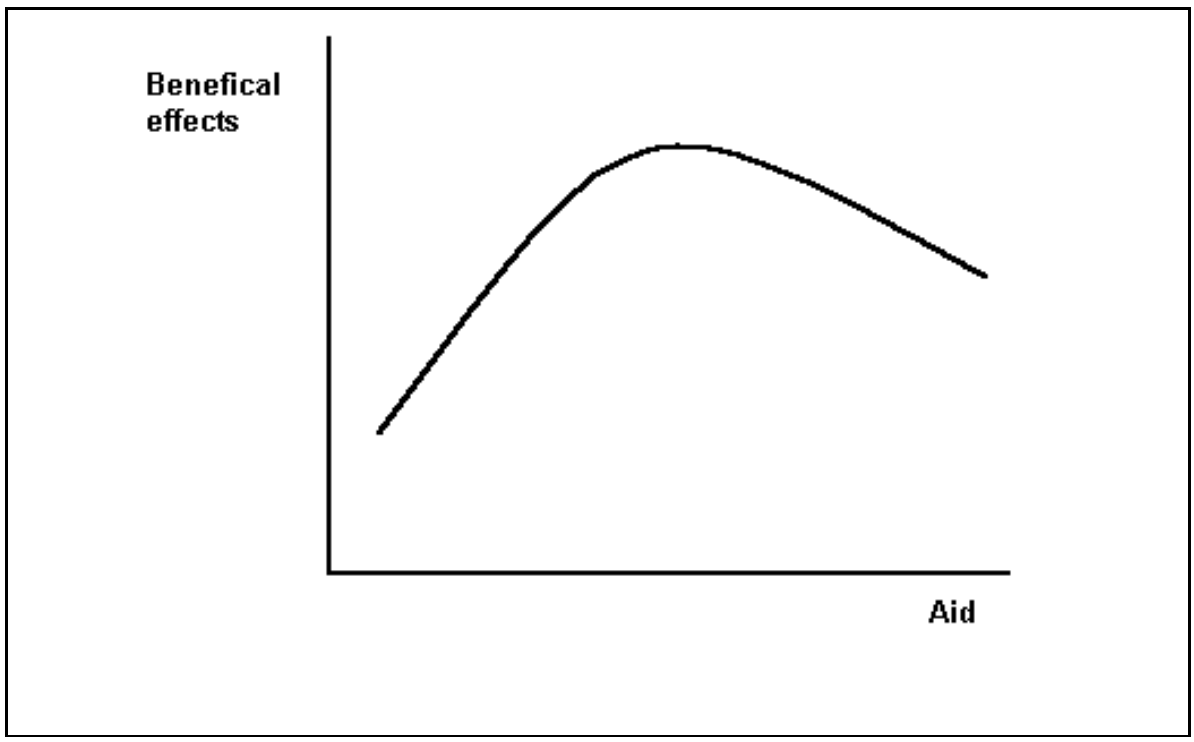


Figure 3

[1]. These data are of course in nominal terms. However, IMF data show that the dollar-based import price index for the developing countries (the most appropriate deflator for aid flows from their point of view) to have risen by only ten to twenty per cent over this period.

[2]. Several agencies couch this objective in terms of gender, although their actual concerns are linked to women's position rather than gender *per se*.

[3] It is simple to introduce taxes. HoweNext, we reestimated equation 3 from Table 4 by inserting the fitted value for *AIDGNP* (denoted by *FITAIDGNP*). These results are presented in Table 6. The advantage of presenting the results in this manner is that they can give information about two issues. First, by adding the coefficients for *AIDGNP* and *FITAIDGNP*, we find the implied coefficient for *AIDGNP* had the equation be estimated with instruments for *AIDGNP*. Since all exogenous variables of the base equation are also used as instruments the implied coefficient would be the same had the equation be estimated with two-stage least squares (TSLS), as had been done by Burnside and Dollar (1997). A simple calculation shows that the coefficient for *AIDGNP* would be 0.4315 when the equation had been estimated with TSLS and *POP*, *MORTAL* and *CIVIL* were used as instruments. However, when *POP*, *MORTAL*, *CIVIL* and *DEBTSERV* were used as instruments the TSLS estimate would have produced a coefficient for *AIDGNP* of 0.1433, whereas it would have been 0.2902 when *POP*, *MORTAL*, *CIVIL* and *PRIGHTS* had been used as instruments. Hence, the results appear to be very sensitive to the used set of instruments. Second, the significance of *FITAIDGNP* may be used as a test of the null hypothesis of exogeneity of *AIDGNP*. ver, this would not change the basic message of the paper.

[4]. Our story does not distinguish types of aid. It is of course clear that some types of aid, notably debt relief, require rather less management capacity than others. Though even debt relief has associated Consultative Group meetings to prepare for and attend and donor monitoring and evaluation requirements to satisfy.

[5] The number of observations for the regressions is less than 4 times the number of countries on account of the absence of data for some countries.

[6] Some have argued (e.g. Krugman, 1994) that the success of the East Asian economies can be accounted for by factor inputs alone. Hence if these variables are included then the dummy variables may not be significant.

[7] Under the null hypothesis of normality this test is chi-squared distributed with two degrees of freedom. It should be lower than 5.99 to be significant at the five per cent level.

[8] We also tried other instruments as well, including the donor dummy used by Boone. For reasons of space, and because of the fact that they were not significant we have not presented them.

[9] This is a version of the Hausman test for endogeneity (see Mukherjee *et al.*, 1998).

[10] This test was also conducted with INVGDP, which yielded similar results. For reasons of space these results are no presented.

[11] It was indeed argued long ago by Mosley (1980) that it is unlikely that aid is endogenous with respect to growth (rather than the level of income).

[12] An extended discussion of *Assessing Aid* may be found in Lensink and White (1999).

[13] Again, we also tested this for model with INVGDP but the results not presented for reasons of space.

[14] We also tested the product of the policy variable with the square of aid (which is the form used by Burnside and Dollar), but again found insignificant results.

[15] Sala-i-Martin uses a weigthed average with the likelihoods as weights. He shows that results of his empirical analysis do not differ very much when an unweighted average is used.