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Explaining development aid allocation by growth: A meta study

Hristos Doucouliagos and Martin Paldam

UNIVERSITY OF AARHUS

BUILDING 1322 - 8000 AARHUS C - DENMARK ☎ +45 8942 1133

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Explaining development aid allocation by growth: A meta study

Hristos Doucouliagos, Deakin University, Melbourne, Australia*
Martin Paldam, University of Aarhus, Aarhus, Denmark#

Abstract:
The empirical literature explaining the driving forces behind the flows of development aid consists of (at least) 166 studies. One factor that has been analyzed in 30 of these studies is growth in the recipient country. *A priori* the effect may as well be positive as negative. This is an interesting factor for two reasons: (1) It is relatively easy to interpret the results, and (2) it is an important piece in the picture which suggests aid ineffectiveness. The paper is a meta-analysis of the 211 growth-aid estimates found in the 30 empirical studies. Additionally, we present new evidence using a panel data for 147 countries for the period 1967-2004. The result from both the meta-analysis and the primary data analysis is that growth does generate aid, so the dominating sign is positive. This result is driven partly by the large development banks.

Jel: F35, O19
Keywords: Aid allocation, growth, meta-analysis

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∗ School of Accounting, Economics and Finance, Deakin University, 221 Burwood Highway, Burwood, Victoria 3125, Australia. E-mail: douc@deakin.edu.au.
School of Economics and Management, Aarhus University of Aarhus (building 1322), 8000 Aarhus C, Denmark. E-mail: mpaldam@econ.au.dk.

1. Introduction: A quantitative study of a literature

The ***AAL*** (Aid Allocation Literature) consists of 166 empirical studies of the way development aid is allocated.[1] The AAL studies the *motives* driving aid by analyzing their effect. Motives are often intertwined in practice as policies are generated by coalitions, and different motives often lead to related outcomes, so it is difficult to untangle what drives aid.

At present, we only consider the allocation effect, φ, of economic growth in the recipient country. Growth as a motive for aid allocation is researched in 30 of these studies, but it is an important variable for two reasons:

The first reason is that the results are relatively easy to interpret as many of the most discussed aid motives are irrelevant for φ: It is well-known that the rate of absolute convergence is about zero (see Barro and Sala-i-Martin 2004), so the level of income and the growth rate are independent. Furthermore, it is likely that the growth rate is only marginally dependent of the "strategic location" of countries, and of their colonial past.[2] Hence, it can be said that the estimates of φ provide relatively clean evidence on the basic aid motives.

If aid is allocated mainly because of s*hort-run humanitarian concerns, we expect that it is increased to countries with crises, as shown by low growth. However, it is more complex if high growth results in more aid. If it is given as a commercial* (selfish) *investment in future business with the country, we expect that high growth makes it more interesting t*o invest in. However, a pure development banking view sees aid as a source of cheap finance for good projects. High growth countries generate more such projects, and thus should attract more aid.

The second reason to study the literature on φ is that it analyzes the reverse causality of the one dealing with *aid effectiveness on growth* (surveyed in Doucouliagos and Paldam 2006c and 2007a). We are thus dealing with two bodies of literature that approach – from both sides – the well-known *zero correlation puzzle*: Aid and growth are essentially uncorrelated. This seems to suggest aid ineffectiveness as well as unclear donor motives.

We are studying φ using the technique of *meta-analysis*; that is, we provide a quantitative synthesis and analysis of the 30 studies that have researched the effect. In all of these studies, growth is only one explanatory factor in a more complex model. The studies contain no less than 211 estimates of φ, which represents something like 25 man-years of research. We find it worthwhile to take this effort seriously and take stock of the extant evidence.

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1. A Master List of the 166 papers is posted at http://www.martin.paldam.dk under *working papers, aid project*.
2. It is not known how the strategic position of countries affects growth. Some research suggests that colonial past matters for income levels in the long run; however it has a small effect on growth rates in the short-run, see Acemoglu *et al*. (2005) and Sturm and Haan (2005).

Research is a process of truth searching where new results are produced by *innovation*, and confidence is build by *independent replication*, which is replication of research findings by other researchers on new data sets. Meta-analysis is a quantitative study of this process. In this paper, we apply meta-analysis to the body of literature estimating the same effect (φ) to ask:

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

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

In order to analyze these questions, meta-analysis uses *all* results reported in the literature as the data. To study (Q1), it has developed tests of convergence of the results as data expands, and better estimation models are developed. To study (Q2), each data point is provided with a string of information characterizing the way the said estimate is reached, almost as a check list. 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.

Other studies in our project – Doucouliagos and Paldam (2007b, c and d) – investigate other factors that influence aid allocation. In 2007b, we show that the evidence is strong that the aid share (the share of aid in GDP) is negatively related to income per capita, with an absence of a middle-income bias.[3] Additionally, we find evidence in favor of the country-size bias, with a negative association between aid allocation and population size in the recipient country. In 2007c, we show strong evidence that aid is allocated on the basis of bureaucratic allocation rules. Finally, in 2007d we show that improvements in human rights are rewarded with more aid.

Below, Section 2 looks at the stylized facts about the zero correlation puzzle. Section 3 discusses the theory and the problem of causality. Section 4 tests (Q1), i.e., if the findings in the AAL converge to a non-zero result. Section 5 studies (Q2) by analyzing the effect of various explanatory factors on the estimates of φ. Section 6 presents new evidence using a panel of 147 countries for the 1967-2004 period. Section 7 concludes the paper. Table 1 defines the variables discussed for easy reference.

3. Throughout this paper the term aid share refers to the aid as a percentage of GDP.

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)
P_{it}	Population of recipient country
g_{it}	Growth rate of gdp in recipient country
$\varphi = \partial h / \partial g$ or $\varphi^{H} = \partial H / \partial g$	Aid allocation effect of growth, g may be lagged
$\mu = \partial g / \partial h$	Aid effectiveness on growth, h may be lagged

2. Growth and aid have no correlation

In this section, we show that the raw data suggest a near zero correlation between economic growth and aid allocations. From a development perspective, this *zero correlation result* is one of the most depressing stylized facts. The correlation between (g, h)-pairs is essentially zero in cross-country and time-series data sets. This result goes back to Griffin and Enos (1970) and Mosley (1987).[4] See also Rajan and Subramanian (2005), Easterly (2006) and Herbertsson and Paldam (2007).

Many – both learned and lay – has been deeply puzzled and dismayed by the zero correlation result. Several lines of argument have been developed that predict a positive correlation. There are, however, counter arguments to these. See Doucouliagos and Paldam (2007a) for a review.

Table 2: Cross-country correlations between aid and growth (unlagged) for 170 countries

5-years			10 years			15 years			20 years		
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

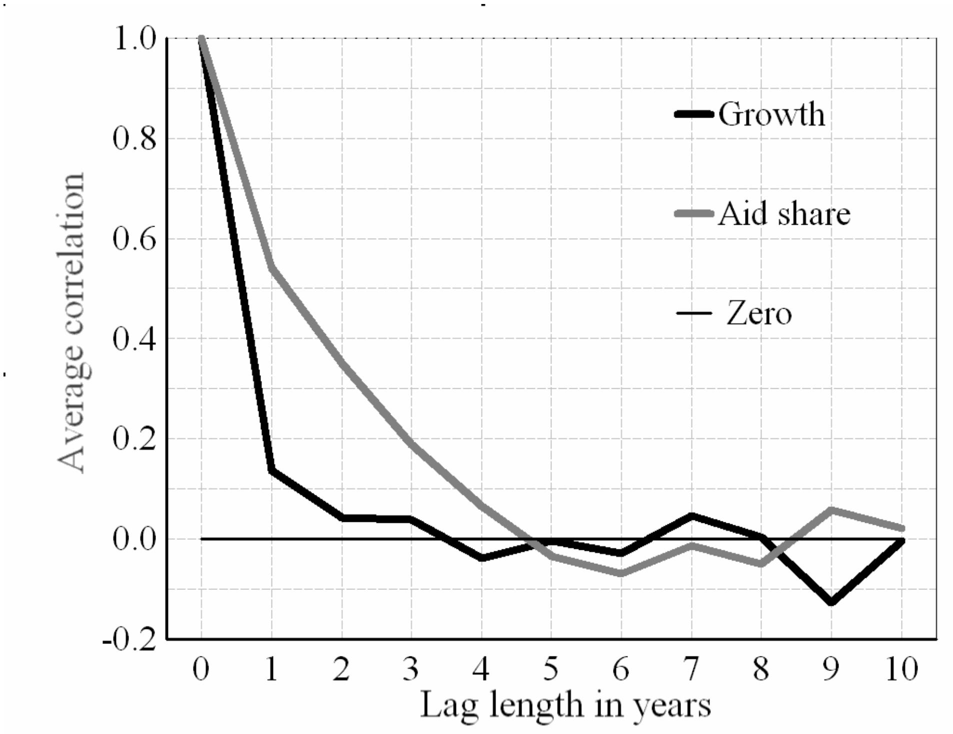
Note: The same table has been recalculated for LDCs alone. It barely changes the results.

4. Paul Mosley has written extensively on the zero correlation result and the contrast between this result and the micro result that approximately 50% of all development projects succeed. A contrast he has termed the *micro-macro paradox*.

2.1 Looking at the data: The basic correlations

Table 2 shows typical results for pure cross-country correlations. They are all very close to zero, though they get increasingly negative as the time period increases.

Figure 1. Average autocorrelation functions for aid shares and growth rates



Note: Calculated on data for 44 Sub-Saharan African countries 1990-2005

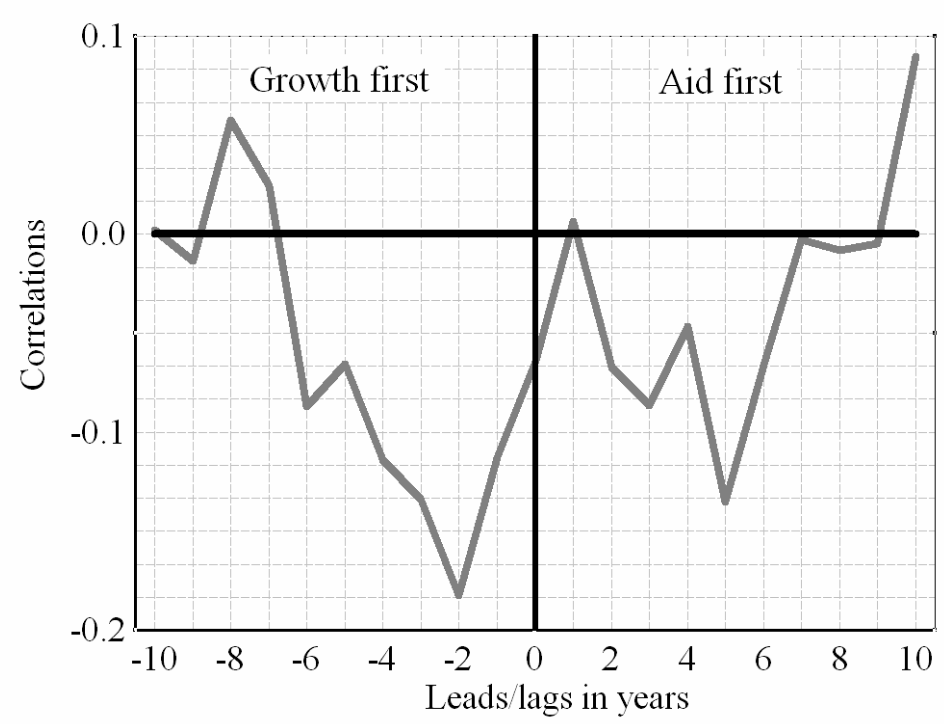
Figures 1 and 2 are constructed for the data of 44 Sub-Saharan African countries for the period 1990-2005 where the aid share was 14.5 % on average for the last two decades.[5] Figure 1 compares the average autocorrelation functions for growth and aid, and the average correlogram between the two series. There is little autocorrelation in the growth rates, but considerable autocorrelation in the aid shares. Both of these results are well known to generalize to all data. The very significant autocorrelation in the aid shares is often termed a “bureaucracy effect”. It is a robust finding in the AAL, see Doucouliagos and Paldam (2007c).

Figure 2 shows the correlogram between growth and aid for the same countries as in Figure 1. Correlograms for all LDCs are shown in Herbertsson and Paldam (2007) – they look

5. South Africa is excluded, and Somalia has no data. A few of the other 44 countries have data gaps (Liberia, Eritrea, and Equatorial Guinea), but all results do cover at least 42 countries.

rather similar. All correlations are within the range from +0.1 to −0.2. Hence, we are dealing with a weak pattern.

Figure 2. Average correlograms between average aid and average growth



Note: All correlations are primary correlations. From section 4 all correlations are partial ones. Calculated on same data as Figure 1.

The *left hand side* of the figure analyzes the effect from growth to aid, which is the subject of the present article. Only the negative correlation around −2 is significant. We hence conclude that there appears to be a small simple negative correlation of growth to aid. This is likely to be an emergency aid effect which has no long-run consequences.

The *right hand side* of the figure analyzes the effect from aid to growth. There appears to be no permanent growth effect. This is very much in accordance with the literature as shown in Doucouliagos and Paldam (2007a).

This pattern in the simple correlations should be borne in mind when we turn to the meta study of the partial correlations reported in the literature.

3. Theory and the problem of causality

In this section, we first review the typical empirical aid allocation model. Then we discuss the motives driving the flows, and finally we turn to the problem of causality including the possibility of simultaneity biases.

3.1 The models in the AAL

The basic model in the AAL consists of two linked sub-models: The R-model, $[\ ]_R$, that represents the effects of the recipient characteristics, and the D-model, $[\ ]_D$ for the effects of the relations between the donor and the recipient:

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

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 become very large. However, as the interests of the various donors differ, the D-model becomes difficult to include. Other authors consider one 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 characteristics of the recipient country *i*, such as income (y_i), country size (P_i), and growth (g_i), which are donor independent.[6] Often they are supplemented by political characteristics, Π, such as a democracy index, a corruption index, a human rights measure, etc. This 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 gives 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., FDIs 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]

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6. There may be some correlation in donor growth rates, but this is ignored in the literature.
7. It is often assumed that the R-model contains the (good) *humanitarian* motives, while the D-model hides the (bad) *selfish* motives of the donors. This is not necessarily the case. Part of the problem is that the aid decision

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 study, 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^H .

Some of the variables – 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. Therefore, we have converted all the 211 estimated coefficients to partial correlations. This was possible in all cases, and it generates comparable estimates of φ. Regression coefficients cannot be used as they are not all comparable across all studies. For many studies, elasticities could not be calculated. An alternative approach is to use t-statistics. However, partial correlations are derived from t-statistics, but have the advantage of interpretability. Nevertheless, we do use t-statistics in some of the analysis.

3.2 Economic growth as a motive driving aid

The present analysis deals with the R-model only. We have found various remarks about the reasons why economic growth in the recipient countries should matter for aid. Table 3 summarizes these reasons.

Table 3. The three connections from the growth rate to aid allocation

	Driving motive	Effect
M1	*Humanitarian*: Aid is given to increase welfare in the recipient country. Low growth means that a country has more problems and needs more aid.	$\varphi < 0$
M2	*Commercial*: Aid is an investment in present and future donor business. High growth makes a country become more interesting to invest aid in.	$\varphi > 0$
M3	*Efficiency*: Aid is concessional finance to worthwhile projects in LDCs. Dynamic countries generate more such projects.	$\varphi > 0$

M1 appears to give a clear negative connection, $\varphi < 0$, between economic growth and aid. There are however complex issues of lags that may cause the observed effects to appear less clearly. Some of these issues will be discussed in Section 3.3.

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.

M2 sees aid as an investment in future business. 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.

M3 is the efficiency argument. Dynamic countries generate more worthwhile projects and, hence, need more finance. The World Bank and the regional development banks had the original purpose to finance development projects on near-commercial conditions.[8] Over time, these goals and purposes have been softened,[9] but it is clear that efficiency and high benefit/cost ratios play a considerable role for the Bank and its regional sisters. We thus expect aid from the development banks to be positively related to growth, $\varphi > 0$.

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 that they are fairly stable. For example, it is not clear how they should react to the end of the Cold War. 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. However, 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 6 below).

3.3 The humanitarian motive: What should we observe?

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

Imagine a poor country having one very bad harvest 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 two calendar years, and as rain then returns, a high growth the next year. As the aid comes in one calendar year, we will observe a negative correlation for two years (for lags -1 and 0) and a short positive spike for

8. See IBRD Articles of Agreement (as amended February 16, 1989) on the Bank, notable Purpose and Article III Section 1.

9. At the World Bank Home Page "about us" the Bank gives a summary that shortened 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.

lag (+1). If we are dealing with 2 years of bad harvest, we may get a picture a bit like Figure 1.

Imagine a civil war lasting 5 years. During the war, we typically observe that growth suffers and that aid is reduced to emergency aid, so we observe a positive correlation between aid and growth within a 5 year lag structure. 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 thing would happen in a country getting an unusually nasty government: This is likely to chase away both aid, investments and thus growth, till the government is toppled, and then an aid package and normal business will return.

From the correlations in 2.2, 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.

Also, we know from other studies in our project that a whole set of highly meta-significant factors does influence aid allocations. It is important to control the relation from these variables as well. As already mentioned, 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. That is, it is arguable that the estimate of φ ought to come from a more complex 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 may differ from the correlations shown in Table 2.

3.4 Two bodies of literature: The AAL and the AEL

The zero correlation result is important for two bodies of literature – the AAL analyzing $g \rightarrow h$ and the AEL analyzing $h \rightarrow g$ – making causality a major concern. Both bodies of literature find very small effects, but they may both suffer from simultaneity biases, so we shall discuss if they are most likely to offset or reinforce each other.

In the interest of brevity, we shall term the results that aid is humanitarian and efficient the *good* results, and the results that aid are commercial and inefficient the *bad* results. This classification is independent for the two variables. It is, of course, close to the heart of the economist that selfish motives may generate good outcomes.

Based on two comprehensive literature searches (allowing many cross checks) we have compiled two master lists of references. The AAL covers 166 studies (till 1/1-2006), while the AEL covers 101 studies (till 1/1-2005).[10]

The ***AAL*** (Aid Allocation Literature) looks at many factors explaining aid. Several are highly significant as we show in other papers in our project. The present study considers the 30 of AAL-studies that report: $g \Rightarrow h$, analyzing the allocation effect of growth, $\varphi = \partial h / \partial g$. Most authors hope to find the "good" result that $\varphi < 0$.

The ***AEL*** (Aid Effectiveness Literature) mostly deals with: $h \Rightarrow g$, defining *aid effectiveness* as $\mu = \partial g / \partial h$. Most authors of the AEL hope to find the good result that $\mu > 0$, and they succeed. However, the results converge neither to statistical nor economic significance; see Doucouliagos and Paldam (2007a).

If either of the two causal relations were strong, it would generate a simultaneity bias in the estimates of the relation with the reverse causality. Table 4 looks at what would happen in the 4 possible cases for the 2 effects, φ and μ. In view of the results of our meta studies of the AEL, we conclude that $\mu \geq 0$, so the two possibilities for $\mu < 0$ are shaded in gray. Thus, if aid is mainly humanistic, the two effects offset each others, and if aid is commercial or directed towards project efficiency, they *reinforce* each other. The results are sufficiently weak so that we conclude that there is not likely to be biases of a size that matters either way.

Table 4. The structure of the possible simultaneity biases for all possible true results

	True result				Reverse causality bias		Causes results to look		Together
	AAL		AEL		On φ	On μ	Of φ	Of μ	
(1)	$\varphi < 0$	good	$\mu > 0$	good	Up	Down	Less good	Less good	Offsetting
(2)	$\varphi < 0$	good	$\mu < 0$	bad	Down	Down	More good	More bad	Reinforcing
(3)	$\varphi > 0$	bad	$\mu > 0$	good	Up	Up	More bad	More good	Reinforcing
(4)	$\varphi > 0$	bad	$\mu < 0$	bad	Down	Up	Less bad	Less bad	Offsetting

As simultaneity biases may occur, some effort has been put into the control for simultaneity especially in the AEL. Here, the literature has not demonstrated that such biases exist. In the present study, only 2 of the 30 papers control for simultaneity, and once again these attempts do not produce results that differ from the general picture.

10. The AEL master list is also an Appendix to Doucouliagos and Paldam (2006a). We have found more studies since that paper was completed – they do not change the results.

The hope one may have that identification is possible is due to the *lag structure* in the likely decisions. Since the AAL looks at reactions of aid to economic changes in the recipient country, there is likely to be a discovery lag, a decision lag, an implementation lag, and an effect lag. As two countries are involved, all these lags may add to at least half a year as regards emergency aid, and considerably more as regards aid meant to affect growth.

Thus, if we consider the full cycle: $g \rightarrow h \rightarrow g$, we are surely dealing with several years. Most studies in the AAL use 1-2 year lags. The AEL use averages for g and h over a period such as 5 years and one lag. Consequently, the effects should be fully sorted out.

4. The meta-analysis

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 4.1 and 4.2, respectively; then 4.3 presents tests of the symmetry of the funnel, and the presence of a genuine empirical effect.

4.1 The data for the meta-analysis

The data analyzed from now are the estimates given of φ in the 30 studies. 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 main disadvantage of (1) is that some authors (and/or journals) follow the strategy of reporting many estimates, while others report only few, and (1) thus comes to weigh papers by strategy. The advantage is that it offers more estimates from which the source of variation (heterogeneity) between estimates can be explored. Many meta-analysts prefer to use the average-set. We use both. If they tell the same story we are on safer ground.

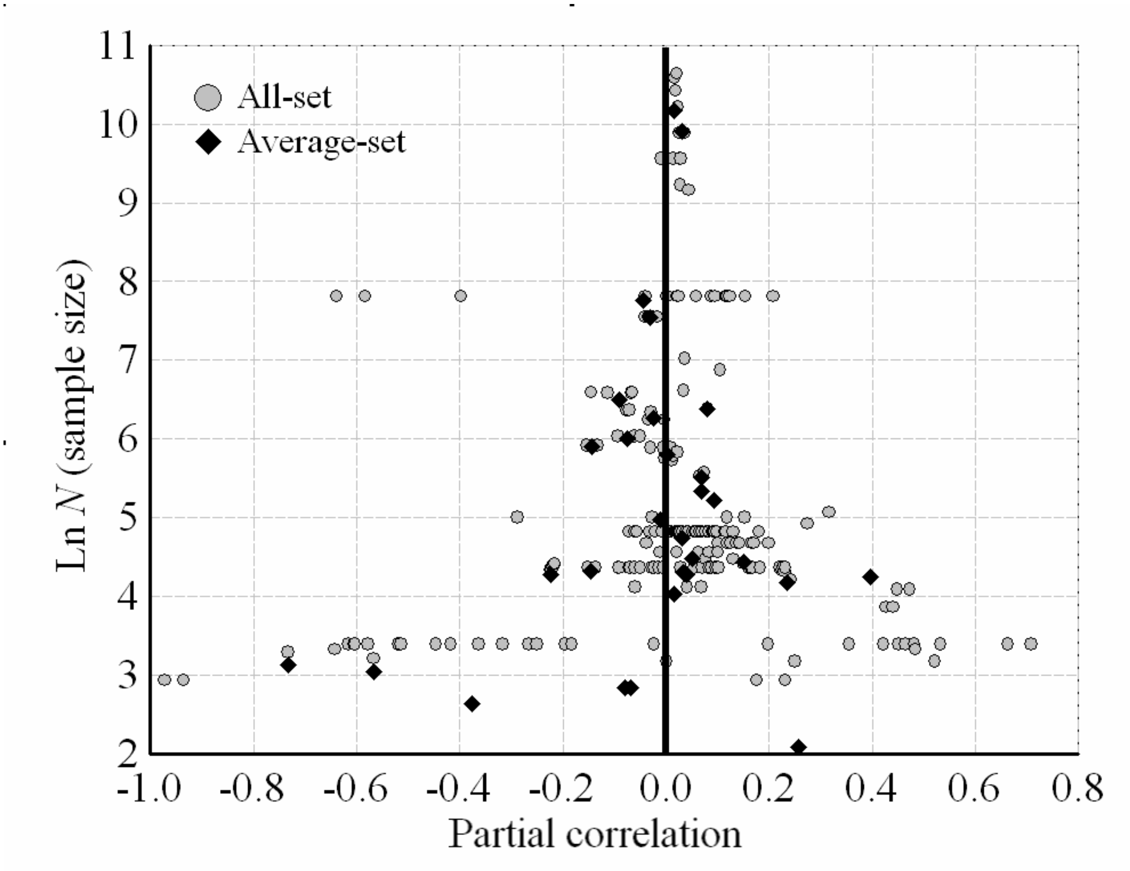
4.2 Funnel plots of the data

Funnel plots are used as a graphical way of illustrating the distribution of empirical findings, showing the relationship between an effect (partial correlations in our case) and a measure of precision (sample size in our case). See Stanley (2005) for details and other examples. Figure

11. In chronological order they are: Henderson (1971): McKinlay (1978); McKinlay and Little (1978, 1979); Maizels and Nissanke (1984); Frey and Schneider (1986); Karunaratne (1986); Bowles (1987); Bowles (1989); Tsoutsoplides (1991); Gang and Khan (1990); Gang and Lehman (1990); McGillivray and White (1993); Gounder (1994); Gounder and Doessel (1994); Gounder (1995); Ball and Johnson (1996); Boone (1996); Gounder and Doessel (1997); Gounder (1999); Tarp *et al.* (1999); Hudson and Mosley (2001); de Silva (2002); Feeny and McGillivray (2002); Kilby (2002); Harrigan and Wang (2003); McGillvray (2003); Feeny and McGillivray (2004); Bertélemy and Tichit (2004); and Bertélemy (2005).

3 presents a funnel plot for all 211 growth-to-aid partial correlations, listing also the sample size, N, and the weighted average partial correlation, r_w,[12] and the average-set. 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 symmetrical, although the average-set plot is less so.

Figure 3. Funnel plot for the all-set (n = 211, r_w= +0.013)
and the average-set (n = 30, r_w= +0.014)



4.3 Identifying Genuine Empirical Effects and looking for asymmetries: The FAT-PET

Two standard tests in meta studies are: (a) the MST that tells us if the estimates increase in statistical significance with the degrees of freedom as they should, and (b) the FAT-PET that considers the symmetry of the funnel plot: Does it lie symmetrically around something that is significantly different from zero? If the FAT-PET lacks symmetry, it typically points to a skewness in the reported results, which has to be interpreted. Of these the more powerful test is the FAT-PET test (Stanley 2005a, 2007). The test does two things: (1) tests for publication

12. We used sample size as the weight.

selection bias and (2) estimates the size of the genuine empirical effect *net* of selection effects.[13]

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. However, if there is publication bias, smaller studies will search for larger effects in order to compensate for their larger standard errors.[14] Following this logic, the FAT-PET regression is:

$$t_i = \varepsilon_i / se_i = \beta_1 + \beta_0 (1/se_i) + v_i \tag{2}$$

where ε_i is the *standardized* effect, and se_i is its associated standard error. For details, see for example Egger *et al.* 1997; Sutton *et al*. 2000; Rothstein *et al*, 2005; Stanley 2005a. If publication selection bias is present, the constant, β_1, in equation (2) will be statistically significant. Simulations show that the MRA estimate of β_0 in equation (2) also serves as a test for genuine empirical effect corrected for publication bias. Because $1/ se_i$ is the precision of this estimate of empirical effect, Stanley has named this test (H_0: $\beta_0 = 0$) the 'precision-effect test' (PET), which makes the meta-regression model (2) a FAT-PET.[15]

Table 5 presents the FAT-PET tests. With one exception, the constant is not statistically significant. The one exception is in column 7.2 where it is weakly significant. We conclude that there is *no publication selection bias* present in this literature.[16] The FAT-PET thus confirms statistically the symmetry observed in Figures 3 and 4. This is very reassuring, as it implies that inferences can be drawn from the available reported estimates with a great degree of confidence.

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13. The MST results are available from the authors. They confirm the findings of the FAT-PET and the MRA.
14. This can be done by modifying specifications, functional form, samples, and even estimation technique.
15 One can estimate an alternative version of equation 2 by regressing a standardized effect (such as a standardized regression coefficient, an elasticity or a partial correlation) on a constant and the associated standard errors. However, because of likely heteroscedasticity, it is normal to divide the entire equation by the standard error. This produces the WLS version (equation 2), where the dependent variable is now the t-statistic (standardized effect divided by its standard error) and the RHS has also been divided through by standard errors.
16. This finding is interesting, as most investigations in economics have detected the presence of publication selection effects. See for example: 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; and Mookerjee 2006. An exception is the literature on unions and productivity (Doucouliagos, Laroche and Stanley 2005). Interestingly, this finding is also different to what has been found in the aid-growth effectiveness literature (see Doucouliagos and Paldam 2007a).

Table 5. Funnel asymmetry tests: Growth-aid effects, All-Set

(The dependent variable is t-statistic)

	(1)	(2)	(3)	(4)
	All observations, all studies		All observations, published	
Variable	All-set	All-set	All-set	All-set
Constant	-0.354	0.916	-0.244	-0.118
	[-1.6]	[1.8]	[-1.2]	[-0.4]
1/*se*	0.013	**-**	**0.015**	-
	[1.7]		[3.2]	
Current growth/*se*	-	**-0.082**	-	**-0.047**
		[-3.4]		[-3.4]
Lagged growth/*se*	-	**0.097**	-	**0.064**
		[4.5]		[4.7]
Average growth/*se*	-	-0.100	-	**0.056**
		[-1.3]		[2.6]
Adjusted R^2	0.01	0.09	0.04	0.17
k	30	30	26	26
N	211	211	165	165

Bolded figures are statistically significant at least at the 5 percent level of significance. The standard error associated with each estimate is *se*, while *k* is the number of studies. Figures in squared brackets are t-statistics calculated using standard errors derived by applying the bootstrap.

The coefficient on $1/se_i$ is an unbiased and efficient estimate of the genuine effect (Stanley 2007), in our case that of growth on aid. When all estimates are combined, the partial correlation of growth on aid is between +0.01 and +0.02 (columns 7.1 and 7.3).[17] This is strongly statistically significant when only published studies are used. More meaningful (informative) is the effect for different measures. We distinguish between the most recent growth experience (current growth) and the growth rate in a former period (lagged growth) and the growth rate averaged over several years. Since this is a WLS regression, all of the right-hand-side variables including the constant are divided by se_i. Current growth has a negative effect on aid allocated. When all estimates are examined, average growth appears to have no effect on aid. The coefficient for average growth is not robust, being negative in column 7.2 and positive in column 7.4. In sharp contrast, the coefficient on lagged growth is consistently positive and always statistically significant. We conclude from the FAT-PET tests that the literature has established 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

17. The FAT-PET tests have been run also for the average-set producing similar results. Also, since some of the estimates in the all-set are not independent, we have reestimated the FAT-PET models using clustered data analysis. Again, the results are similar.

coefficients on current growth and lagged growth (net effect = +0.015 in column 7.2, Wald test χ^2 =11.88, with p-value of 0.0006 for the All-Set; and net effect = +0.017 in column 7.5, Wald test χ^2 =32.19, with p-value of 0.0000 for the All-Set with only published estimates).

The differential impact of the current and lagged growth rates is informative. Current growth reflects the most recent growth experience of a developing nation. The negative coefficient on this is consistent with aid given for humanitarian reasons. Lagged growth reflects more distant growth performance. The positive coefficient is consistent with the notion that aid is given to finance good projects, as more such projects emerge in a growing economy.

The meta-analysis results presented here and the correlograms presented earlier reach different conclusions. However, they differ in two ways: First, the correlograms presented in Section 2 explored the association between *average* growth and *average* aid. The extant empirical literature has considered average growth and current aid, current growth on current aid and lagged aid on current aid. None of the 30 studies looks at average growth on *average aid*. Second, the earlier graphs involved *simple* correlations, whereas the meta-analysis deals with partial correlations. Aid commitments may be allocated over several years and be based on the average growth performance. Hence, we believe that using average growth and average aid might be a more appropriate representation of the underlying data generating process. Accordingly, Section 6 below presents econometric analysis of average growth on average aid allocated.

5. Explaining the pattern of results

The 211 estimates found in the 30 studies allow us to conduct meta-regression analysis (MRA), regressing estimated effects on hypothesized covariates. In the MRAs, the dependent variable is the calculated partial correlation between growth and aid allocated. In addition to the different measures of economic growth (current growth rate, lagged growth rate and average growth rate), we include 19 potential control or moderator variables. They are dummy variables controlling for key study differences divided in five groups: (i) Two measures of the dependent variable aid, in per capita terms or as a percent of GDP, with dollar allocations as the base. (ii) Seven different donors: donor is the US, donor is the UK, donor is Australia, donor is France, donor is Japan, donor is the World Bank, and donor is another multilateral aid agency, with the base being all other donors. (iii) Five measures of data differences: used 1970s data; used 1980s data; used 1990s data; used panel data; used single country data, with the base being the use of cross-sectional data from the 1960s for several countries; (iv) Four measures of specification: controlled for the level of per capita income or population size; controlled for lagged aid; controlled for commercial interests; and controlled for security interests.[18] (v) One variable (OLS) to capture differences in estimation between those studies that used OLS and those that did not.

Our MRA is based on the so-called Mixed Effects model. This allows study effects to differ systematically according to specified covariates, and according to random factors that are not related to any covariates.[19] In a Mixed Effects meta-analysis model, study differences are assumed to result from sampling error, systematic differences due to the research process, as well as *random* differences between studies. To estimate the Random Effects model, we assume that the total variance in the growth-to-aid effects consists of variance due to sampling error, as well as variance due to other factors that are *randomly* distributed. We used the standard error of each partial correlation to calculate the variance due to sampling error, and we estimate the second variance term using the so-called iterative restricted maximum likelihood method, or REML (see Raudenbush 1994 for details).[20]

5.1 Results

Table 6 presents the MRA results. Column 8.1 presents the results for the general model with all potential covariates included. Column 8.2 presents the results of the specific model after sequentially eliminating any variable whose t-statistic was less than one.[21]

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. Both *Japan* and *World Bank* have positive coefficients indicating that these donors are less motivated by humanitarian concerns. This compares to *Australia* which

18. Descriptive statistics for these moderator variables are available from the authors.
19. In effect, this means that there is not a single growth-to-aid allocation effect that all studies are estimating. Rather, there is a distribution of such effects.
20. The fixed effects results are available from the authors, but given the extent of study heterogeneity, we prefer to draw inferences from the random effects results.
21. A Wald test confirms the validity of eliminating these redundant variables: for 8.2 compared to 8.1, the Wald test statistics is 6.36, with a p-value of 0.70.

has a negative coefficient (more motivated by humanitarian concerns), although this is only significant in the average-set.

Table 6. Meta-regression analysis, Source of between study variation, Growth-aid effects, Mixed effects models
(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	-0.06 [-0.7]	**-0.15** [-2.0]	-0.79 (-0.8)	0.05 [0.8]	**0.26** [3.1]
Lagged growth	0.07 [1.5]	**0.08** [2.7]	**0.14** (5.3)	**0.30** [4.0]	-
Avr. growth	**-0.22** [-3.3]	**-0.22** [-3.4]	**-0.12** (-3.1)	-	-
Per capita	0.00 [0.0]	-	-	-	-
% GDP	-0.04 [-0.5]	-	-	-	-
OLS	0.10 [1.6]	0.10 [1.9]	**0.11** (2.6)	-	**0.16** [2.2]
Panel	-0.08 [-1.7]	-0.06 [-1.5]	-	-0.21 [-1.8]	-0.11 [-1.5]
1970s	**0.08** [2.0]	**0.07** (2.1)	-	-	**-0.17** [-2.8]
1980s	**0.18** [2.8]	**0.17** (3.2)	**0.07** (2.0)	-	-0.08 [-1.6]
1990s	**0.07** [2.2]	-	-	-	-
USA	-0.08 [-1.1]	-	-	-	-
UK	-0.08 [-1.2]	-	-	-	**-0.48** [-3.3]
Australia	-0.16 [-1.2]	-0.17 [-1.2]	**-0.33** (-5.4)	-	**-0.25** [-2.9]
France	-0.11 [-1.6]	-	-0.20 (-1.8)	-	**-0.56** [-5.1]
Japan	0.11 [1.7]	**0.18** [3.8]		-	-
World Bank	**0.02** [2.5]	**0.02** [5.5]	**0.03** (6.0)	-	**0.03** [2.7]
Multilateral	-0.05 [-0.5]	-	**-0.14** (-3.2)	-	-
Single	**-0.40** [-2.6]	**-0.32** [-2.2]	**-0.34** (-2.2)	-	-
Incrementalism	0.25 [1.6]	0.29 [1.9]	**0.47** (3.9)	-	-
Humanitarian	-0.10 [-0.9]	-	-	-	-
Commercial	**-0.11** [-2.2]	**-0.10** [-2.8]	-	0.15 [1.2]	**-0.08** [-3.7]
Security	0.04 [0.9]	-	**-0.18** (-6.1)	0.08 [1.1]	-
I^2	0.95	0.95	-	0.34	0.97
τ^2	0.02	0.02	-	0.01	0.01
Adjusted R^2	-	-	0.69	-	
k	30	30	30	6	11
N	211	211	30	20	107

Notes: All estimates use the Mixed Effects model, except for column 8.3 which uses the Fixed Effects model. t-statistics in squared brackets are derived using the bootstrap. Bold indicates statistically significant at least at the 5% level. I^2 measures the degree of heterogeneity between studies. τ^2 measures between study variance. *k* is the number of studies. Some observations are lost due to missing information on the covariates.

The coefficient on Single is negative and strongly significant. Studies that analyze a single recipient country report larger negative 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.

Column 8.3 reports the specific model using the average-set and the fixed effects model.[22] Most of the results are similar to those from the All-Set. Table 6 reports also the results from the MRA for sub-samples of the available estimates. Column 8.4 uses only those estimates that use World Bank aid allocations.[23] The coefficient on lagged growth is large and statistically significant – more aid is allocated to countries recording sound growth in the past.[24] Column 8.5 uses only those estimates that use lagged growth. Some of the results are similar, especially those relating to *Australia*, *World Bank* and *Commercial*.[25]

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-on-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.[26] In other words, the indirect effect has a positive coefficient. 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 (cyclicality) in the reported growth-aid effects (column 8.2). However, this is not evident

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22. The between study variance (τ^2) for this dataset is zero, so the fixed effects model is applicable. The results for the general model are available from the authors.
23. These studies are: Boone (1996); Frey and Schneider (1986); Gang and Khan (1990); Henderson (1971); Karunaratne (1986); and Maizels and Nissanke (1984).
24. 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.
25. We have considered also various combinations of journal rankings. For example, reestimating the tests for only those papers published in journals with a Social Science Citation Index of 0.50 or more does not change the results.
26. On the use of meta-regression coefficients to infer direct and indirect effects see Doucouliagos and Ulubasoglu (2008).

when only the World Bank estimates are analyzed. Third, there are significant donor differences. Fourth, specification matters.

6. The size of the effect

In this section, we present our own 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.[27] 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. The results are presented in Table 7.

All regressions control for country size, lagged dependent variable, as well as country and year specific fixed effects. The first panel in Table 7 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. We make use of the panel nature of the data and include both country and time period specific fixed effects. 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 6. When aid is also measured as a 5-year average, the evidence suggests a positive association between growth and aid (both measured as 5-year averages). Our panel data analysis thus suggests that

27. 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.

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-on-aid effect has become stronger in the new century. More aid is now allocated to those countries that grow faster.

Table 7 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	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	-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	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 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. *, **, *** denotes statistical significance at the 10%, 5% and 1% levels, respectively.

Table 2 reports first order (simple) correlations for different aid-growth pairs for various time periods. Three negative coefficients between growth and aid are reported. Table 3 extended this by considering both leads and lags. It is shown there that lagged growth has a negative correlation with aid allocated. Simple correlations, however, can be misleading. Hence, Table 5 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 (individual study) panel data analysis reveals a 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 (M2 and M3 from Table 3).

7. Conclusion

This paper commenced with a correlation study of the raw data, and then it presented a meta study of 30 papers that estimated the allocation effect of growth in the recipient country on aid to the country. The results of the correlation study suggested that the aid allocation effect of growth may on average be marginally *negative*, but the meta-analysis of the partial correlation from the 211 model estimates in the 30 studies find a more complex picture where the average result is *positive*. A positive effect of growth on aid emerges also from our own analysis of 147 countries, using data that extends into the new century.

The credibility of the meta-analysis estimates is enhanced by the fact that: (a) the meta tests have rejected that publication selection biases are important in this literature, and (b) the results are confirmed by the primary data analysis.

The dominating effect of growth on aid is thus positive. 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. With these conclusions in mind, we return to the two purposes of our study as stated in the introduction: One purpose was to see if the weak results in the aid to growth studies may be due to simultaneity bias. As both the growth-aid and aid-growth coefficients are found to be positive, the simultaneity bias causes *both* effects to be exaggerated (line (3) in Table 3). Thus, the simultaneity bias in aid effectiveness studies is *upward* not downward as we had hoped.

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 growth, do not dominate. Commercial and efficiency considerations turn out to be more important.

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Note: The papers in our project not yet published are available from: http://www.martin.paldam.dk, under "working papers", "development aid project".

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