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Explaining development aid allocation by growth:

A meta study and a new look at the data

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I. INTRODUCING A LITTLE KNOWN RELATION

Development aid is a significant global phenomenon. A large empirical literature has emerged to explore the motives behind aid allocations. One of the more important motives is the recipient's humanitarian needs, typically measured by per capita income or population, and less commonly so by economic growth. This paper considers the causal relation from economic growth in a recipient country to the development aid it receives: The *growth-aid relation*, with the slope, φ. The literature on aid allocations has developed four hypotheses about φ:

H1: *Humanitarian interests*: Poor development is a humanitarian concern. Predict $\varphi < 0$.

H2: *Development banking interests*: Development banks are charged with the financing of worthwhile development projects. Economic growth generates many such projects. Predict $\varphi > 0$.

H3: *Commercial interests*: Donor country business sees aid as a public investment in their future business. Growth makes countries more promising. Predict $\varphi > 0$.

H4: *It is the result of modeling biases*: Typical prediction $\varphi < 0$, see section II.

The importance of humanitarian interests (H1) is of particular concern, given the primary stated objectives of development aid. The sign on φ predicted by the four hypotheses differs, so that the net outcome is undetermined and remains an empirical issue. As the signs differ we suspect that the average size of φ is small. No attempt has previously been made to sum-

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marize neither this literature nor the data to test these hypotheses. This paper offers the first attempt to do so, by presenting a meta-analysis of the empirical literature, as well as analysis of the primary data.

The meta-analysis provides a quantitative synthesis and systematic review of the relevant results in the extant empirical studies. We have found 30 studies where φ is estimated: [1] The estimates of φ are typically small and positive. Research is a process of truth searching where new results are produced by innovation, and confidence is build by independent replication, which is replication by other researchers on new data sets. Meta-analysis is a quantitative study of this process, it asks:

(Q1) Do the findings of the research process converge to something we can term the true value of φ?

(Q2) What factors explain the heterogeneity in the reported empirical results?

To analyze these questions, meta-analysis uses all results reported in the literature as the data. To study (Q1), methods have been developed to study convergence as data expands, and models and estimators improve. To study (Q2), each data point is provided with a string of information characterizing the way the said estimate is reached. The string covers data, model specification, and estimation differences. The meta study thus analyzes if results change over time, vary across countries, exhibit structural shifts due to innovations, etc.

Our primary data analysis is based on panel data analyses of aid allocations to 147 countries for the period 1967-2004. This involves a larger and more comprehensive dataset than that used in the extant empirical studies. The results from the panel data analysis confirm those of the meta-analysis.

Section II looks at the correlation between growth and aid, and at the causal structure in the aid-growth-income nexus, and discusses hypothesis H4. Section III discusses the three hypotheses H1 to H3. The meta-analysis is presented in sections IV and V, where section IV concentrates on (Q1), while section V studies (Q2). Section VI presents new evidence using a panel of 147 countries for the 1967-2004 period. Section VII concludes the paper.

1. Doucouliagos and Paldam (2008) report a meta-analysis of the reverse causality, of the effect of aid on growth.

II. THE ZERO CORRELATION FACT AND THE INCOME-GROWTH-AID NEXUS

This section first documents the zero correlation fact: That the raw data indicate that development aid and economic growth are basically uncorrelated. The section then turns to the causal relations in the income-growth-aid nexus, and gives a short survey of our knowledge about the three relations, which may cause biases in the ($g \rightarrow h$)-relation. The evidence about these relations comes from a handful of meta-analyses of the literature on the macroeconomics of development aid. This literature has now reached almost 300 empirical papers divided into: The ***AAL*** (Aid Allocation Literature) that consists of 166 papers about the way aid is allocated, and the ***AEL*** (Aid Effectiveness Literature) that consists of 152 papers of the effects of aid on savings, investment, and growth.[2] Table 1 defines the variables used throughout the paper for easy reference.

Table 1

Variables and concepts used

i, j, t	Indices for recipient, donor and time
T	Years of time period used
N, n	Observations in sample, number of estimates
H_{it}^{j}	Aid matrix
$h_{it}^{j} = H_{it}^{j} / Y_{it}$	Aid share, note that j is often missing
$Y_{it},\ y_{it} = Y_{it} / P_{it}$	GDP and gdp (GDP per capita)
g_{it}	Growth rate of gdp in recipient country
$\varphi = \partial h / \partial g$	Aid allocation effect of growth, g may be lagged
$\mu = \partial g / \partial h$	Aid effectiveness on growth, h may be lagged

II.1. The zero correlation fact

Table 2 shows the correlations between aid, h, and growth, g, for all countries in the WDI for which these data are reported. Both the AAL and the AEL typically work with a period of either 5 or 10 year averages, so sections (1) and (2) of the table are the most relevant ones.[3] Table 2 shows a correlation that starts at zero for the period of T = 5, and then gradually grows more and more negative as the period increases to T = 10, 15, and 20.[4]

2. Christensen *et al.* (2007 and 2009) are bibliographies of the two literatures, which overlap a little.
3. Most of AEL treats this fact rather gingerly. The zero correlation result has also confirmed by regressions starting by Griffin and Enos (1970). It was thoroughly examined by Mosley (1987), and latter by Easterly (2006), Jensen and Paldam (2006) and more recently by Rajan and Subramanian (2008).
4. If the DCs are deleted it makes the four averages marginally smaller as DCs have slightly above average growth and zero aid shares. If the correlations are calculated using Kendall's τ, to reduce the weight of outliers, it still changes nothing. These tables are available from the authors.

Table 2

Cross-country correlations between aid and growth (unlagged) for 170 countries

(1) 5-year averages			(2) 10-year averages			(3) 15-year averages			(4) 20-year averages		
Period	N	Cor	Period	N	Cor	Period	N	Cor	Period	N	Cor
60 – 65	92	-0.12	60 – 70	89	-0.02	60 – 75	91	0.06	60 – 80	91	0.04
65 – 70	103	-0.00	65 – 75	105	0.08	65 – 80	106	0.05	65 – 85	107	0.01
70 – 75	111	-0.01	70 – 80	113	0.03	70 – 85	114	0.03	70 – 90	114	-0.02
75 – 80	122	0.06	75 – 85	121	-0.03	75 – 90	121	-0.12	75 – 95	119	-0.17
80 – 85	134	0.09	80 – 90	133	-0.06	80 – 95	132	-0.14	80 – 00	134	-0.13
85 – 90	143	-0.12	85 – 95	138	-0.18	85 – 00	143	-0.10	85 – 05	140	-0.06
90 – 95	169	-0.00	90 – 00	171	0.00	90 – 05	166	-0.06			
95 – 00	178	0.09	95 – 05	170	-0.01						
00 – 05	175	-0.02									
Average	1227	-0.00	Average	1040	-0.02	Average	873	-0.04	Average	705	-0.06

N = number of observations. Cor = first order (simple) correlations

The pattern of correlations has been further examined in Herbertsson and Paldam (2007), who report two additional facts. First, if T continues growing, the correlation becomes more negative, and from $T = 30$ it is statistically significantly negative. However, causality in such long-run relations is difficult to interpret. The most reasonable interpretation is probably that the negative correlation reflects a selectivity effect: Successful countries growing fast gradually loose aid. Second, correlogrammes of the two series show some short-run interactions that wash out already for $T = 5$: (i) There is a short-run activity effect, so that g rises, when h is spent. (ii) There is a crisis effect, where unusually low gs give some aid the same year or one year later. Both of these effects are fairly small. The crisis effect predicts that we should find a small negative coefficient on the ($g \rightarrow h$)-relation below.

II.2. The income-growth-aid nexus: Possible biases?

That the raw aid and growth data are essentially uncorrelated is a well-known fact that has baffled and dismayed hundreds of researchers. The zero correlation fact is at the center of the large research into the income-growth-aid nexus. The AAL developed in part as a response to this: Researchers have responded to the zero correlation in the raw data by estimating econometric models of the effects of aid on growth, focusing on the partial effects of aid on growth once other determinants of growth are controlled for. However, a recent meta-analysis of this literature shows that only 38% of the estimates from econometric models were of a positive and statistically significant association between growth and aid (Doucouliagos and

Paldam 2008). Nevertheless, debate on the effects of aid on growth continues (McGillivray et al 2006).

Figure 1 shows the causal relations in the nexus: The effects of income on growth; the effect of income levels on aid; the effects of aid on growth; and the effects of growth on aid. This paper studies the black arrow, i.e. the (g➔h)-relation. The figure suggests that this relation might have two biases.

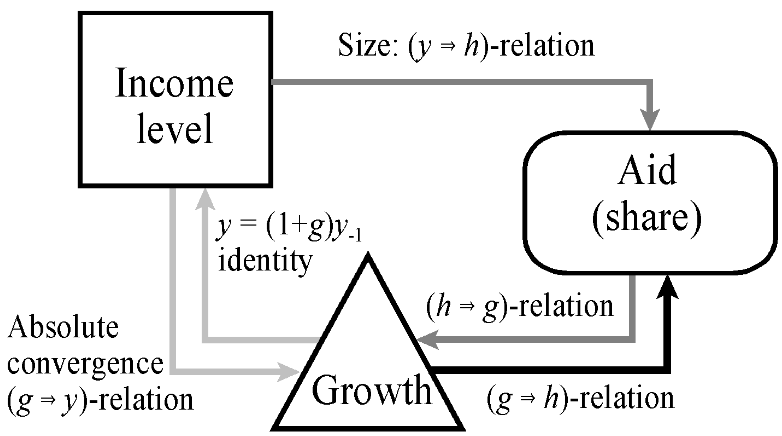
B1 An omitted variable bias may occur if the relation from g to h goes via y: g ➔ y ➔ h

B2 A simultaneity bias occurs if h ➔ g, as analyzed in the aid effectiveness literature

These possibilities are both analyzed in a whole body of literature, which have been analyzed by prior meta studies, so we know much about the possible sizes of these biases.

Figure 1

The causal links in income-growth-aid nexus



II.3. B1: The bias if y is omitted

As regard B1, it is a product of and the (y➔h)-relation and the net effect of the (g➔y)-relation and the identity. The relations will be covered separately:

Regarding the (g➔y)-relation, we want to know how much of the variation in income levels is generated by variation in the growth rates in a 5-year perspective. This is not a trivial calculation, but we do know that high and low growth rates are distributed arbitrarily across the cross-country distribution of income, i.e. the level of absolute convergence is insignificant

(Barro and Sala-i-Martin, 2004). Hence, growth gives some noise, but not a clear direction.[5] However, the identity will give a small positive effect. We assume that the (g→y)-relation is positive, but it is surely small, such as a couple of percent due to the identity.

The (y→h)-relation is often referred to as the poverty effect on aid (the allocation of aid to poor countries). Here we are on firm ground: Doucouliagos and Paldam (2009b) contains both a primary study of the data and a meta study of 124 studies publishing no less than 1,049 estimates of the poverty effect. The results from the two techniques agree: The aid share is negatively and linearly related to income, so that poorer countries receive more aid. However the explanatory power of the relation is modest, it provides a marginal R^2 of approximately 0.09 – 0.12 only.

The bias (B1) is the product of the (g→y)-effect and the (y→h)-effect. Obviously the product of a small and a modest effect is a very small effect (i.e., with the sizes mentioned we get 0.02 x 0.10 = 0.002). Effects of that size will not give a detectable omitted variable bias.

Also, we know that many of the studies listed in the Appendix control for income and that this does not affect the results. Thus, we know that we need not fear (B1).

II.4. B2: No evidence of a simultaneity bias has been found

Simultaneity between the (g→h)- and the (h→g)-relation has been endlessly discussed in connection with the latter relation, i.e. the aid effectiveness effect.

The (h→g)-relation has been analyzed in 162 studies producing 892 estimates of the aid effectiveness on growth effect, μ. Doucouliagos and Paldam (2008, 2009c) cover this literature and conclude that it has overwhelmingly demonstrated aid ineffectiveness. As data has increased, the best compound estimate of μ has converged to zero. The latest updated estimate of the best value of μ based on the full literature until 1-1-2009 is a partial correlation of +0.017, with a t-ratio of 0.81.

About 30% of the estimates have tried to adjust aid effectiveness estimates for simultaneity. It is difficult to find good instruments to sort out the causality, and the ones tried often move the coefficients a little, but equally often down as up, so when the aggregate effect of using an IV-estimator is assessed, it is insignificant. We thus conclude that the literature has failed to show that a simultaneity bias exists in the estimate of aid effectiveness.[6]

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5. A lucid discussion of the way income inequality is generated and the role of growth in the process is found in Aghion, Caroli and García-Peñalosa (1999). It appears almost equally easy to argue that the sign is positive or negative on the (g→y)-effect.
6. See however the last paragraph of section V.2 below.

For the present analysis, it simplifies things a great deal that we can take it for given that aid has no effect on growth: It means that there is no reason to expect that the bias B2 matters. In fact, it also argues that the effect, we are chasing at present, can not be large, because if it were large, it would have caused a bias in the aid effectiveness literature.

III. THEORIES ABOUT THE GROWTH-AID RELATION

In this section, we first review the typical empirical aid allocation model. Then we discuss the motives driving aid flows, concentrating on the three hypotheses (H1) to (H3).

III.1. Models of the AAL

The basic model in the AAL consists of two linked sub-models: The recipients' characteristics R-model, $[\ ]_R$, and the donor-recipient relationship D-model, $[\ ]_D$:

$$H_{it}^{j} = \left[a_1 y_{it} + a_2 P_{it} + \varphi^H g_{it} + a_3 \Pi_{it} + ...\right]_R + \left[b_1 X_{it}^{j} + b_2 F_{it}^{j} + b_3 S_{it}^{j} + b_4 C_{it}^{j} + ...\right]_D + \varepsilon_{it}^{j} \qquad (1)$$

H is *the aid matrix*. Only two of the 30 papers (Bertélemy and Tichit 2004 and Bertélemy 2005) consider the full matrix of donors, recipients, and time. This makes the number of observations very large. However, as the interests of the various donors differ, the full D-model becomes difficult to include. Other authors consider a single donor or a group of donors. For example, the team of McKinlay and Little published a set of papers estimating the aid function separately for Britain, France, Germany, and the USA, using the framework of equation (1), and finding fairly different coefficients between the countries.

The ***R-model*** is the first bracket $[]_R$ in (1). It uses data for the recipient country *i,* such as income (y_i), country size (P_i), and growth (g_i). Often they are supplemented by political characteristics, Π, such as a democracy index, a corruption index, a human rights measure, etc. The present paper tries to isolate the effects of one of the variables, *g*, in this sub-model.

The ***D-model*** is the second bracket $[]_D$. It includes characteristics of recipient-donor relations such as exports from donor to recipient (*X*), FDI (*F*), the importance of the recipient for the foreign policy (*S*) of the donor, and the historical relations between the two countries (*C*). Some of these variables may have influenced the variables in the R-model, e.g., FDI from the donor may in some cases be important for g and y in the recipient country, but the set-up (1) assumes that the influence is small in the short-run.[7]

The most ingenious part of the AAL is the many attempts to define and compile the variables of the D-model. In the present meta-analysis, the D-model is only relevant as far as to allow us to identify the effect of g by reducing the variance of, and possible biases in, the estimate of φ.

Some of the variables – such as P and y – are normally in logs, and some lags may enter the specification as well. Obviously, a great many scaling issues are involved when papers have to be compared, as we do (see section IV.2).

The present analysis deals with the effect of recipient country growth only. We have found various remarks about the reasons why economic growth in the recipient countries should matter for aid, but we have identified only three clear hypotheses. In most of the 30 studies it appears as if growth is just "thrown in" as one of the main macroeconomic indicators.

III.2. Economic growth is independent of most other motives driving aid

When we analyze the motives that have been found to effect aid allocations most are only weakly related to growth. This applies to former colonial status. A literature exists that ascribes some of the differences in income levels today to colonial past (see Acemoglu *et al.* 2005), but it is clearly a very small effect on growth rates in a 5-10 year perspective. Also, while ex-colonial links are important for bilateral flows, they are not very important for aggregate aid flows.

The same applies to the "strategic position" of countries. It is well-known that countries which have such a position, seen from the point of view of a donor, may receive extra aid from that donor. However, we have found no analysis showing a link from strategic position to growth. A related finding is that several studies have shown that the country's voting record in the UN influences the aid they receive, but the voting appears to be unrelated to their growth.

In short, most of the motives in the D-model seem to be irrelevant for the effect of the growth variable. This also applies to most of the non-economic variables in the R-term. For

7. It is often assumed that the R-model contains the humanitarian motives, while the D-model hides the selfish motives of the donors. This is not necessarily the case. Part of the problem is that the aid decision has several levels. One is the choice of recipient country, where the D-model is often found to be important; another level is the choice of the aid program, in the country chosen, where the D-model is often less important. Yet another level is the amount of aid allocated, which is the subject of this paper.

example, there are no clear relations between democracy and growth, and between inequality and growth.[8]

III.3. Three growth related motives

In section III we dismissed H4. This leaves us with the three motives mentioned in the introduction:

(H1) The declared goal of aid: To help countries to develop so that world poverty can be reduced. The *humanitarian motive* gives a clear negative connection, $\varphi < 0$, between economic growth and aid. In particular we note that low growth due to war and natural disasters is a misfortune that can be partly alleviated by aid. There are complex issues of lags that may cause the observed effects to appear less clearly, as will be discussed in the next subsection. The other two motives suggest the reverse sign on φ.

(H2) The *development banking motive*: Development banks move approximately one-third of the total ODA-flow. For example, in 2007 they contributed 39 of the 117 billion US$ in total aid (OECD (2008). The original purpose of the World Bank and the regional development banks was to finance development projects on concessional conditions. Consequently, high benefit/cost ratios play a considerable role for the Bank and its regional sisters. Growing countries generate more such projects and, hence, need more finance.[9] We thus expect aid from the development banks to be positively related to growth, $\varphi > 0$.[10]

(H3) The *commercial interest motive* sees aid as a donor government investment in the future business of donor country firms. The state in the donor country primes the pump for future cooperation. This might not be a bad thing for the recipient as it helps with integration into the world market, but clearly it is an attempt to build channels for future trade flows. Here it is clear that the connection is positive, $\varphi > 0$, between growth and aid.

One may ask if there are reasons to expect that the relative importance of the three motives will change over time. This is of course an empirical question, but *a priori* it is likely

8. For example, Doucouliagos and Ulubasoglu (2008) find that democracy has no direct effect on economic growth.
9. See IBRD Articles of Agreement (as amended February 16, 1989) on the Bank, notably Purpose and Article III Section 1. Over time, this goal has been softened; see the World Bank Home Page “about us”. Here the Bank gives a summary that (abbreviated) says: The World Bank’s mission is global poverty reduction and improvement of living standards, by providing low-interest loans, interest-free credit, and grants to developing countries for education, health, infrastructure, communications, and many other purposes.
10. It is also worth mentioning that the most influential paper on aid effectiveness in the period 1996 and for the next decade (Burnside and Dollar 2000, available as a working paper from 1996), recommended a concentration of aid to countries with *good policies*.

that they are fairly stable. For example, it is not clear how they should react to the end of the Cold War.

Also, we know that the World Bank did have a period where it was involved with many Structural Adjustments, and relatively few projects, but then it changed back again. Also, there was a recent period where the Bank was influenced by the idea that aid was more efficient in countries with high growth due to “good policy”. So perhaps there has been some cyclicality in Bank policy that may be reflected in φ. We have found no signs of such cyclicality in the Bank, but there is some evidence of this when all donors are considered (see Table 5 below).

III.4. The humanitarian motive: What should we observe?

Given that countries which suffer a misfortune receive some extra aid, we may speculate how it would appear in models such as the ones we consider.

Imagine a poor country having a bad harvest in year Y1 due to lack of rain. As a consequence, it receives some extra aid in the form of food, with a delay of half a year. If the country is north of the equator, this would appear as low growth in Y1 where the harvest fails, and as rain then returns, a high growth in Y2, when aid comes. Thus, we will observe a positive correlation between growth and aid in the short-run. However, on the southern hemisphere the result will be the reverse.

Imagine a civil war lasting 5 years. During the war, we typically observe that growth suffers and that aid is reduced to emergency aid. When peace is made there is typically a rebuilding boom, and at the same time a special aid package is normally given, so once more we should observe a rather strong positive correlation with some lags to both sides.

Very much the same outcome would occur in a country getting an unusually nasty government: It is likely to chase away both aid and investments and thus growth, until the government is toppled, and then an aid package and normal business will return.

From the correlations in II.1, we predict that the average φ reported by the literature should be a small negative one. However, the examples given show that it is important to control the relation for a range of exogenous events. This is precisely what is done in the literature covered by the meta study, where the effect φ is estimated in a whole set of relations that control the model for factors that are known to influence aid allocations. There is very strong evidence that aid has strong inertia, and that aid per capita is negatively correlated to gdp, y, and to population, P, of the recipient countries, as well as influenced by donor interests. It is important to control the relation for these variables as well.

That is, it is arguable that the estimate of φ ought to come from a larger model with a complex set of controls. And, in fact, all the 211 estimates we have found in the AAL are reached within the framework of a larger model where the authors attempt to explain as much of the allocation of aid as possible. Consequently, the results reached in the 30 studies are *partial* correlations, which are likely to differ from the simple correlations shown in Table 2.

IV. META STUDY: DISTRIBUTION AND META AVERAGE OF THE ESTIMATES

The 30 studies included in the meta-analysis are referenced in the Appendix.[11] We first look at the data and associated funnel plots of the results in IV.1 and 2, respectively; then IV.3 presents tests of the symmetry of the funnel, and the presence of a genuine empirical effect of growth on aid allocated.

IV.1. Data for the meta-analysis

The data analyzed in the meta-analysis are the estimates of φ reported in the 30 studies.[12] They are coded as two data sets: (1) The ***all-set*** is all 211 estimates reported, and (2) the ***average-set*** is the 30 averages of the estimates reported in each paper. The advantage of using the all-set is that it offers more estimates from which the source of variation (heterogeneity) between studies can be explored. The main disadvantage of using the all-set is that some authors (and/or journals) follow the strategy of reporting many estimates, while others report only few, so when the all set is used the meta-analysis comes to weigh papers by reporting strategy. Many meta-analysts prefer to use the average-set. We use both. If they tell the same story, we can have some trust in the robustness of the result.

The 211 estimates of the effect φ are not directly comparable across all studies, due to differences in data and variable definitions and scaling. To make them comparable, they have been converted into partial correlations.[13] This was possible in all cases. An alternative

11. They are: Henderson (1971); McKinlay (1978); McKinlay and Little (1978, 1979); Maizels and Nissanke (1984); Frey and Schneider (1986); Karunaratne (1986); Bowles (1987, 1989); Tsoutsoplides (1991); Gang and Khan (1990); Gang and Lehman (1990); McGillivray and White (1993); Gounder and Doessel (1994, 1997); Gounder (1994, 1995, 1999); Ball and Johnson (1996); Boone (1996); Tarp *et al.* (1999); Hudson and Mosley (2001); de Silva (2002); Kilby (2002); Feeny and McGillivray (2002, 2004); Harrigan and Wang (2003); McGillvray (2003); Bertélemy and Tichit (2004); and Bertélemy (2005).
12. The 30 studies are the population of studies that we were able to identify. It is quite common for meta-analysis to be conducted on a small number of studies.
13. We would have preferred to use elasticities, but many of the studies do not provide enough information.

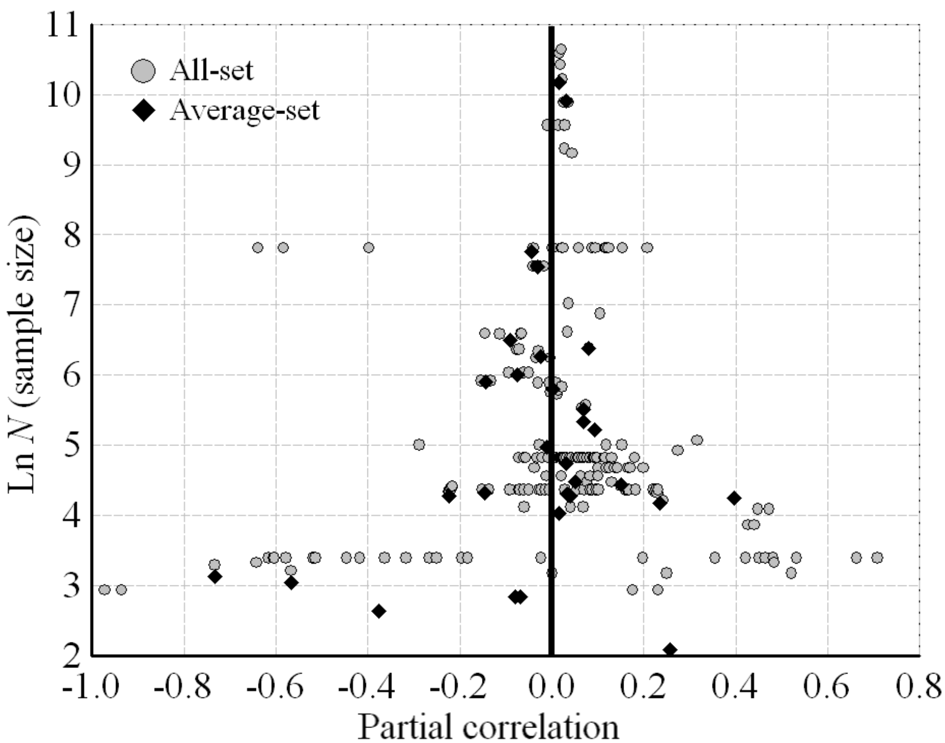
approach is to use t-statistics as done in IV.3. However, partial correlations are derived from t-statistics, and have the advantage of interpretability.

IV.2. A Funnel plot showing the distribution of the data

Funnel plots are used to illustrate the distribution of empirical findings, showing the relationship between an effect (partial correlations in our case) and a measure of precision (measured here by the sample size).[14] See Stanley (2005) for details and other examples. Figure 2 presents two funnel plots, one for the all-set of 211 growth-to-aid partial correlations and one for the average-set of 30 partial correlations over the sample size, *N*. As the estimates differ very much as to the size of *N*, we have used ln*N* on the vertical axis. Both plots appear to be roughly symmetrical, although the average-set plot is less so. Figure 2 lists the weighted average partial correlation, r_w,[15] The weighted average is essentially the same whether the all-set or the average-set is used.[16]

Figure 2.

Funnel plot for the all-set (n = 211, r_w= +0.013) and the average-set (n = 30, r_w= +0.014)



14. The theory and practice of the funnel plot is surveyed in Stanley and Doucouliagos (2009).
15. We used sample size as the weight, so that larger studies are given greater weight.
16. The FAT-PET tests in section IV.4 will only be presented for the All-set.

IV.3. The FAT-PET technique

The standard test in meta studies is increasingly the FAT-PET (the Funnel Asymmetry Test – Precision Effect Test). It does two things: (1) Tests for funnel asymmetries, $\gamma \neq 0$, which can often be interpreted as a publication selection bias; and (2) Estimates the *meta average*, ε_M, which is the average estimate adjusted for the selection bias.[17] It is not unusual to find a substantial difference – such as a factor 2 – between the plain average and the meta average of the estimates.[18]

Smaller samples have larger standard errors. If publication selection bias is absent from a literature, no association between a study's reported effect and its standard error should appear. Reported estimates will then randomly differ from the underlying population effect, which is estimated by ε_M, the meta-average. However, if there is publication bias, smaller studies will search for larger effects in order to compensate for their larger standard errors.[19] Following this logic, the FAT-PET regression involves regressing the estimated partial correlations of the effect of growth on aid (ε_i), on a constant and the associated standard errors (se_i), where the constant is the meta-average (ε_M), i.e. $\varepsilon_i = \varepsilon_M + \gamma se_i + v_i$. In order to reduce heteroscedasticity, this equation is divided through by se_i, producing the weighted least squares version of the FAT-PET:

$$t_i = \varepsilon_M p_i + \gamma + u_i \qquad (2)$$

Here $t_i = \varepsilon_i/se_i$ and $p_i = 1/se_i$. Note that $p_i = 1/se_i$ is the *precision* of the estimate, defined as the inverse of the standard error of the estimate. The two coefficients, ε_M and γ are the meta-average and the asymmetry test statistic respectively.[20]

Equation (2) is estimated in Table 3, which also controls for differences in the definition of the growth variable in the 30 studies. Two sets of standard errors are reported: standard errors that are robust to heteroskedasticity and standard errors that are also robust to any data dependence that might arise when studies report several estimates. Columns 1 and 2

17. The more recent development in the FAT-PET test is due to Stanley (2005a, 2008). It largely replaces the Meta-Significance Test (MST) that tells us if the estimates increase in statistical significance with the degrees of freedom as they should. The MST results are available from the authors. They confirm the findings reported.
18. Large publication biases are reported by e.g.: Card and Krueger 1995; Ashenfelter *et al*. 1999; Görg and Strobl 2001; Ashenfelter and Greenstone 2004; Abreu *et al*. 2005; Doucouliagos 2005; Nijkamp and Poot 2005; Rose and Stanley 2005; Stanley 2005; Mookerjee 2006 and Doucouliagos and Paldam (2008). However, no biases are found in the literature on unions and productivity (Doucouliagos, Laroche and Stanley 2005) and unions and profits (Doucouliagos and Laroche 2009).
19. This can be done by modifying specifications, functional form, samples, and/or estimation technique.
20. Because p_i is the precision of this estimate of empirical effect, Stanley (2008) has named this estimate of the meta average the 'precision-effect test' (PET), which makes the meta-regression model (2) a FAT-PET. Equation (2) is reached from $\varepsilon_i = \varepsilon_M + \gamma\, se_i + v_i$, by a division by se_i, to reduce heteroskedasticity.

use all available estimates, while columns 3 and 4 use only those estimates that have been published in a journal.

If publication selection bias is present, the constant, γ, in equation (2) will be statistically significant. Simulations show that the MRA estimate of the meta average ε_M in equation (2) corrects the average rather well for publication selection biases (Stanley 2008).

The constant γ is not statistically significant, except in column (2) where it is weakly significant. We conclude that this literature has little *publication selection bias*. The FAT-PET thus confirms the observation of symmetry in Figure 2. This is reassuring, as it implies that inferences can be drawn from the available reported estimates with some confidence. The meta average and the plain average is (almost) the same.

IV.4. Interpreting Table 3: A small positive (*g*➔*h*)-relation

The coefficient, ε_M, on p_i is the meta average of the growth-aid effect, φ, measured as a partial correlation. When all estimates are combined in columns (1) and (3), φ is between +0.01 and +0.02. This is statistically significant when only published studies are used.

Table 3.

Estimates of equation 2 for the All-Set

	(1)	(2)	(3)	(4)
	All studies		All published	
Variable	All-set	All-set	All-set	All-set
γ, test for asymmetry	-0.354	**0.916**	-0.244	-0.118
	(-1.6, 1.0)	(1.8, 1.8)	(-1.2, -0.7)	(-0.4, -0.3)
ε_M, meta-average	0.013	-	**0.015**	-
	(1.8, 1.2)		(4.8, 3.1)	
	Meta-averages for different growth variables			
Current growth/se	-	**-0.082**	-	**-0.047**
		(-3.4, -2.6)		(-3.4, -2.0)
Lagged growth/se	-	**0.097**	-	**0.064**
		(4.5, 3.3)		(5.1, 2.9)
Average growth/se	-	-0.100	-	**0.056**
		(-1.2, -3.8)		(2.6, 1.8)
Adjusted R^2	0.01	0.09	0.05	0.17
k	30	30	26	26
N	211	211	165	165

All estimates are based on equation 2, with columns (2) and (4) extended into a multivariate framework. Bolded figures are statistically significant at least at the 10 percent level of significance. N is the number of observations and *k* is the number of studies. Figures in brackets are t-statistics using standard errors that are robust to hetero-skedasticity, followed by t-statistics that use standard errors derived using clustered data analysis.

Columns 1 and 3 combine all estimates of φ, regardless of the measure of growth. This might distort estimates of the meta-average. Additional information on the effect is obtained by distinguishing between *current growth*, *lagged growth* and *averaged growth* (which cover 4-7 years), see columns 2 and 4.[21] *Current growth* has a negative effect on aid allocated. When all estimates are examined, *average growth* appears to have no robust effect on aid (even the sign differs). In contrast, the coefficient on *lagged growth* is consistently positive and always statistically significant.

The reverse impact of current and lagged growth rates is informative. The negative coefficient on current growth reflects the most recent growth experience of a developing nation. This is consistent with aid given for humanitarian reasons. The positive coefficient on lagged growth reflects more distant growth performance. This is consistent with the notion that aid is given to finance good projects, as more such projects emerge in a growing economy. Consequently, we can conclude from the meta-analysis that the literature has established a small *negative* association between current growth and current aid allocated and a *positive* association between lagged growth and current aid allocated. The magnitude of the effect of lagged growth is given by the sum of the coefficients on current growth and lagged growth.[22]

The extant empirical literature has considered average growth and current aid, current growth on current aid and lagged aid on current aid. Interestingly and rather surprisingly, *none* of the 30 studies looks at average growth on *average aid*. Aid commitments may be allocated over several years and be based on the average growth performance. Hence, it is our view that using average growth and average aid might be a more appropriate representation of the underlying data generating process. Accordingly, to further explore the data, section VI below presents econometric analysis on the as yet unexplored association between average growth on average aid allocated.

21. That is, columns 2 and 4 allow ε_M to differ between current growth, average growth and lagged growth.
22.The net effect = +0.015 in column (2), Wald test χ^2 = 11.88, with p-value of 0.0006 for the All-Set; and the net effect = +0.017 in column (5), Wald test χ^2 = 32.19, with p-value of 0.0000 for the All-Set with only published estimates.

V. META STUDY: FACTORS INFLUENCING THE RESULTS

The 211 estimates found in the 30 studies allow us to conduct meta-regression analysis (MRA), regressing estimated effects on hypothesized covariates.

V.1. The MRA-technique

In the MRAs, the dependent variable is the calculated partial correlation between growth and aid. In addition to the different measures of economic growth (*current growth*, *lagged growth* and *average growth*), we include 19 potential control or moderator variables. They are dummy variables controlling for study differences divided in five groups:

(i) Two measures of the dependent variable aid, in *aid per capita* terms or as the *aid share* in % of GDP, with dollar allocations as the base.

(ii) Seven different donors: *US*, *UK*, *Australia*, *France*, *Japan*, *World Bank*, and other *multilateral* aid agencies, with the base being all other donors.

(iii) Five measures of data differences: *1970s, 1980s,* and *1990s* are three dummy variables capturing time period differences; *panel* data and *single* country data capture differences in the type of data used, with the base being the use of cross-sectional data from the 1960s for several countries;

(iv) Four measures for controls included: *Lagged aid* means that a lagged dependent variable was included in the model; *Humanitarian* means controlled for income level or population size; *Commercial* means controlled for commercial interests; *Security* means controlled for security interests.[23]

(v) One variable to capture estimator differences: *OLS* for estimates using OLS only.

V.2. Interpreting Table 4

Table 4 reports the MRA results. Column (1) presents the results for the general model using the all-set with all potential covariates included. Column (2) presents the results of the specific model after sequentially eliminating any variable whose t-statistic was less than one.[24]

23. Descriptive statistics for these moderator variables are available from the authors.
24. A Wald test confirms the validity of eliminating these redundant variables: for (2) compared to (1), the Wald test statistics is 0.81, with a p-value of 0.60.

Table 4.

Meta-regression analysis: Sources of between study variation Growth-aid effects,
The dependent variable is partial correlations

	(1)	(2)	(3)	(4)	(5)
	All observations (211), all studies (30)			Sub sets	
	All-set	All-set	Average-set	World Bank	Lagged
Variable	General	Specific	Specific	Estimates	Growth
Constant	-0.04 (-0.3)	**-0.17** (-1.9)	-0.79 (-0.8)	0.03 (1.6)	**0.33** (5.6)
Lagged growth	0.04 (0.8)	**0.08** (1.8)	**0.14** (5.3)	**0.13** (4.9)	
Avr. growth	**-0.24** (-3.7)	**-0.25** (-4.0)			
Aid per capita	0.01 (0.2)			0.12 (5.8)	
Aid share	-0.06 (-0.5)			-0.07 (-1.9)	
OLS	0.10 (1.2)	0.11 (1.3)	**0.11** (2.6)		**0.18** (3.1)
Panel	-0.08 (-1.2)	-0.07 (-1.1)		**-0.19** (-7.5)	**-0.18** (-3.3)
1970s	0.07 (1.5)	**0.06** (1.1)			**-0.10** (-3.6)
1980s	**0.17** (2.5)	**0.15** (2.2)	**0.07** (2.0)		**-0.06** (-2.9)
1990s	0.08 (1.5)	0.07 (1.3)			
USA	-0.03 (-0.6)				**-0.19** (-8.6)
UK	-0.08 (-1.2)				**-0.57** (-11.1)
Australia	-0.10 (-0.6)		**-0.33** (-5.4)		**-0.37** (-8.1)
France	-0.10 (-1.4)	-0.07 (-1.2)	-0.20 (-1.8)		**-0.65** (-12.6)
Japan	**0.12** (2.1)	**0.15** (3.0)			
World Bank	**0.02** (2.1)	**0.02** (3.4)	**0.03** (6.0)		**0.03** (7.8)
Multilateral	0.01 (0.2)		**-0.14** (-3.2)		**-0.11** (-3.8)
Single	**-0.44** (-3.1)	**-0.34** (-2.6)	**-0.34** (-2.2)		
Lagged aid	0.27 (1.5)	**0.19** (2.3)	**0.47** (3.9)		
Humanitarian	-0.13 (-1.5)				
Commercial	**-0.07** (-2.1)	**-0.06** (-1.9)		**0.20** (6.1)	**-0.09** (-6.7)
Security	0.02 (0.6)		**-0.18** (-6.1)	**0.13** (3.1)	
Adjusted R^2	0.21	0.19	0.69	0.68	0.59
k	30	30	30	6	11
N	211	211	30	20	107

Notes: t-statistics in brackets use standard errors derived through clustered data analysis. Bold indicates statistically significant at least at the 10% level. N is the number of observations and *k* is the number of studies. Some observations are lost due to missing information on the covariates.

A positive coefficient on an MRA variable means that the variable results in larger (more positive) growth-on-aid effects. Thus, the positive coefficient on lagged growth indicates that larger positive (smaller negative) growth-aid effects are found when lagged growth is used. This is consistent with the FAT-PET results presented earlier. Average growth has a negative coefficient. The 1970s and 1980s both have a positive coefficient. Studies that include data from these decades find, on average, larger positive (smaller negative) growth-aid effects. We interpret this to mean that aid allocations during these two decades were less motivated by humanitarian concerns compared to the 1960s (noting that 1990s is not statistically significant). Both *Japan* and *World Bank* have positive coefficients indicating that these donors are less motivated by humanitarian concerns.

The coefficient on *Single* is negative and statistically significantly negative. Studies that analyze a single recipient country report larger negative (smaller positive) growth-aid effects, compared to studies that analyze groups of countries. Also interesting is the negative sign on *Commercial*, indicating that those studies that control for donors' commercial interests motives also find larger humanitarian effects.

Table 4 reports also the results from the MRA for sub-samples of the available estimates. Column (4) uses only those estimates that use *World Bank* aid allocations.[25] The coefficient on lagged growth is large and statistically significant – more aid is allocated to countries recording sound growth in the past.[26] Column (5) uses only those estimates that use lagged growth.[27]

The negative coefficient on *Commercial* has important implications. The inclusion of commercial interests in an aid allocation regression results in larger negative (or smaller positive) growth-aid effects. When commercial interests are omitted from the regression, the coefficient on growth measures the *total* effect of growth on aid. When commercial interests are included, the coefficient on growth measures the *direct* effect. For lagged growth, the results indicate that the direct effect is smaller than the total effect.[28] In other words, the indirect effect has a positive effect. Hence, this is consistent with lagged growth having a direct positive effect on aid allocations, as well as a positive indirect effect through commercial interests. Growth stimulates commercial interests between the donor and the recipient and these commercial interests result in more aid allocated.

Consequently, we draw four conclusions from the MRA. First, the way growth is measured makes a difference to reported results. Second, there is evidence of time variation

25. These studies are: Boone (1996); Frey and Schneider (1986); Gang and Khan (1990); Henderson (1971); Karunaratne (1986); and Maizels and Nissanke (1984).
26. The coefficient on *Panel* is interesting. Panel data can be considered to capture short-run effects, while cross-sectional data captures long-run effects. Hence, the negative coefficient on *Panel* suggests that aid is given for humanitarian concerns in the short-run.
27. We have also considered other measures of journal rankings, e.g., the tests have been re-run for only the papers published in journals with a Social Science Citation Index above 0.49. It does not change the results.
28. On the use of meta-regression coefficients to infer direct and indirect effects see Doucouliagos and Ulubasoglu (2008).

(cyclicality) in the reported growth-aid effects in column (2). However, this is not evident when only the World Bank estimates are analyzed. Third, there are significant donor differences. Fourth, specification of the aid allocation model matters.

VI. A PRIMARY STUDY OF THE GROWTH-AID EFFECT

In this section, we present a basic empirical analysis of the effect of growth on aid. The extant studies use data up to the year 2000. We use data from 1967 to 2004 for a sample of 147 developing countries. This involves both a longer time span, as well as a broader group of countries.[29] Eight different measures of the dependent variable are used: total Official Development Assistance (ODA) in millions; ODA per capita; 5-year average of ODA; 5-year average of ODA per capita; as well as these four measures in natural logarithmic form. Four different measures of the key explanatory variable are used: the current growth rate, lagged growth, the 5-year average growth rate, and the 5-year average growth rate lagged one period. All regressions control for country size, lagged dependent variable, as well as country and year specific fixed effects. The results are reported in Table 5.

VI.1. Interpreting Table 5

The first panel in Table 5 uses data for the 1967-2004 period, while the second panel uses a slightly shorter period, 1967-2000 (this is the period that is explored by the extant studies). Panel C adds per capita GDP as an explanatory variable so that both income level and growth are included as regressors. The specification follows the R model (equation 1), controlling for bureaucracy effects (lagged dependent variable) and population size.

Our main interest lies in the results where growth is measured as a 5-year average, especially when aid is similarly measured, controlling for both country-specific dummies as well as time-specific dummies. The results are clearly sensitive to the measure of development assistance. The average rate of growth has no effect on the annual dollar amount of aid allocated. Interestingly, if aid levels are measured in logarithms, there is a negative association that is statistically significant up to 2000. This effect disappears when more recent data is included. This is consistent with the MRA results presented in Table 4. When aid is

29. The average number of countries included in this literature is 84, while the median is 83. Of course, some of the studies did not have access to the same number of countries, and we are fortunate to have more years of data. The list of countries is available from the authors.

also measured as a 5-year average, the evidence suggests a positive association between growth and aid (both measured as 5-year averages).

Table 5.

Allocation of ODA on the basis of growth, 1967-2004

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Explained:	$m	pc	5y $m	5y pc	Ln $m	Ln pc	Ln 5y $m	Ln 5y pc
Growth:				Panel A: 1967-2004				
Current	99.43	19.50	**178.15**	-53.33	**0.44**	**0.44**	0.57	0.57
	(1.5)	(0.5)	(2.1)	(-0.5)	(2.2)	(2.2)	(1.1)	(1.1)
Lagged	**97.72**	37.50	99.15	49.99	0.15	0.14	0.24	0.22
	(2.5)	(1.6)	(1.2)	(0.9)	(1.1)	(1.0)	(0.8)	(0.8)
5y avr.	85.94	53.40	**323.91**	**127.00**	-0.22	-0.24	**0.77**	**0.76**
	(0.4)	(0.6)	(2.8)	(1.8)	(-0.6)	(-0.6)	(2.1)	(2.0)
5y, 1 lag	692.53	-0.01	10.50	0.01	0.47	0.50	0.37	0.37
	(1.6)	(1.1)	(0.1)	(1.2)	(0.5)	(0.5)	(1.1)	(1.2)
Growth:				Panel B: 1967-2000				
Current	42.07	3.86	**119.06**	-67.90	**0.35**	**0.35**	0.25	0.26
	(0.7)	(0.1)	(2.6)	(-0.6)	(1.7)	(1.7)	(0.5)	(0.5)
Lagged	54.71	28.20	26.18	27.70	0.07	0.07	-0.02	-0.05
	(1.5)	(1.2)	(0.4)	(0.5)	(0.5)	(0.5)	(-0.1)	(-0.2)
5y avr.	-192.54	37.40	**181.41**	89.60	**-0.47**	**-0.48**	0.42	0.39
	(-1.1)	(0.4)	(3.2)	(1.5)	(-1.8)	(-1.8)	(1.4)	(1.4)
5y, 1 lag	671.28	**-0.01**	70.00	0.01	-0.26	-0.23	0.02	0.04
	(1.2)	(1.9)	(0.5)	(0.8)	(0.3)	(0.2)	(0.1)	(0.1)
Growth:				Panel C: 1967-2004, with per capita GDP				
Current	99.12	18.40	**184.38**	-65.40	**0.43**	**0.43**	0.47	0.46
	(1.5)	(0.5)	(2.1)	(-0.6)	(2.2)	(2.2)	(0.9)	(0.9)
Lagged	**102.95**	**39.50**	101.51	42.60	0.16	0.15	0.16	0.14
	(2.5)	(1.7)	(1.3)	(0.8)	(1.1)	(1.0)	(0.6)	(0.5)
5y avr.	89.63	68.3	**326.08**	**120.00**	-0.07	-0.09	0.70	0.68
	(0.4)	(0.7)	(2.8)	(1.8)	(-0.2)	(-0.2)	(1.9)	(1.8)
5y, 1 lag	684.71	-0.01	10.91	0.01	-0.14	0.64	0.55	0.55
	(1.6)	(1.0)	(0.1)	(1.0)	(0.2)	(0.7)	(1.5)	(1.5)

Notes: The dependent variable is an ODA variable, either in million US $, in $ per capita, or averages over 5 years. The independent variable is the real growth rate, either the current, the lagged or a five year average. Ln denotes the natural logarithm. Bold indicates statistically significant at least at the 5% level. Each cell reports the coefficient of the growth variable from *separate* regressions, alternating between different measures of the dependent and of the growth variable. All estimations include fixed country effects and fixed period effects. All regressions include also a lagged dependent variable and population as a proxy for country size. The sample in panel A includes 147 countries. The number of observations ranges from 808 for the regressions using 5-year averages to 4,188 for regressions using current growth. The sample size in panel B ranges from 673 for the regressions using 5-year averages to 3,663 for regressions using current growth. Panel C is the same as panel A, except that GDP per capita is added as a regressor. Shaded cells are the main ones of interest. Absolute values of t-statistics reported in brackets.

Our panel data analysis thus suggests that after controlling for both country- and time-specific effects, some aid is allocated on the basis of growth, and that where this occurs, the association is positive: Countries that record faster rates of growth receive more aid. Comparing the results of Panel B to those from Panel A, we can see that the growth-aid effect has become stronger in the new century. More aid is now allocated to those countries that grow faster.

Table 2 reported first order (simple) correlations for different aid-growth pairs for various time periods. Three negative coefficients between growth and aid are reported. Simple correlations, however, can be misleading. Hence, Table 4 reports FAT-PET regressions of the population of 211 estimated partial correlations estimates, showing that lagged growth has a *positive* effect on aid, after other determinants of aid allocation are controlled. The FAT-PET findings are derived from the extant empirical estimates. Using a larger set of countries for a longer time span and a different specification, our own panel data analysis confirms the positive association between the average rate of growth and the average aid allocations. We conclude from the FAT-PET results and our panel data analysis that growth and aid are connected through the commercial and efficiency motives.

VII. CONCLUSION: THE EFFECT OF GROWTH ON AID IS SMALL AND POSITIVE

This paper deals with the little known effect of the growth of a country and the development aid it receives. The paper commenced with a theoretical discussion of the relation, arguing that the sign on the effect was theoretically undetermined, and likely to be small.

We then discussed if the other related relations within the aid-growth-income nexus were likely to bias the estimates of φ. Using the results from prior meta studies, we concluded that φ could be estimated with little fear of biases.

Next we presented a meta-analysis of 30 papers that estimated the allocation effect of growth in the recipient country on aid to the country. The meta-analysis of the partial correlations from the 211 model estimates in the 30 studies find a complex picture where the average result is small and positive between lagged growth and current aid allocations.

Finally the paper presents a primary study of the data (for 147 countries for the period 1967 to 2004) confirming the positive effect of growth on aid.

The main purpose of the paper was to see what the relatively clear case of the growth effect on aid allocation said about the motives for aid giving. We conclude that the (short-run) humanitarian motives, as measured by an effect of low growth, do not dominate. This may be attributed, at least in part, to the aid given as concessional loans from the World Bank, as such loans are given to finance projects with high benefit/cost ratios in accordance with the Bank charter. For other aid, the growth effect is negative with recent growth, but positive for a one year lag. Since the effect of the World Bank is so clear, it dominates in the aggregate.

This paper studies only one of the motives that has been researched in the large effort to explain aid allocation. Other motives include the allocation of aid on the basis of the recipient's humanitarian needs as measured by per capita income and/or population size, the donor's commercial interests, and the strategic and historical ties between recipients and donors. A comprehensive assessment of the aid allocation process requires a systematic review of these and other motives.

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APPENDIX: STUDIES COVERED BY THE META-ANALYSIS

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SUMMARY

This is a double study of a little researched relation: The relation from economic growth in a less developed country to the development aid it receives. One part is a quantitative and systematic review of the literature of 30 empirical studies of aid allocation where a growth coefficient is estimated. A second part is a primary study of the data using a panel of 147 countries for the period 1967-2004. The growth-aid relation should be negative if humanitarian motives dominate aid allocation decisions. The result from both the meta-analysis and the primary data analysis suggests a very small effect between lagged growth and aid allocations, with a dominating positive sign. This result appears to be driven partly by the large development banks.

(JEL: F35, O19. Keywords: Aid allocation, growth, meta-analysis)