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Aid effectiveness on growth

A meta study

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Abstract:

The AEL (aid effectiveness literature) is econometric studies of the macroeconomic effects of development aid. It contains about 100 papers of which 68 are reduced form estimates of the effect of aid on growth in the recipient country. The raw data show that growth is unconnected to aid, but the AEL has put so much structure on the data that all results possible have emerged. The present meta study considers both the best-set of the 68 papers and the all-set of 543 regressions published. Both sets have a positive average aid-growth elasticity, but it is small and insignificant: The AEL has not established that aid works. Using meta-regression analysis it is shown that about 20 factors influence the results. Much of the variation between studies is an artifact and can be attributed to publication outlet, institutional affiliation, and specification differences. However, some of the difference between studies is real. In particular, the aid-growth association is stronger for Asian countries, and the aid-growth association is shown to have been weaker in the 1970s.

JEL: B2, F35, O35

Keywords: Aid effectiveness, meta study, economic growth

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1. Introduction

Development aid is an important industry. At present the annual flow of transfers amounts to more than US$60 billion. Many doubt the effectiveness of this flow on the welfare of receiving nations. It is a sad fact that the basic model where growth is explained by aid on cross-country or panel data shows that *absolute* aid effectiveness is *rejected*. This has led policy makers to express concerns about the effectiveness of aid, while researchers have generated a large and controversial literature trying to prove *conditional* aid effectiveness, where effectiveness is analyzed after the relation is controlled for country heterogeneity. However, different authors have used different controls, and this has produced a wide range of results which do not seem to converge.

The subject of the present paper, and two parallel ones, is thus the AEL, **A**id **E**ffectiveness **L**iterature. It analyzes the impact of aid empirically on macro economic data. A thorough search of the literature gave a total of 97 AEL studies[1] – they are listed in Appendix 2. Even though there are almost 100 studies, the aid effectiveness controversy continues. Recently most studies have found that aid does work under certain conditions, but may even be harmful under other conditions. However, Hansen and Tarp (2000) claimed that (almost) all aid works.

Accordingly, the aim of this paper is to use meta-analysis to synthesize the evidence. Has the AEL established that aid has an impact on economic growth? And, if it has, how large is it? Further, we use meta-regression analysis to investigate the source of heterogeneity/variation in the available results. Till now the reviews of the AEL have been qualitative and confined to only a portion of the available evidence, either because they are old as White (1992) or Jepma (1995) or partial as Tsikaka (1998) or Hansen and Tarp (2000). Ours is the first qualitative assessment of the entire body of evidence.

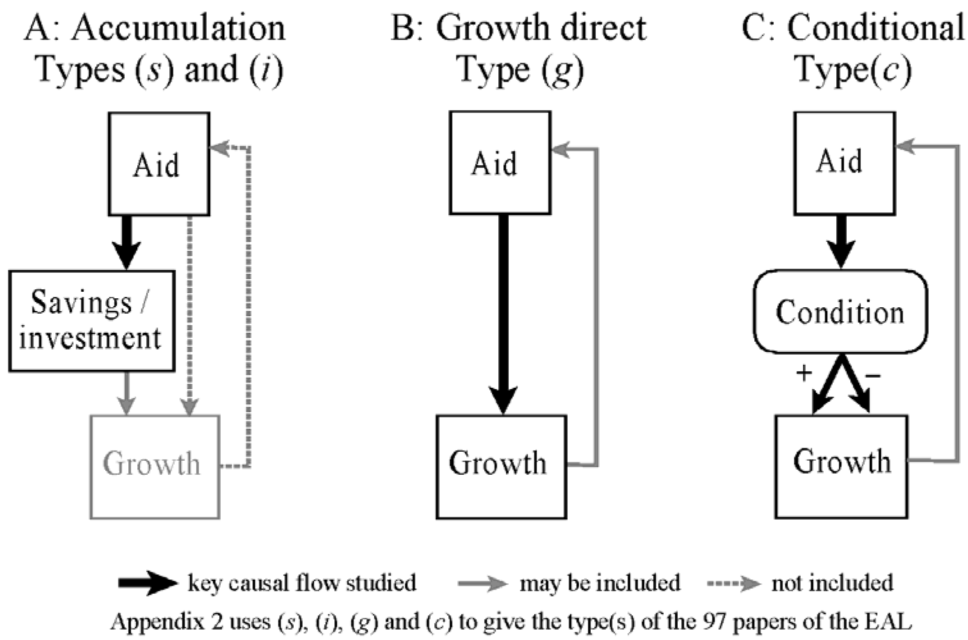
This paper is structured as follows: Section 2 defines and classifies the AEL and explores some of the puzzles in the literature, while section 3 discusses the theory of the aid-growth association. The data used for the meta-analysis are discussed in section 4. The heart of the paper is sections 5 and 6, where the evidence is used to answer our key questions – is there an aid-growth effect, and what explains the differences in results? The paper is concluded with a number of suggestions for future research in section 7. Appendix 1 presents a short introducetion to the techniques of meta-analysis, while Appendix 2 lists the AEL.

1. Extensive searches of Econlit, Proquest, Web of Science and Google were undertaken, from which we could track citations backward. Paper available after 1st of January 2005 are not included.

2. The AEL and some aid-growth puzzles

The AEL asks if development aid is effective in generating development. The basic measure for development is the economic growth rate. Consequently the AEL tries to answer the question by estimating the effect, μ, of aid, h, on growth, g, using macro cross-country or panel data, or time series data on individual countries. The 97 studies of the AEL use three families of models characterized by their causal structure, as shown in figure 1. About half of the studies contain estimates of models of more than one type. With the resulting overlapping we have reached the following amounts of studies:

Figure 1. The causal structure in the three families of AEL models



A: 43 papers contain *accumulation estimates* of the impact of aid on savings or investment. They are marked as type (*s*) and (*i*) in Appendix 2. These models are covered in Doucouliagos and Paldam (2005a), which shows that aid has an unclear effect on accumulation.

B: 68 papers contain a total of 543 *direct estimates*, using reduced form models of the effect of aid on growth. They are marked as type (*g*) in Appendix 2. They are the data of the present meta-analysis.

C: 31 papers contain *conditional estimates*, where the effect of aid on growth depends upon a third factor *z*, so that if *z* is favorable, the result is growth, and vice versa if *z* is unfavorable. These studies are marked as type (*c*) in Appendix 2. They are covered in Doucouliagos and Paldam (2005b). Till now 10 such z's have been proposed, but none have survived independent replications.

The AEL has been fuelled by the fact that the evidence is weak and contradictory. Notably three pieces of evidence do not mesh:

(P1) *Contrasting country stories*: South Korea received substantial aid for a decade just before its take off-into high growth. Tanzania has been a main recipient for 40 years, and has had little growth. Considerable aid for 30 years to Zambia goes together with an unusually poor economic performance.[2]

(P2) *Micro-macro result*: Studies summarizing project evaluations typically find that about half of all projects succeed while the other half fails, but hardly any harms development. Thus, by aggregation the micro evidence should show that aid increases growth.[3]

(P3) *The zero correlation observation*: The raw data for economic growth and the share of development aid have no correlation – there is no *absolute* aid effectiveness as already mentioned.[4] It is puzzling indeed that the raw data show no relation between aid and growth. (P3) contrasts with (P2). Since Mosely (1986), the contrast has been known as the *micro-macro paradox*.

The zero-correlation-observation (P3) has an important implication: Any conclusion that μ is non-zero, based on these data, must be due to the *imposition of structure on the data.* Researchers have done this in four ways: (S1) Limit the data to a particular subset; (S2) aid is only one factor of growth, so a *control set*, $\boldsymbol{x}_j$, of j other variables is often included in the aid-growth relation; (S3) the (h,g)-relation is likely to have various biases, so researchers have looked for the right *estimator*; and (S4) aid effectiveness may depend on something, so a *conditioning factor, z*, has been entered in the relation – see the C group of studies above. Consequently, many possibilities exist for applying structure to the data. This has allowed researchers to reach all four possible answers to the AEL question. Namely, the effect of aid on growth is: positive, insignificant, negative, or (in the studies of family C) it depends on another variable, z, see here table 3 below.

2. Many country studies of the aid-growth connection exist, see e.g., White (1998). Below we only include country studies that contain econometric estimates.

3. The micro-macro result appears to be uncontroversial, see e.g. Cassen (1986, 1994) and IBRD-OED (annual).

4. The raw data for the AEL analysis are (h,g)-pairs averaged over, e.g. 4 years. The standard source, WDI, gives a total of 1008 such (h,g)-pairs (2005). Simple descriptive regressions between these data show no connection, see Doucouliagos and Paldam (2005c) and Herbertsson and Paldam (2005). This applies to cross-country regressions and to panel regressions with and without controls for fixed effects and GDP-levels.

The purpose of our study is to analyze the pattern in the answers. Why do some authors find a positive effect, others no effect and still others a negative effect? Is the heterogeneity in the estimates an artifact of the way studies are conducted (e.g. specification, estimation and data differences), or does it reflect a real phenomenon associated with the existence of a distribution of aid-growth effects?

The question lies at the heart of controversy over the impact of foreign aid. If differences in results are created by the application of structure to the data, then the information available to taxpayers and policy makers is distorted, and we need to quantify the impact of specification differences on aid-growth effects. If the variation in results is due to an underlying distribution, so that aid increases growth in certain circumstances and decreases it in others, then it is vital to identify the conditions and realign aid to take advantage of them.[5]

A look at the raw data permits us to make another point: From a statistical point of view these data are ideal for AEL research: The (*h,g*)-data come in adequate numbers. The average aid share is 7.4%. This is substantial relative to other variables that are found to effect growth, i.e., it is about half the share of net investments, and larger than either the share of the education budget or the share of the health budget in most LDCs. Furthermore, the standard deviation of the aid share is 9.4, so aid data have considerable variation.

3. The models of the B family of the AEL

The basic modeling set-up is as listed in Table 1. Note that when the first papers were made in the late 1960s few aid data were available, so panel estimation was impossible, but it was not developed as an econometric technique, anyhow. Instead the older papers spent a lot of space in the papers discussing politics/policy and economic theory.

Several of the early papers were rather explicit politically, with some researchers belonging to the *new left* – notably Griffin (1970) and Weisskopf (1972) – while others were explicitly *libertarian* – notably Friedman (1958) and Bauer (1971). Interestingly authors from both schools believed that aid could easily become harmful to the recipient countries, though for different reasons. Certainly excessive aid may distort the economy of a country and create a low growth economy. Several studies of such extreme cases exist see e.g. Paldam (1997). Economic theory enters as a frame of reference for the variables authors choose for controls

5. A parallel body of literature deals with the reverse causality. It explains aid flows (see Alesina and Dollar (2000). It does not point to growth in the recipient country as an important causal factor for giving aid. Hence, while reverse causality may give a bias in the AEL-relation, we expect that the bias is small. This is confirmed in Doucouliagos and Paldam (2005c).

and conditioning. That choice also depends upon the availability of the data. We have found more or less explicit references to four types of economic theory in the AEL. Of which the two first are discussed further in Doucouliagos and Paldam (2005a).

Table 1. The studies included are based on models of the following type

Model	(1) $g_{it} = \alpha + \mu h_{it} + \gamma_j \boldsymbol{x}_{jit} + u_{it}$		
Variable		μ	effect of aid, estimated
g_{it}	real growth rate	α, γ_j	coefficients to be estimated
h_{it}	aid as share of GDP, GNI	$_{it}$	index to countries and time
$\boldsymbol{x}_{itj}$	vectors of *j* controls	u_{it}	residuals

Note: The time unit is normally 3-5 years to reduce variation.

Type 1: IS-LM macro theory. The AEL deals with the activity, ΔY, which is caused in the longer run, by an amount H of aid entering a country. The early AEL spent some effort on classifying effects. Two main problems were found: (1) Aid is *fungible*, so what aid actually finances is often different from the marginal outcome. The AEL tries to bypass the fungibility complication by using *reduced form* estimates between aid and "final outcome" variables. (2) The short-run *activity* effect should be separated out from the longer-run *capacity* effect, which is the key purpose of aid. The (IS, LM)-framework suggests that there is both an activity and a capacity effect.

Type 2: Two-gap models. For the first 2 decades of aid, its macro economic rationale was *Harrod-Domar* type models, which were made explicitly to dynamize the IS-LM model. The policy implication was that the main constraint to development was the *savings* necessary to finance investments. The original Harrod-Domar model is a closed private sector model, so savings are constrained by domestic savings behavior. The introduction of a public sector budget balance gives the first *gap*. When the model is opened, the balance of payment provides a *second gap*,[6] where savings can be provided as transfers from the DC world. This is the approach in the accumulation family of models. This model disappeared from the theory of economic growth during the 1960s, but lingered on in development economics due to its operationality and the clear policy prescriptions it generated.

However, gradually the Harrod-Domar framework was replaced by the more flexible *neo-classical framework*, even in development economics. Since the 1990s, the AEL has used

6. The best known model of this type was Chenery and Strout (1966). Chapter 2 in Easterly (2001) gives the sad story of the savings gap in development.

state of the arts growth theory. It implies a richer set of channels from aid to growth, and propose that aid effectiveness is analyzed directly from aid to growth.

Type 3: Barro type growth regressions. Since the early 1990s the best known empirical tool in modern growth theory has been the Barro type growth regression,[7] and it is what most of the recent part of AEL has in mind. The model is set up to study convergence, i.e., the coefficient β, to the GDP level, $\log y_{it}$, in the following relation:

(2) $g_{it} = \alpha + \beta \log y_{it} + \boldsymbol{\gamma}_{jit} \boldsymbol{x}_{jit} + u_{it}$, see table 1 for definitions of variables.

If we treat log y_{it} as one of the controls (2) turns into model (1) from table 1. These regressions have been run for many ***x***-sets, time periods, country sets, and with different estimators: As a pure cross-country with no t-index, as a panel regression with both indices, or as time-series data with only the t-index. Also, biases have been removed by doing TSIV-estimates using some of the controls in the first stage, or as GMM-estimates using lags systematically.

These equations are simple and easy to use, and they have some relation to the neoclassical growth model as discussed in Barro and Sala-i-Martin (2004). However, the connection is weak, in the sense that the model only suggests some of the controls, while others are debatable *ad hoc* variables. Also, the choice of variables is often based on data availability. A large number of model *variants* are easy to propose and estimate, and it is impossible to tell what the right specification is, though some specifications are easier to justify than others.

The one-equation estimate of μ may easily be biased. Some examples may suffice. The standard Barro estimates have the share of public consumption, c_{it}, as one of the variables in the x-set. If c is singled out the model looks like this:

(3) $g_{it} = \alpha + \mu h_{it} + \nu c_{it} + \boldsymbol{\gamma}_{jit} \boldsymbol{x}_{jit} + u_{it}$

One of Barro's results is that public consumption is harmful for growth, $\nu < 0$.[8] Imagine a full crowding out of the capacity effect of aid, so that aid only increases c. Then surely (3) biases the estimate of μ upwards. However, Barro's control set also includes variables for education and health, which are assisted by aid and have a positive effect on growth. If they are left in, it biases the estimate of μ downwards.

7. It is published in various versions since 1991. The newest is Barro and Sala-i-Martin (2004; cpt. 12).
8. That result is neatly reproduced in the AEL. When c_{it} is included in the AEL relation it gets a negative coefficient, which is often significant. However, the negative coefficient to c_{it} in the Barro equation is disputed.

Type 4: Political economy model. A new approach notes that aid is a new external rent entering the economy. Here it may influence domestic political stability, and consequently growth via the *stability-growth channel*: If political stability changes, the investment climate improves, investment changes and so does growth. An extra rent can in principle have two effects: It may turn some internal distributional fights from a negative sum game into a positive sum game, and hence be politically stabilizing and *increase* growth.[9] Alternatively, it is a new contestable rent that increases distributional fights, and *reduces* political stability and growth as resources are often found to do, see e.g. Collier and Hoeffler (2000). This gives two possible outcomes and hence a subject for empirical analysis.

The theories referred to in the AEL are thus a well-known set of theories, which has changed in line with the general development of economic theory. Before we turn to the survey of papers, a few words should be added about the techniques used.

Estimators**:** All models can be estimated by a rapidly growing battery of estimators. The choice appears to depend primarily on availability. When a new tool appears, it moves the frontier of best practice outward. Consequently the new tool has to be applied for articles to be accepted. However, only one example (Giles 1994) has been reported in any of the papers in the AEL where the use of more advanced econometrics has changed the substantial results (from just below to above significance).[10] We test for the effect of estimation technique below, and find that it does not appear to matter.

4. Two data sets for the meta study: The best-set and the all-set

The data we wish to submit to our analysis is the *population* of the AEL. A comprehensive search revealed 97 studies, which explored the impact of foreign aid on savings, investment or growth. Table 2 lists the number of studies and estimates that are used in our meta-analysis. While in some models a positive impact of aid on investment does cause a positive impact on growth, we prefer to separate the former studies from the latter. Accordingly, we separate these studies into different categories as pictured in Figure 1.

In this paper we focus only on the foreign aid and economic growth literature of column B of Table 2. Our measure of size of the effect is the partial correlation between foreign aid and economic growth. While most studies provide enough information from which to calcu-

9. If distributional fights had no costs, they would, of course, be zero-sum games.
10. The AEL thus seems to support the critique of econometrics in chapter 6 of McCloskey (1998).

late the elasticity of growth with respect to foreign aid, many do not.[11] Hence, we use partial correlations as this enables us to include all available empirical studies.

Table 2. Statistics of the AEL

	A: Accumulation		B: Growth	C: Conditional			Proxy	Sum
	Savings	Investments		Good Policy	Medicine	Others		
Papers, best-set	21	37	68	23	15	10	8	182
Regressions, all-set	61	122	543	162	85	23	29	1025
Sample size	1890	3872	11312	5523	4284	663	2264	29976

Note: The proxy studies are the ones where the empirics use aid-proxy data – such as capital inflows – to draw conclusions regarding aid. This was often done in the early papers, where few aid data existed.

Table 2 shows that the AEL has published 1025 regressions, and the aggregated sample used is 29,976 observations. The total number of annual observations for aid and growth available is about 4,050, so the size of the effort made has led to massive *data mining*. We have concentrated the discussion of data mining in Doucouliagos and Paldam (2005c). Appendix 1 explains how the statistics deals with this problem.

We derive two data sets. The ***best-set*** consists of 68 observations, one from each of the 68 papers, using the key regression from each paper. The ***all-set*** consists of 543 regressions reported in the 68 papers, greatly increasing the data available for tests, but it gives some interdependence between data points.

The papers are: Griffin and Enos (1970); Kellman (1971); Papanek (1973); Gupta (1975); Stoneman (1975); Gulati (1976; 1978); Mosley (1980); Dowling and Hiemenz (1983); Gupta and Islam (1983); Singh (1985); Landau (1986; 1990); Mosley *et al.* (1987; 1992); Levy (1988); Rana and Dowling (1988); Mahdavi (1990); Gyimah-Brempong (1992); Islam (1992); Lensink (1993); Mbaku (1993); Snyder (1993); Boone (1994); Giles (1994); Murty, Ukpolo and Mbatu (1994); Bowen (1995); Hadjimichael *et al.* (1995); Reichel (1995); Most and van den Berg (1996); Amavilah (1998); Durbarry, Gemmell and Greenaway (1998); Campbell (1999); Fayissa and El-Kaissy (1999); Svensson (1999); Burnside and Dollar (2000; 2004); Hansen and Tarp (2000; 2001); Lensink and Morrisey (2000); Collier and Dehn (2001); Dalgaard and Hansen (2001); Gounder (2001); Guillaumont and Chauvet (2001); Hudson and Mosley (2001); Larson (2001); Lensink and White (2001); Lu and Ram (2001); Teboul and Moustier (2001); Collier and Dollar (2002); Gomanee, Girma and Morrissey (2002); Brumm (2003); Dayton-Johnson and Hoddinott (2003); Denkabe (2003); Easterly

11. These are typically studies that do not measure aid as the percentage of GDP.

(2003); Kosack (2003); Moreira (2003); Ovaska (2003); Ram (2003; 2004); Chauvet and Guillaumont (2004); Collier and Hoeffler (2004); Dalgaard, Hansen and Tarp (2004); Easterly, Levine and Roodman (2004); Economides *et al.* (2004); Jensen and Paldam (2004); Roodman (2004); and Shukralla (2004);

Figure 2. Funnel plot: Partial correlations of aid and growth

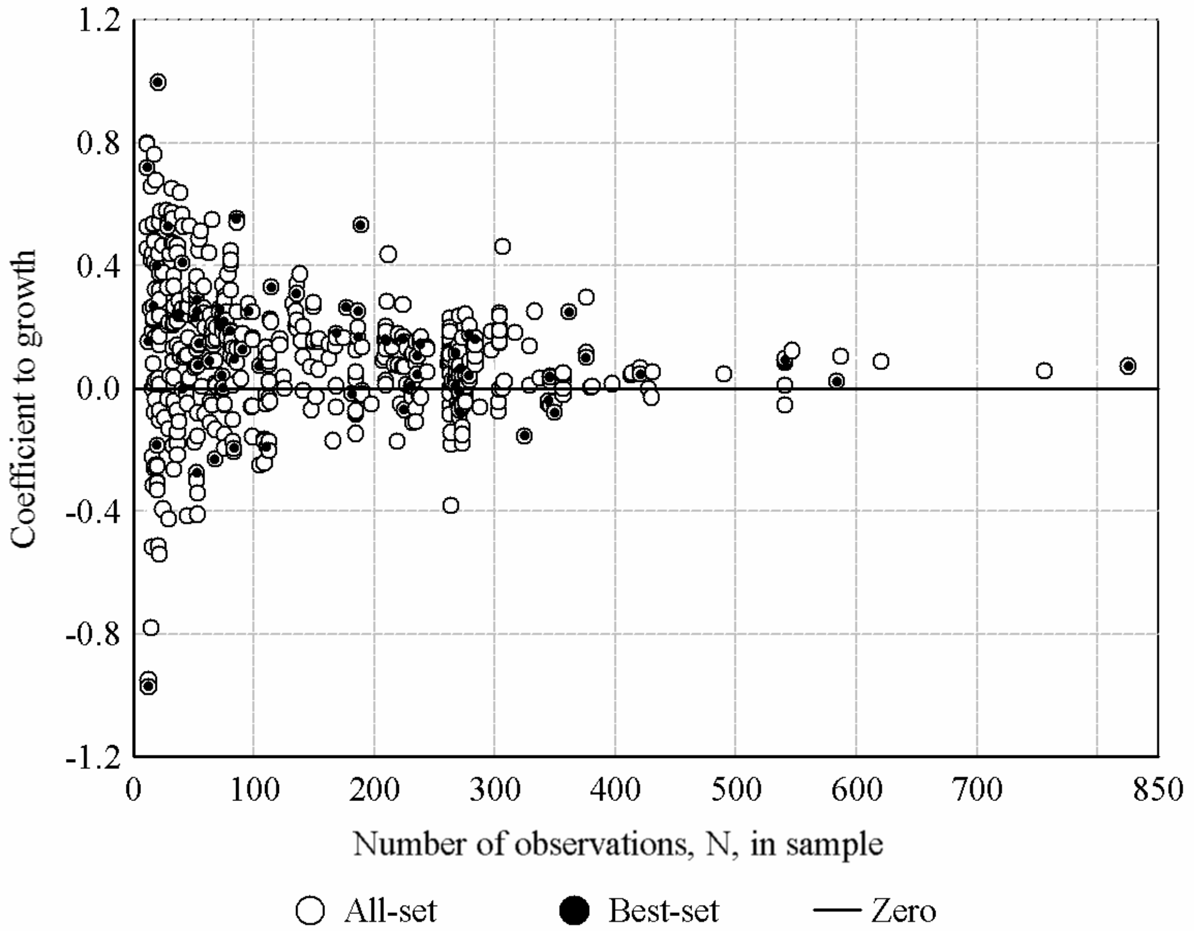


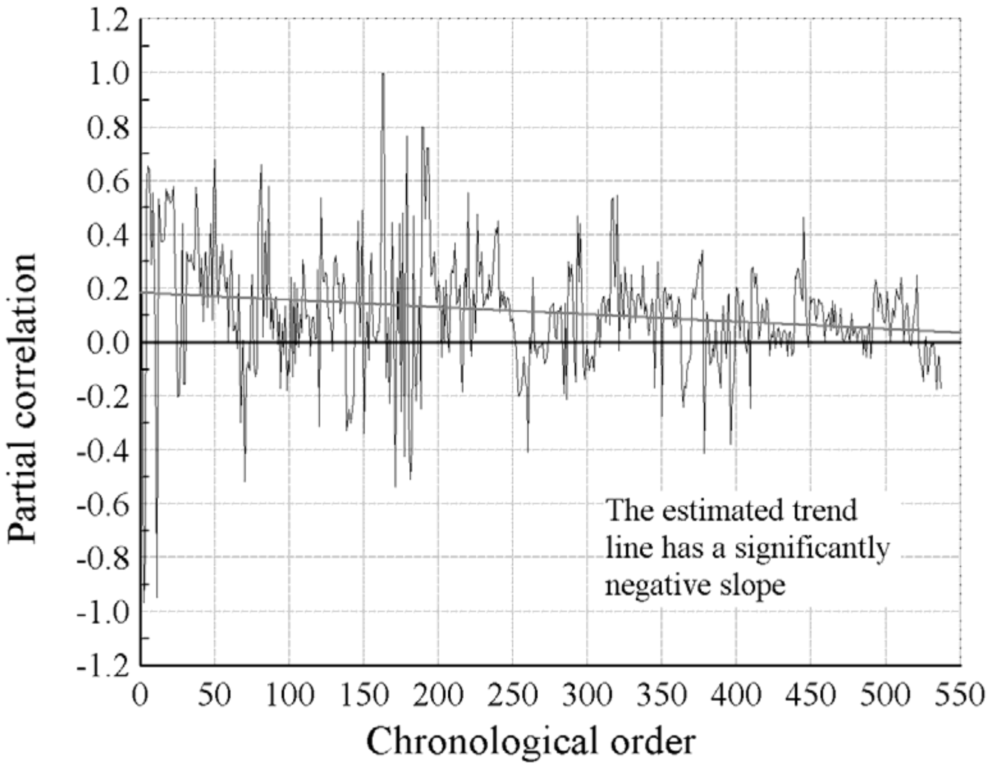
Figure 2 is a funnel plot of the partial correlations, showing their association to the sample size, for the all-set and best-set, respectively. It is obvious that the best-set is more extreme than the all-set – researchers prefer regressions that show something. A majority of the estimates are positive, but most are statically insignificant. The weighted average partial correlation is +0.07 for the all-set and is +0.09 for the best-set, with sample size used as weights.[12] Funnel plots should be symmetrical around the true population effect, if there is only one, and

12. Standard practice in meta-analysis requires that effect sizes (such as correlations) are weighted by the sample size of the study assuming that larger studies will, *ceteris paribus*, be more accurate (Hunter and Schmidt 2004).

the sampling error should be larger for the smaller studies so we expect that they are more spread out than the larger studies. Both properties appear to be present.

Figure 3 is a time series graph of the empirical findings presenting the same partial correlations as in Figure 2, but this time in chronological order. It is clear that although most results are above zero, they fluctuate around the zero line, and they have a slight downward time trend.[13]

Figure 3. Time series graph of aid-growth partial correlations



The downward trend in the 543 results of the AEL shown on figure 3 may have two explanations: (E1) Aid has a declining effectiveness over time, or (E2) the increasing number of observations makes data mining – for positive results – increasingly difficult. These possibilities are further analyzed below. It will be demonstrated that (E2) is the better explanation.

4. Anatomy of failure: The ineffectiveness result

In this section we show that the conclusion that can be drawn from the entire extant literature is that it has not proved that aid affects growth. However, there is evidence of heterogeneity,

13. The trend line drawn is +0.18538 –0.00027n, where n = 1, … 543. The t-ratio of the slope is -4.42.

raising hope that aid may contribute to growth under certain circumstances. Appendix 1 gives a brief introduction to the meta-analysis and the tests used.

4.1 Vote counting

Table 3 classifies the empirical results by sign and statistical significance. As explained in Appendix 1, this is almost an extreme bounds analysis, but it is not a reliable way to summarize the results of a literature. However, it offers a first overview of what the literature has established. As suggested by figure 2, the best-set has relatively more significant results. Almost half, 46%, of the 68 studies found a significantly positive effect, while 54% are either not statistically significant or negative. Much the same pattern appeared in the 543 estimates of the all-set. This can also be seen in Figure 4, which is a histogram of the 543 t-statistics reported in the AEL. The average t-statistic is 1.05, the median is 1.15, and the weighted average t-statistic is 1.22 (using sample size as weights).

Table 3. Meta extreme bounds analysis

Group	Positive		Negative	
	Significant	Insignificant	Insignificant	Significant
68 Studies	31 (46%)	22 (32%)	9 (13%)	6 (9%)
543 estimates	207 (38%)	198 (36%)	106 (20%)	32 (6%)

Figure 4. Histogram of t-statistics

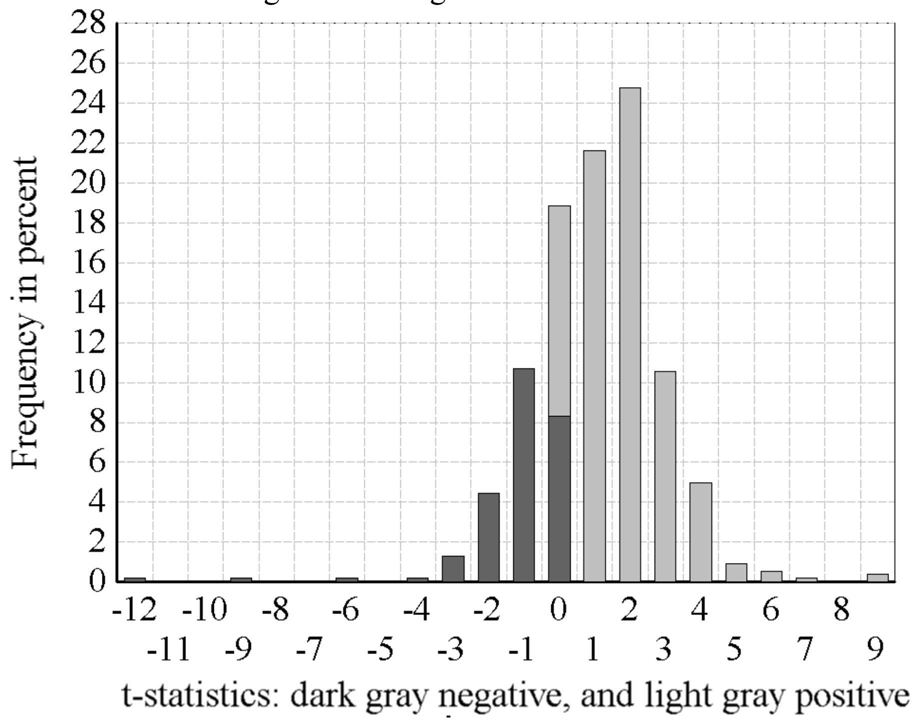


Table 4 gives the standard meta-analysis tests made to determine: (M1) Do the results of all studies combined indicate the presence of a genuine effect among the two variables. This is tested by the MST test and the MSTMRA test given in columns (1) to (4) of the table. The desired outcome for a genuine effect is that that the coefficient to ln(*df*) should be significantly positive. This is not the case. (M2) Does the literature suffer from *polishing* effects, so that the results are too good in small samples? This is tested by the FAT-tests of columns (5) and (6) of the table, where the desired outcome (for no polishing) is that the constant is zero. The FAT tests show that results are polished in the AEL. This is the typical finding in meta-analysis (Stanley 2005).

Table 4. Meta-significance and funnel asymmetry tests

	(1)	(2)	(3)	(4)	(5)	(6)
	MST	MST	MSTMRA	MSTMRA	FAT	FAT
Appendix	(3A)	(3A)	(7A)	(7A)	(5A)	(5A)
Variable	All-set	Best-set	All-set	Best-set	All-set	Best-set
Constant	0.27 (1.14)	1.05 (1.20)	-0.96 (-1.09)	1.00 (0.92)	1.71 (3.69)***	3.78 (1.46)
ln(*df*)	-0.04 (-0.77)	-0.17 (-0.97)	0.01 (0.03)	-0.16 (-0.77)	-	-
1/SE	-	-	-	-	-0.002 (-0.32)	-0.006 (-0.17)
Adjusted R^2	0.00	0.01	0.11	0.08	0.00	0.00
F-statistic	0.76	3.52	1.96***	1.62	0.10	0.03
N	543	68	418	63	540	65

Note: *, **, *** statistically significant at the 10%, 5% and 1% level, respectively. t-statistics in brackets.

5. Meta-regression analysis

In the previous section it was shown that there is a positive, but statistically insignificant association between development aid and economic growth. In this section we use meta-regression analysis to take a closer look at the variation in the empirical results and identify some of the sources of these differences. Meta-regression analysis is gaining widespread appeal among economists, and the AEL is fertile ground for its application. Recent examples include Gorg and Strobl (2001), Doucouliagos and Laroche (2003) and Jarrell and Stanley (2004).

5.1 Variables

The variables used in our meta-regression analysis (MRA) are defined in table 6. We consider six classes of explanatory variables:

Table 6. Definition of variables and their size and effect, when used alone

Variable	BD means binary dummy that is 1 if condition fulfilled, otherwise 0	Mean	SD	Eff.	Prob
Dependent	The partial correlation of aid and economic growth	0.11	0.22	-	-
	(C1) Publication Outlet				
WorkPap	BD for unpublished paper	0.26	0.44	-0.05	0.003
Cato	BD for Cato Journal	0.03	0.16	0.08	0.04
JDS	BD for Journal of Development Studies	0.08	0.27	0.01	0.71
JID	BD for Journal of International Development	0.05	0.22	-0.01	0.80
EDCC	BD for Economic Development and Cultural Change	0.06	0.23	-0.16	0.00
AER	BD for American Economic Review	0.04	0.20	-0.11	0.00
AE	BD for Applied Economics	0.11	0.31	0.04	0.38
	(C2) Author Details				
Danida	BD for author(s) affiliated with the Danida group	0.09	0.29	0.01	0.50
WorldBk	BD for author(s) affiliated with the World Bank	0.09	0.29	-0.15	0.00
Gender	BD if at least one of the authors is female	0.12	0.33	0.03	0.39
Expectations	BD for author with realized expectations about aid-growth relation	0.10	0.30	-0.05	0.02
Influence	BD for authors acknowledging other authors in the AEL	0.22	0.42	0.03	0.15
	(C3) Data				
Panel	BD for use of panel data	0.67	0.47	-0.06	0.01
NoCount	Number of countries included in the sample	48	28	-0.09	0.02
NoYears	Number of years covered in the analysis	20	8	-0.01	0.00
Africa	BD for countries from Africa included	0.83	0.37	-0.13	0.00
Asia	BD if countries from Asia included	0.75	0.43	-0.02	0.49
Latin	BD if countries from Latin America included	0.76	0.43	-0.09	0.01
Single	BD if data from a single country	0.05	0.22	0.16	0.08
Y1960s	BD if data for the 1960s	0.21	0.40	0.02	0.53
Y1970s	BD if data for the 1970s	0.81	0.39	-0.11	0.00
Y1980s	BD if data for the 1980s	0.84	0.37	-0.10	0.00
SubSam	BD if data relate to a sub-sample of countries	0.28	0.45	0.03	0.18
LowInc	BD if data relate to a sub-sample of low income countries	0.09	0.28	-0.03	0.38
EDA	BD for use of EDA data	0.24	0.43	-0.10	0.00
Outlier	BD if outliers were removed from the sample	0.13	0.34	-0.05	0.00
	(C4) Conditionality				
Nonlinear	BD for aid squared added	0.18	0.38	0.03	0.03
AidPolicy	BD for aid interacted with policy	0.26	0.44	-0.10	0.00
Institutions	BD for other aid interacted terms (mainly institutions)	0.26	0.44	-0.21	0.00
	(C5) Specification and Control				
Capital	BD for control for domestic savings or investment	0.47	0.50	0.14	0.00
FDI	BD for control for foreign capital inflows (other than aid)	0.27	0.44	0.10	0.00
GapModel	BD for two-gap model	0.28	0.45	0.07	0.01
Theory	BD for paper developing a theory	0.30	0.46	-0.05	0.02
Average	Number of years involved in data averaging	6.7	5.4	0.01	0.58
LagUsed	BD for use of lagged value of aid	0.11	0.31	0.06	0.13
Inflation	BD for control for inflation	0.14	0.35	-0.03	0.05
Instability	BD for control for political instability	0.29	0.46	-0.08	0.00
Fiscal	BD for control for fiscal stance	0.12	0.32	0.00	0.96
GovSize	BD for control for size of government	0.12	0.32	0.05	0.01
FinDev.	BD for control for financial development	0.32	0.47	-0.04	0.03
Ethno	BD for control for ethnographic fractionalization	0.32	0.47	-0.09	0.00
Region	BD for regional dummies	0.36	0.48	-0.08	0.00
HumCap	BD for control for human capital	0.25	0.43	-0.02	0.42
Open	BD for control for trade openness	0.29	0.46	0.06	0.00
PopSize	BD for control for population size	0.29	0.46	0.06	0.01
GdpLev	BD for control for per capita income	0.63	0.48	-0.11	0.00
Policies	BD for control for policies	0.35	0.48	-0.10	0.00
	(C6) Estimation				
OLS	BD for use of OLS	0.68	0.47	0.04	0.002
Gr&Aid	BD for equations system with *both* a growth and an aid equation	0.04	0.20	0.07	0.00
Gr&Savings	BD equations system with *both* a growth and a savings equation	0.02	0.13	0.08	0.04

The two first are general priors of (C1) journals and (C2) authors. Such priors are explored by 8 publication outlet dummies and 6 author characteristics. The remaining 4 classes of variables are (C3) 14 data characteristics, (C4) 18 variables for model formulation and controls, (C5) are 4 variables for the inclusion of conditional variables, where aid is supplemented with a second order aid term, and finally (C6) are 3 variables for estimation techniques.

Note that (at least) two of the variables are encompassing variables: *DevJourn* and *AidBus* are thus encompassing several other more partial variables. We have calculated the effect of each variable separately in the two right-hand columns, and the effects of groups of variables and all (non-encompassing) variables are analyzed in tables 7a and 7b.

As regards (C2) we are influenced by our findings on the aid-conditionality literature, which found that two prolific groups produced significantly different results: One was affiliated with the World Bank and the other with Danida (Danish Development Aid). The variable *influence* tests whether "friends" acknowledged in the paper may influence results.

The 14 variables (C3) for data differences try to capture the differences in data used by researchers. This includes controls for type of data (typically panel or cross-sectional), sample size (countries and years), region (Africa, Asia, Latin America), time period covered, and whether parts of samples are used (sub-sample, low income sample and removal of outliers). Model specifications (C4) are made to influence results – we use 18 variables that capture most of the differences in specifications, and are hence able to perform a meta-robustness testing. Through these we are able to explore how robust the aid-growth effects are and can quantify the effects of changing specification, as well as data differences etc.

5.2 Explaining the partial correlation between aid and economic growth

The MRA results are presented in Table 7a using OLS on the all-set. Several alternative specifications are given to explore the sensitivity of the results. Table 7b considers alternative regression techniques on both the all-set and the best-set. In both tables the dependent variable is the partial correlation between foreign aid and economic growth.

Table 7a. OLS Meta-Regression Analysis, all-set

Variable	(1)	(2)	(3)	(4)	(5)
Constant	0.19 (11.81)***	0.39 (6.45)***	0.04 (0.69)	0.36 (2.65)***	0.19 (6.50)***
WorkPap	-0.08 (-4.74)***	-	-	0.03 (0.58)	0.03 (1.67)*
Cato	-0.11 (-2.62)***	-	-	-0.05 (-0.50)	-
JDS	-0.05 (-1.96)*	-	-	0.01 (0.05)	-
JID	-0.07 (-2.86)***	-	-	-0.09 (-1.58)	-0.7 (-2.12)**
EDCC	-0.23 (-3.92)***	-	-	-0.62 (-3.60)***	-0.59 (-3.64)***
AER	-0.14 (-6.47)***	-	-	-0.01 (-0.15)	-
AE	-0.04 (-0.73)	-	-	-0.11 (-1.63)	-0.15 (-2.48)**
Danida	-	0.06 (2.81)***	-	0.12 (2.25)**	0.13 (4.55)***
WorldBk	-	-0.12 (-5.34)***	-	0.05 (0.83)	0.06 (1.74)*
Gender	-	0.01 (0.17)	-	0.02 (0.19)	-
Expectations	-	0.07 (2.79)***	-	0.02 (0.39)	-
Influence	-	0.07 (4.03)***	-	0.10 (3.57)***	0.12 (5.84)***
Panel	-	0.01 (0.31)	-	-0.01 (-0.21)	-
NoCount	-	-0.00 (-0.13)	-	-0.01 (-0.42)	-0.001 (-2.41)**
NoYears	-	0.001 (0.02)	-	-0.01 (-0.14)	-
Africa	-	-0.07 (-1.52)	-	-0.03 (-0.65)	-
Asia	-	0.10 (2.22)**	-	0.10 (2.06)**	0.11 (3.04)***
Latin	-	-0.14 (-2.94)***	-	-0.06 (-1.19)	-
Single	-	0.06 (0.52)	-	0.20 (1.24)	0.27 (2.56)**
Y1960s	-	-0.11 (-2.34)**	-	-0.04 (-0.73)	-
Y1970s	-	-0.10 (-2.38)**	-	-0.14 (-3.17)***	-0.13 (-3.91)***
Y1980s	-	-0.12 (-2.22)**	-	-0.12 (-1.66)	-
SubSam	-	-0.01 (-0.28)	-	-0.03 (-0.96)	-
LowInc	-	0.01 (0.01)	-	0.02 (0.38)	-
EDA	-	-0.07 (-3.62)***	-	-0.05 (-2.25)**	-0.07 (-3.86)***
Outlier	-	-0.03 (-1.79)*	-	-0.01 (-0.11)	-
Nonlinear	0.04 (2.93)***	-	-	-0.01 (0.61)	-
AidPolicy	-0.07 (-5.07)***	-	-	0.01 (0.56)	-
Institutions	-0.21 (-7.06)***	-	-	-0.11 (-2.52)**	-0.11 (-3.82)***
Capital	-	-	0.13 (2.53)**	0.06 (1.26)	-
FDI	-	-	0.04 (1.05)	0.06 (1.36)	0.09 (3.49)***
GapModel	-	-	-0.08 (-1.83)*	-0.05 (-0.63)	-
Theory	-	-	0.02 (0.75)	-0.02 (-0.41)	-
Average	-	-	0.00 (0.56)	0.00 (0.08)	-
LagUsed	-	-	0.01 (0.30)	0.06 (1.18)	-
Inflation	-	-	-0.05 (-1.83)*	-0.07 (-1.77)*	-0.05 (-2.47)**
Instability	-	-	-0.01 (-0.36)	0.10 (1.55)	0.13 (2.71)***
Fiscal	-	-	0.06 (1.50)	0.05 (1.11)	-
GovSize	-	-	0.07 (2.82)***	0.09 (2.39)**	0.09 (4.24)***
FinDev	-	-	0.03 (1.21)	0.03 (0.96)	0.04 (2.31)**
Ethno	-	-	0.00 (0.11)	-0.11 (-2.03)**	-0.16 (-3.48)***
Region	-	-	-0.04 (-2.15)**	-0.02 (-0.87)	-
HumCap	-	-	-0.10 (-3.52)***	-0.04 (-0.75)	-
Open	-	-	0.00 (0.10)	-0.01 (-0.22)	-
PopSize	-	-	0.04 (1.59)	-0.03 (-0.58)	-
GdpLev	-	-	0.00 (0.06)	0.04 (0.92)	-
Policies	-	-	-0.03 (-1.24)	-0.11 (-3.30)***	-0.12 (-5.51)***
OLS	-	-	0.03 (1.93)*	-0.01 (-0.47)	-
Gr&Aid	-	-	0.10 (2.68)***	-0.03 (-0.76)	-
Gr&Savings	-	-	0.02 (0.42)	-0.02 (-0.48)	-
Adjusted R^2	0.13	0.16	0.11	0.30	0.31
Cor(ob, fit)	0.38	0.44	0.38	0.61	0.58
N	543	474	539	474	487

*, **, *** statistically significant at the 10%, 5% and 1% level, respectively. White heteroscedasticity-consistent standard errors and covariances used. t-statistics in brackets. Cor(ob, fit) is the correlation between observed and fitted partial correlations.

Table 7b. Sensitivity of Meta-Regression Analysis of table 7

Variable	(4) from 7a OLS All-Set General	(6) WLS All-Set General	(7) OLS All-Set Bootstrap General	(8) OLS Best-Set Specific
Constant	0.36 (2.65)***	0.49 (5.30)***	0.36 (2.46)***	0.15 (1.43)
WorkPap	0.03 (0.58)	-0.02 (-0.88)	0.03 (0.46)	-
Cato	-0.05 (-0.50)	-0.22 (-4.24)***	-0.05 (-0.50)	-
JDS	0.01 (0.05)	-0.01 (-0.23)	0.01 (0.05)	0.23 (2.42)**
JID	-0.09 (-1.58)	-0.07 (-2.15)**	-0.09 (-1.43)	-
EDCC	-0.62 (-3.60)***	-0.57 (-6.36)***	-0.62 (-3.56)***	-0.52 (-2.12)**
AER	-0.01 (-0.15)	-0.02 (-0.36)	-0.01 (-0.11)	-
AE	-0.11 (-1.63)	-0.12 (-2.14)**	-0.11 (-1.56)	-
Danida	0.12 (2.25)**	0.09 (2.89)***	0.12 (1.95)*	-
WorldBk	0.05 (0.83)	-0.09 (-3.05)***	0.05 (0.85)	-
Gender	0.02 (0.19)	-0.08 (-2.54)**	0.02 (0.17)	-
Expectations	0.02 (0.39)	0.11 (3.73)***	0.02 (0.36)	-
Influence	0.10 (3.57)***	0.03 (1.82)*	0.10 (3.37)***	0.09 (1.74)*
Panel	-0.01 (-0.21)	0.04 (0.89)	-0.01 (-0.17)	-
NoCount	-0.01 (-0.42)	0.001 (1.83)*	-0.01 (-0.45)	-0.004 (-3.04)***
NoYears	-0.01 (-0.14)	0.001 (0.08)	-0.01 (-0.21)	-
Africa	-0.03 (-0.65)	-0.10 (-2.34)**	-0.03 (-0.55)	-
Asia	0.10 (2.06)**	0.04 (1.03)	0.10 (2.16)**	0.20 (2.18)**
Latin	-0.06 (-1.19)	-0.02 (-0.56)	-0.06 (-1.09)	-
Single	0.20 (1.24)	0.35 (2.95)***	0.20 (1.15)	-
Y1960s	-0.04 (-0.73)	-0.03 (-1.29)	-0.04 (-0.63)	-
Y1970s	-0.14 (-3.17)***	-0.10 (-2.96)***	-0.14 (-3.31)***	-0.16 (-2.34)**
Y1980s	-0.12 (-1.66)	-0.29 (-5.14)***	-0.12 (-1.62)	-
SubSam	-0.03 (-0.96)	-0.04 (-1.70)	-0.03 (-0.96)	-
LowInc	0.02 (0.38)	0.02 (0.55)	0.02 (0.44)	-
EDA	-0.05 (-2.25)**	-0.04 (-2.26)**	-0.05 (-1.76)*	-
Outlier	-0.01 (-0.11)	0.00 (0.05	-0.01 (-0.10)	-
Nonlinear	-0.01 (-0.61)	0.03 (1.65)	-0.01 (-0.12)	-
AidPolicy	0.01 (0.56)	0.02 (0.85)	0.01 (0.50)	-
Institutions	-0.11 (-2.52)**	-0.05 (-2.04)**	-0.11 (-2.94)***	-
Capital	0.06 (1.26)	0.05 (1.43)	0.06 (1.11)	0.20 (4.02)***
FDI	0.06 (1.36)	0.08 (2.48)**	0.06 (1.13)	-
GapModel	-0.05 (-0.63)	-0.09 (-1.91)*	-0.05 (-0.68)	-
Theory	-0.02 (-0.41)	-0.05 (-2.04)**	-0.02 (-0.32)	-
Average	0.00 (0.08)	-0.00 (-0.08)	0.00 (0.08)	-
LagUsed	0.06 (1.18)	0.08 (4.64)***	0.06 (1.21)	-
Inflation	-0.07 (-1.77)*	-0.08 (-2.54)**	-0.07 (-1.48)	-
Instability	0.10 (1.55)	0.01 (0.46)	0.10 (1.33)	-
Fiscal	0.05 (1.11)	0.01 (0.15)	0.05 (0.95)	-
GovSize	0.09 (2.39)**	0.06 (2.37)**	0.09 (2.20)**	0.19 (2.58)**
FinDev	0.03 (0.96)	0.06 (3.44)***	0.03 (0.92)	-
Ethno	-0.11 (-2.03)**	-0.01 (-0.22)	-0.11 (-1.79)*	-
Region	-0.02 (-0.87)	-0.03 (-2.35)**	-0.02 (-0.83)	-
HumCap	-0.04 (-0.75)	0.05 (1.88)*	-0.04 (-0.75)	-
Open	-0.01 (-0.22)	-0.03 (-1.37)	-0.01 (-0.21)	-
PopSize	-0.03 (-0.58)	-0.02 (-1.03)	-0.03 (-0.53)	-
GdpLev	0.04 (0.92)	0.01 (0.01)	0.04 (0.80)	-
Policies	-0.11 (-3.30)***	-0.04 (-1.56)	-0.11 (-2.48)**	-
OLS	-0.01 (-0.47)	-0.04 (-2.49)**	-0.01 (-0.43)	-
Gr&Aid	-0.03 (-0.76)	-0.03 (-0.82)	-0.03 (-0.61)	-
Gr&Savings	-0.02 (-0.48)	0.01 (0.04)	-0.02 (-0.34)	-
Adjusted R^2	0.30	0.55	0.30	0.35
Cor(ob, fit)	0.61	0.54	0.61	0.66
N	474	474	427	63

Note: See table 7a. Column (4) is repeated for ease of cross-reference.

Tables 7a and b have a total of 8 columns, with different sets of variables and estimation techniques. Not surprisingly, many of the variables are not statistically significant.[14] However several variables are significant as well as robust to specification of the MRA. Table 7b uses WLS-regression in column (6). Normally, the inverse of the standard error variance is used as weights (see Longhi *et al.* 2005). However, Hunter and Schmidt (2004) argue that sample size is a better set of weights to use. The WLS results are broadly similar to the OLS results, although there are some differences.[15] Many of the observations are not strictly statistically independent. Accordingly, column (7) reports the results of using the bootstrap to generate standard errors. Once again, the results are broadly in line with the OLS results.[16] Finally the MRA was repeated for the best-set. The results after sequentially eliminating any statistically insignificant variables are presented in column (8).[17] There are much fewer degrees of freedom, but the main results are the same as in the other columns.

(C1) ***Publication outlet:*** *EDCC* has a negative sign that is always statistically significant, but it is mainly due to 3 papers written from a Marxist/Left-wing perspective. The papers published in *JDS* tend to have positive results, but this journal may be seen as "belonging" to the aid business. The two papers published in the *Cato Journal* have negative results, as this journal has a libertarian orientation, which predicts negative effects of aid on growth. AE and JID also have negative results, which are often significant. Note that these outlet effects either reflect the editorial policy of the journals or the self-selection of authors.

(C2) ***Groups/influence:*** The most significant result here is that writers from the *Danida* group consistently find results that are more pro-aid (with about 0.1 points) than others, while the results for researchers from the *World Bank* deviate less from the other results.[18]

It is also important that the *influence* variable tends to be significant. Researchers tend to confirm the results of those they are associated with. The influence variable has a robust significant positive coefficient indicating that studies conducted by authors who receive comments/assistance from other authors publishing in the same field tend to report higher partial correlations. This does not mean, however, that these studies are biased. Indeed, they may be better constructed ones.

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14. Multicollinearity is often a problem with MRA, and note also that sample size changes as different variables are added/omitted.
15. We prefer the OLS results because the meta-regression WLS results can be influenced by outliers (see Hunter and Schmidt 2004).
16. The bootstrap used 1000 replications with replacement.
17. The WLS estimates for the best-set are broadly similar. Since there is no issue of statistical independence of the estimates in the best-set, there is no need to use the bootstrap to derive standard errors.
18. See however Doucouliagos and Paldam (2005b) on the results for the aid-policy interaction term.

(C3) ***Data.*** The number of countries included in a sample has a negative coefficient – the larger the sample the weaker is the aid-growth effect. This result was found also by Doucouliagos and Paldam (2005a) for the aid-conditionality literature. *Ceteris paribus*, we would expect that if an aid growth association exists, it should be robust to sample size. This confirms the results of the MST and FAT tests in table 4. The results from small samples are polished, to make them too good – and that means too positive for aid. This confirms the second hypothesis (E2) of the trend on figure 3.

The coefficient on *NoCount* captures the impact of sample size after controlling for outliers. The negative coefficient on *NoCount* indicates that authors are able to select samples to polish results (as did the FAT-test in table 4). There are often solid grounds for removing outliers from samples. However, the *Outlier* variable was not statistically significant.

The three decade variables *Y1960s* to *Y1980s* show that the aid-growth association reported was weaker in the 1970s, where many countries borrowed heavily on the commercial market, and thus were less dependent on aid. Also, the 1970s were the period of the Oil Crisis which generated rather strong economic fluctuations that were independent of aid.

The use of EDA as a measure of aid leads to lower aid-growth effects. The relation between EDA and ODA data is: $EDA = a\ ODA + \varepsilon$, where $a \approx 0.42$ and ε is small, as the correlation between the two aid series is 0.83, where both are available. If decision makers consider ε to be random, we expect the partial correlations to be exactly the same. However, this is not likely, and the result then comes to depend upon the time horizon of the decision makers. Imagine that the decision makers have a long time horizon. Then they recognize that loans have to be paid back. Hence they react much stronger to EDA data than to the ODA data. Thus the elasticities to the EDA data should be systematically larger. However, if the decision makers are myopic then they react to ODA data and do not care about the size of the gift element, which matters in the longer run only. Thus the elasticities to the ODA data should be systematically larger. We actually find that the elasticities to the ODA data are significantly higher and thus one more indication that decision makers are myopic.[19]

Regional differences in the aid-growth association are also detected. The inclusion of Asian economies in a sample increases the association, which confirms that there is a distribution of aid-growth associations – with aid having higher effects in some regions. This

19. This is the standard result in the literature on vote and popularity functions, see Nannestad and Paldam (1994). It is also the only really strong explanation for the phenomenon of debt crises, which seems to appear every 20-30 years in a surprising number of countries.

is an important factor that is a real phenomenon. The explanation for this variation is beyond the scope of this paper. [20]

(C5) ***Model formulation and controls***. Here the results differ somewhat between tables 7a and 7b. While many of the variables are significant in some columns very few are robust throughout. The most robust result for the (C4) variables is that controlling for the share of government results in larger aid-growth effects, as predicted in section 3, where we argued that it was an obvious misspecification to include the share of government, see the discussion of equation (3). We note that it biases the results upward by about 0.1.[21]

(C6) ***Estimation techniques.*** As mentioned at the end of section 3 there is no apparent difference in results according to the techniques used, once other study differences are controlled for: cross-sectional, panel and time series data basically produce the same partial correlation. Also, the choice of estimator leaves results unchanged. Using lagged values of aid results in similar results as using current levels of aid.

The MRA explains about one third of the variation in results, with a reasonable degree of correlation between the predicted partial correlations and the observed partial correlations, which is good for this sort of analysis. This means also that the bulk of the variation is unexplained suggesting once again that there may be an undetected conditionality in the literature.

5.4 Meta-probit analysis

The MRA presented in Tables 7a and 7b explains some of the heterogeneity in reported results. Doucouliagos and Paldam (2005a) estimate a meta-probit model to explore the determinants of statistical significance. In this model, the dependent variable is a binary variable assigned a value of 1 if the study found a positive and statistically significant effect and 0 otherwise. We consider the same set of potential explanatory variables as in Tables 7 and 8, and report only those variables that were statistically significant. The four journals – Cato, JID, EDCC and AE – all have negative coefficients, with marginal effects ranging from 0.12 to 0.28. Papers published in these journals are less likely to report statistically significant results. Researchers associated with Danida are more likely to report statistically significant results, while researchers associated with the World Bank are less likely to do so.

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20. Note that we do not discuss the results for (C5), the conditionality variables. They are discussed in Doucouliagos and Paldam (2005b).
21. This may explain why the Danida group gets coefficients that are 0.1 higher than the norm, as they do include the share of the government, and get the expected negative coefficient to that variable.

Table 9. Determinants of statistical significance

Variable	Coefficient	z-Statistic	Marginal Effect
Constant	-0.82	-5.25	
Cato	-3.17	-5.80	-0.28
JID	-0.85	-3.08	-0.20
EDCC	-1.47	-3.09	-0.26
AE	-0.42	-2.08	-0.12
Danida	0.69	2.91	0.25
World Bank	-1.31	-2.46	-0.26
Influence	0.59	3.35	0.21
Sub-Sample	-0.68	-4.45	-0.20
Aid Square	1.30	6.58	0.47
Aid*Institutions	-6.35	-38.10	-0.36
Capital	1.03	5.60	0.33
Inflation	-0.43	-2.01	-0.12
Size of Government	1.40	5.07	0.51
McFadden R^2	0.27		
Sample Size	542		

Note: The dependent variable is a binary variable reflecting whether the aid term of the study has a positive and statistically significant impact on economic growth.

6. Summary and suggestions for future research

The AEL (aid effectiveness literature) has accumulated a large pool of evidence, and the majority of the authors seem to agree that aid has a small positive effect on growth. The aim of this paper was to apply the methods of meta-analyses to the entire literature to see if that conclusion is justified. We used the population of 68 aid-growth studies as our data set. Our conclusions are depressing: Taking all available evidence into consideration, we have to conclude that the AEL has failed to prove that the effect of development aid on growth is statistically significantly larger than zero.

We also investigated the variation in the available results. Some of this variation was found to be a direct outcome of data and specification differences. In particular, we found that journals, friends and institutional affiliation influences reported results. However, we found also that some of the variation was real, e.g. including Asian economies in a sample increases the reported effect of aid on growth. This literature has a larger variation than expected if it is only random variation around one average. It actually suggests that there are several. This lends support to the notion of conditionality: Perhaps aid does contribute to economic growth under certain circumstances and not under other circumstances. The challenge for researchers is to find what those circumstances are.

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Appendix 1: Introduction to meta techniques, especially to the tests used

Meta-analysis uses both descriptive statistics and significance tests, which are developed for the purpose. Note especially that the significance tests have to take into account that all studies are based on a common pool of available macro data that has been thoroughly mined.

Descriptive statistics

Two methods are in general use: Counts of coefficients with different signs and significance and calculations of various averages.

A1 Vote counting

All existing reviews of the aid-growth literature have either explicitly or implicitly used vote counting. Vote counting is similar to Extreme Bounds Analysis (EBA). In EBA, researchers use the same data set and explore the impact of different control variables (see Barro and Sala-i-Martin 2004). The difference here is that rather than the same sample being used with different specifications, we use different samples as well as different specifications. This is effectively a meta-extreme bounds analysis (MEBA).

Counting the number of signs should not be given too much weight, as it does not provide a method for research synthesis. Moreover, it ignores information provided by the confidence intervals. For example, Ram's (2004) estimate of the aid-growth elasticity has a 95% confidence interval of -0.37 to +0.33, while Economides *et al.* (2004) estimate a confidence interval of +0.16 to +0.94. From Ram we conclude that there is a zero elasticity and from Economides *et al.* that there is a positive elasticity. The two intervals do, however, intersect – they both agree that it is possible that the elasticity may be +0.16 to +0.33. With meta-analysis we can combine all studies and avoid the potential problems of sign counting.

A2 Average effects

The effect between two variables (holding other effects constant) established by a literature can be derived as a weighted average of the associated estimates:

(1A) $$\varepsilon = \sum[N_i \varepsilon_i] / \sum N_i$$

where ε is the *standardized* effect (elasticity or partial correlation) from the ith study and N is the sample size.

A3 Confidence intervals

Confidence intervals in meta-analysis can be calculated in several ways. Hunter and Schmidt (2004) derive the formula for the standard error in the mean correlation for a homogenous group of studies, as well as the standard error in the mean correlation for a heterogeneous group of studies. Hedges and Oklin (1985) use a slightly different procedure. We prefer to follow Adams *et al.* (1997) and use resampling techniques to construct bootstrap confidence intervals, which are more conservative. The 95% confidence intervals of elasticities were constructed using the bootstrap of 1000 iterations (with replacement) to generate the distribution of aid and aid-growth interaction elasticities (see Efron and Tibshirani 1993). The lower and upper 2.5 % of the values of the generated distribution are used to construct the 95 % confidence intervals.

Regression based tests

The data for the two following tests are a set of n estimates of the same effect, ε, with the associated tests statistics (t_i, s_i, d_i), where t_i is the t-statistics; s_i, is the standard error; d_i is the degrees of freedom of the estimate. All n estimates use variants of the same estimation equation and sub-samples of the same data. Both tests use the population of observations and are robust to data mining.

A5 Meta-Significance Testing: The MST test (Stanley 2001; 2005)

The idea is that a connection between two variables, such as foreign aid and economic growth, should exhibit a positive relationship between the natural logarithm of the absolute value of the t-statistic and the natural logarithm (ln) of the degrees of freedom in the regression:

(3A) $$\ln |t_i| = \alpha_0 + \alpha_1 \ln df_i + u_i$$

As the sample size for the i^{th} study rises, the precision of the coefficient estimate for the i^{th} study rises also, i.e., standard errors fall and t-statistics rise. Stanley (2005) shows that the slope coefficient in equation (3A) offers information on the existence of genuine empirical effects, publication bias, or both. If $\alpha_1 < 0$, the estimates are contaminated by selection effects, because t-statistics fall as sample size rises. That is, studies with smaller samples report larger t-statistics, indicating that it is easier to mine smaller samples in order to increase the prospects of publication. If $\alpha_1 > 0$, there is a genuine association between aid policy interaction and economic growth, since t-statistics rise as sample size increases. If $0 < \alpha_1 < 0.5$, then there is a genuine association between aid policy interaction and economic growth, as well as publication bias in the literature.

A6 Funnel-Asymmetry Testing: FAT tests (Egger et al. 1997; Stanley 2005)

Smaller samples have larger standard errors. If publication 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, which can be done by modifying specifications, functional form, samples and even estimation technique.

(4A) $$e_i = \beta_0 + \beta_1 s_i + u_i$$

where e_i is the regression coefficient, and s_i is its standard error. Since the explanatory variable in equation (4A) is the standard error, heteroscedasticity is likely to be a problem. Equation (4A) (from Stanley 2005) is corrected for heteroscedasticity by dividing it by the associated standard error. This produces equation (5A):

(5A) $$t_i = \beta_1 + \beta_0 (1/s_i) + v_i$$

If publication bias is present, the constant, β_1, in equation (5A) will be statistically significant.

A7 Meta-Regression Analysis

The impact of specification, data and methodological differences can be investigated by estimating a meta-regression model (known as a MRA) of the following form:

$$\text{(6A)} \quad r_{oi} = \alpha + \beta_1 N_i + \gamma_1 X_{i1} + \ldots + \gamma_k X_{ik} + \delta_1 K_{i1} + \ldots + \delta_n K_{in} + u_i$$

where

r_{oi} is the observed partial correlation (or any other standardised effect) derived from the i^{th} study,

α is the constant,

N_i is the sample size associated with the i^{th} study,

X_{ij} are dummy variable *j* representing characteristics associated with the i^{th} study,

K_{ij} are continuous variable *j* associated with the i^{th} study, and

u_i is the disturbance term, with usual Gaussian error properties (see Stanley and Jarrell 1998).

The regression coefficients quantify the impact of specification, data and methodological differences on reported study effects (r_{oi}). Both the MST and FAT tests can be combined with the MRA. The MSTMRA tests used in table 4 have the following form:

$$\text{(7A)} \quad \ln|t_i| = \alpha_0 + \alpha_1 \ln d_i + \text{XXXX} + u_i$$

The test is the same as before: Is $\boldsymbol{\alpha_1 < 0}$

Appendix 2: The AEL, aid effectiveness literature. This paper covers studies of type (g)

Only papers in English available till 1/1 2005 are included. Papers are classified in 7 *type*s as regards the model estimated: (*s*), (*sp*) and (*i*) are accumulation models, with savings, savings with aid proxies, and investment relations respectively. (*g*) and (*gc*) are growth and conditional growth models.

No	***Type***	***Author and publication details***
1	*sp*	Ahmed, N., 1971. A note on the Haavelmo hypothesis. *Review of Economics and Statistics* 53, 413-14
2	*g*	Amavilah, V.H., 1998. German aid and trade versus Namibian GDP and labour productivity. *Applied Economics* 30, 689-95
3	*ig*	Boone, P., 1994. The impact of foreign aid on savings and growth. WP London School of Econ.
4	*i*	Boone, P., 1996. Politics and the effectiveness of foreign aid. *European Economic Review* 40, 289-329
5	*sgc*	Bowen, J.L., 1995. Foreign aid and economic growth: An empirical analysis. *Geographical Analysis* 27, 249-61. Estimates also in Bowen, J.L., 1998. *Foreign aid and economic growth: A theoretical and empirical investigation*. Ashgate, Aldershot, UK
6	*s*	Bowles, P., 1987. Foreign aid and domestic savings in less developed countries: Some tests for causality. *World Development* 15, 789-96
7	*gc*	Brumm, H.J., 2003. Aid, policies and growth: Bauer was right. *Cato Journal* 23, 167-74
8	*gc*	Burnside, C., Dollar, D., 2000. Aid, policies and growth. *American Economic Review* 90, 847-68 (Working paper available fro World bank since 1996)
9	*gc*	Burnside, C., Dollar, D., 2004. Aid, policies and growth: Reply. *American Economic Review* 94, 781-84 (reply to Easterly, Levine and Roodman, 2004)
10	*sg*	Campbell, R., 1999. Foreign aid, domestic savings and economic growth: Some evidence from the ECCB area. *Savings and Development* 23, 255-78
11	*gc*	Chauvet, L., Guillaumont, P., 2004. Aid and growth revisited: Policy, economic vulnerability and political instability. Pp 95-109 in Tungodden, B., Stern, N., Kolstad, I., eds, 2004. *Toward Pro-Poor Policies - Aid, Institutions and Globalization*. World Bank/Oxford UP
12	*gc*	Collier, P., Dehn, J., 2001. Aid, shocks, and growth. WP 2688 World Bank Policy Research
13	*gc*	Collier, P., Dollar, D., 2002. Aid allocation and poverty reduction. *European Economic Review* 46, 1475-1500
16	*i*	Collier, P., Dollar, D., 2004. Development effectiveness: What have we learnt? *Economic Journal* 114, 244-71
15	*gc*	Collier, P., Hoeffler, A., 2004. Aid, policy and growth in post-conflict societies. *European Economic Review* 48, 1125-45
16	*gc*	Dalgaard, C.-J., Hansen, H., 2001. On aid, growth and good policies. *Journal of Development Studies* 37, 17-41
17	*gc*	Dalgaard, C.-J., Hansen, H., Tarp, F., 2004. On the empirics of foreign aid and growth. *Economic Journal* 114, 191-216
18	*gc*	Dayton-Johnson, J., Hoddinott, J., 2003. Aid, policies and growth, redux. WP Dalhousie Univ.

19 *gc* Denkabe, P., 2004. Policy, aid and growth: A threshold hypothesis. *Journal of African Finance and Economic Development* 6, 1-21 (WP version used)

20 *i* Dollar, D., Easterly, W., 1999. The search for the key: Aid, investment and policies in Africa. *Journal of African Economies* 8, 546-77

21 *g* Dowling, J.M., Hiemenz, U., 1983. Aid, savings, and growth in the Asian region. *The Developing Economies* 21, 4-13

22 *gc* Durbarry, R., Gemmell, N., Greenaway, D., 1998. New evidence on the impact of foreign aid on economic growth. Credit WP Univ. of Nottingham

23 *g* Easterly, W., 2003. Can foreign aid buy growth? *Journal of Economic Perspectives* 17, 23-48

24 *gc* Easterly, W., Levine, R., Roodman, D., 2004. Aid, policies, and growth: Comment. *American Economic Review* 94, 774-80 (Comment to Burnside and Dollar, 2001)

25 *g* Economides, G., Kalyvitis, S., Philippopoulos, A., 2004. Does foreign aid distort incentives and hurt growth? Theory and evidence from 75 aid-recipient countries. WP Athens Univ. of Econ. and Business

26 *g* Fayissa, B., El-Kaissy, M., 1999. Foreign aid and the economic growth of developing countries (LDCs): Further evidence. *Studies in Comparative International Development* Fall, 37-50

27 *i* Feyzioglu, T., Swaroop, V., Zhu, M., 1998. A panel data analysis of the fungibility of foreign aid. *World Bank Economic Review* 12, 29-58

28 *i* Franco-Rodriguez, S., 2000. Recent developments in fiscal response with an application to Costa Rica. *Journal of International Development* 12, 429-41

29 *i* Franco-Rodriguez, S., Morrissey, O., McGillivray, M., 1998. Aid and the public sector in Pakistan: Evidence with endogenous aid. *World Development* 26, 1241-50

30 *sp* Fry, M.J., 1978. Money and capital or financial deepening in economic development? *Journal of Money, Credit, and Banking* 10, 464-75

31 *i* Gang, I.N., Khan, H.A., 1991. Foreign aid, taxes and public investment. *Journal of Development Economics* 34, 355-69

32 *g* Giles, J.A., 1994. Another look at the evidence on foreign aid led economic growth. *Applied Economics Letters* 1, 194-99

33 *sp* Giovannini, A., 1983. The interest elasticity of savings in developing countries: The existing evidence. *World Development* 11, 601-07

34 *igc* Gomanee, K., Girma, S., Morrissey, O., 2002. Aid and growth: Accounting for the transmission mechanisms in Sub-Sahara Africa. Credit WP Univ. of Nottingham

35 *g* Gounder, R., 2001. Aid-growth nexus: Empirical evidence from Fiji. *Applied Economics* 33, 1009-19

36 *sp* Griffin, K.B., 1970. Foreign capital, domestic savings and economic development. *Bulletin of the Oxford University Institute of Economics and Statistics* 32, 99-112

37 *spg* Griffin, K.B., Enos, J.L., 1970. Foreign assistance: Objectives and consequences. *Economic Development and Cultural Change* 18, 313-27

38 *gc* Guillaumont, P., Chauvet, L., 2001. Aid and performance: A reassessment. *Journal of Development Studies* 37, 66-92

39 *g* Gulati U.C., 1976. Foreign aid, savings and growth: Some further evidence. *Indian Economic Journal*

24, 152-60
40 *g* Gulati U.C., 1978. Effects of capital imports on savings and growth in less developed countries. *Economic Inquiry* 16, 563-69
41 *sp* Gupta, K.L., 1970. Foreign capital and domestic savings: A test of Haavelmo's hypothesis with cross-country data: A comment. *Review of Economics and Statistics* 52, 214-16
42 *sg* Gupta, K.L., 1975. Foreign capital inflows, dependency burden, and saving rates in developing countries: A simultaneous equation model. *Kyklos* 28, 358-74
43 *sg* Gupta, K.L., Islam, M.A., 1983. *Foreign Capital, Savings and Growth – an International Cross-Section Study*. Dordrecht, Reidel Publishing Company
44 *sig* Gyimah-Brempong, K., 1992. Aid and economic growth in LDCs: Evidence from Sub-Saharan Africa. *Review of Black Political Economy* 20, 31-52
45 *sigc* Hadjimichael, M.T., Ghura, D., Mühleisen, M., Nord, R., Ucer, E.M., 1995. Sub-Saharan Africa: Growth, savings, and investment, 1986-93. IMF Occasional Paper, No. 118
46 *i* Halevi, N., 1976. The effects on investment and consumption of import surpluses of developing countries. *Economic Journal* 86, 853-58
47 *gc* Hansen, H., Tarp, F., 2000. Aid effectiveness disputed. *Journal of International Development* 12, 375-398. Also pp 103-128 in Tarp, F., Hjertholm, P., eds. 2000. *Foreign aid and development. Lessons learnt and directions for the future*. Routledge Studies in Development Economics: London
48 *igc* Hansen, H., Tarp, F., 2001. Aid and growth regressions. *Journal of Development Economics* 64, 547-70
49 *i* Heller, P.S., 1975. A model of public fiscal behavior in developing countries: Aid, investment, and taxation. *American Economic Review* 65, 429-45
50 *sgc* Hudson, J., Mosley, P., 2001. Aid policies and growth: In search of the Holy Grail. *Journal of International Development* 13, 1023-38
51 *g* Islam, M.A., 1992. Foreign aid and economic growth: An econometric study of Bangladesh. *Applied Economics* 24, 541-44
52 *gc* Jensen, P.S., Paldam, M., 2004. Can the two new aid-growth models be replicated? *Public Choice* forthcoming
53 *g* Kellman, M., 1971. Foreign assistance: Objectives and consequences: Comments (to Griffin and Enos, 1970). *Economic Development and Cultural Change* 20, 142-54
54 *i* Khan, H.A., Hoshino, E., 1992. Impact of foreign aid on the fiscal behaviour of LDC governments. *World Development* 20, 1481-88
55 *i* Khilji, N.M., Zampelli, E.M., 1994. The fungibility of U.S. military and non-military assistance and the impacts on expenditures of major aid recipients. *Journal of Development Economics* 43, 345-62
56 *gc* Kosack, S., 2003. Effective aid: How democracy allows development aid to improve the quality of life. *World development* 31, 1-22
57 *g* Landau, D., 1986. Government and Economic Growth in the less Developed Countries: An empirical study for 1960-1980. *Economic Development and Cultural Change* 35, 35-75

58 *g* Landau, D., 1990. Public choice and economic aid. *Economic Development and Cultural Change* 38, 559-75

59 *sig* Larson, J.-D., 2001. An updated analysis of Weisskopf's savings-dependency theory. *Review of Development Economics* 5, 157-67

60 *sg* Lensink, R., 1993. Recipient government behavior and the effectiveness of development aid. *De Economist* 141, 543-62.

61 *ig* Lensink, R., Morrissey, O., 2000. Aid instability as a measure of uncertainty and the positive impact of aid on growth. *Journal of Development Studies* 36, 30-48

62 *gc* Lensink, R., White, H., 2001. Are there negative returns to aid? *Journal of Development Studies* 37, 42-65

63 *i* Levy, V., 1987. Does concessionary aid lead to higher investment rates in low-income countries? *Review of Economics and Statistics* 69, 152-56

64 *ig* Levy, V., 1988. Aid and growth in Sub-Saharan Africa: The recent experience. *European Economic Review* 32, 1777-95

65 *gc* Lu, S., Ram, R., 2001. Foreign Aid, government policies, and economic growth: Further evidence from cross-country panel data for 1970-1993. *Economia Internazionale/International Economics* 54, 15-29

66 *ig* Mahdavi, S., 1990. The effects of foreign resource inflows on composition of aggregate expenditure in developing countries: A seemingly unrelated model. *Kyklos* 43, 111-37

67 *i* Mavrotas, G., 2002. Foreign aid and fiscal response: Does aid disaggregation matter? *Weltwirtschaft-liches Archiv* 138, 534-59

68 *g* Mbaku, J.M., 1993. Foreign aid and economic growth in Cameroon. *Applied Economics* 25, 1309-14

69 *i* McGillivray, M., 2000. Aid and public sector behavior in developing countries. *Review of Development Economics* 4, 156-63

70 *i* McGowan, P.J., Smith, D.L., 1978. Economic dependency in black Africa: An analysis of competing theories. *International Organization* 32, 179-235

71 *i* McGuire, M.C., 1987. Foreign assistance, investments, and defense: A methodological study with an application to Israel, 1960-1979. *Economic Development and Cultural Change* 35, 847-73

72 *gc* Moreira, S.B., 2003. Evaluating the impact of foreign aid on economic growth: A cross-country study (1970-1998). WP for 15th Annual Meeting on Socio-Economics, Aix-en-Provence, France

73 *g* Mosley, P., 1980. Aid, savings and growth revisited. *Bulletin of the Oxford University Institute of Economics and Statistics* 42, 79-95

74 *ig* Mosley, P., Hudson, J., Horrell, S., 1987. Aid, the public sector and the market in less developed countries. *Economic Journal* 97, 616-41

75 *g* Mosley, P., Hudson, J., Horrell, S., 1992. Aid, the public sector and the market in less developed countries: A return to the scene of the crime. *Journal of International Development* 4, 139-50

76 *g* Most, S.J., Berg, H.v.d., 1996. Growth in Africa: Does the source of investment financing matter? *Applied Economics* 28, 1427-33

77 *g* Murthy, V.N.R., Ukpolo, V., Mbaku, J.M., 1994. Foreign aid and economic growth in Cameroon: Evidence from cointegration tests. *Applied Economics Letters* 1, 161-63

78 *i* Otim, S., 1996. Foreign aid and government fiscal behaviour in low-income South Asian countries. *Applied Economics* 28, 927-33

79 *s* Ouattara, B., 2004. The impact of project aid and programme aid inflows on domestic savings: A case study of Côte d'Ivoire. WP Univ. of Manchester

80 *gc* Ovaska, T., 2003. The failure of development aid. *Cato Journal* 23, 175-88

81 *sp* Over, A.M., 1975. An example of the simultaneous-equation problem: A note on "foreign assistance: Objectives and consequences". *Economic Development and Cultural Change* 23, 751-56

82 *sg* Papanek, G.F., 1973. Aid, foreign private investment, savings, and growth in less developed countries. *Journal of Political Economy* 81, 120-30

83 *i* Quazi, R.M., 2004. Foreign aid and capital flight. A case study of Bangladesh. *Journal of the Asia Pacific Economy* 9, 370-93

84 *sp* Rahman, A., 1968. Foreign capital and domestic savings: A test of Haavelmo's hypothesis with cross-country data. *Review of Economics and Statistics* 50, 137-38

85 *g* Ram, R., 2003. Roles of bilateral and multilateral aid in economic growth of developing countries. *Kyklos* 56, 95-110

86 *gc* Ram, R., 2004. Recipient country's "policies" and the effect of foreign aid on economic growth in developing countries: Additional evidence. *Journal of International Development* 16, 201-11

87 *sg* Rana, P.B., Dowling, J.M., 1988. The impact of foreign capital on growth: Evidences from Asian developing countries. *The Developing Economies* 26, 3-11

88 *sg* Reichel, R., 1995. Development aid, savings and growth in the 1980s: A cross-section analysis. *Savings and Development* 19, 279-96.

89 *gc* Roodman, D., 2004. The anarchy of numbers: Aid, development and cross-country empirics. WP 32 Center for Global Development

90 *gc* Shukralla, E.K., 2004. Aid, incentives, polices, and growth: Theory and a new look at the empirics. WP Western Michigan Univ.

91 *sg* Singh, R.D., 1985. State intervention, foreign economic aid, savings and growth in LDCs: Some recent evidence. *Kyklos* 38, 216-32

92 *s* Snyder, D.W., 1990. Foreign aid and domestic savings: A spurious correlation? *Economic Development and Cultural Change* 39, 175-81

93 *g* Snyder, D.W., 1993. Donor bias towards small countries: An overlooked factor in the analysis of foreign aid and economic growth. *Applied Economics* 25, 481-88

94 *i* Snyder, D.W., 1996. Foreign aid and private investment in developing economies. *Journal of International Development* 8, 735-45

95 *g* Stoneman, C., 1975. Foreign capital and economic growth. *World Development* 3, 11-26

96 *gc* Svensson, J., 1999. Aid, growth and democracy. *Economics and Politics* 11, 275-97

97 *gc* Tebouel, R., Moustier, E., 2001. Foreign aid and economic growth: The case of the countries south of the Mediterranean. *Applied Economics Letters* 8, 187-90

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2005-5: Niels Haldrup, Peter Møllgaard and Claus Kastberg Nielsen: Sequential versus simultaneous market delineation: The relevant antitrust market for salmon

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