RIETI Discussion Paper Series 07-E-044

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RIETI Discussion Paper Series 07-E-044

Aid Proliferation and Economic Growth: A Cross-Country Analysis *

by

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June 2007

Abstract

In this paper, we examine whether aid proliferation hinders aid effectiveness in promoting economic growth. We employ a wide variety of specifications of the standard aid-growth regression using Roodman's (2007a) dataset. Specifically, we include a donor-concentration index as a proxy for donor proliferation and the interaction term between aid and a donor-concentration index as additional independent variables. Our best empirical results are in favor of a hypothesis that aid proliferation involves a negative effect on economic growth of the recipient countries with proper correction for possible biases arising from omitted variable and endogeneity problems.

Keywords: Aid; Aid Proliferation; Economic Growth

JEL codes: F35, O19, O40

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* This research is an output of the project "Economics of Foreign Aid" undertaken at the Research Institute of Economy, Trade and Industry (RIETI). The authors would like to thank RIETI for its generous support for the project and Ryuhei Wakasugi and other participants in RIETI workshops for helpful discussions. The authors are also grateful to the members of the project for helpful comments and suggestions and Yuko Anzai for excellent research assistance. The opinions expressed in this paper are the sole responsibility of the authors and do not necessarily reflect those of RIETI or the Ministry of Economy, Trade and Industry of Japan.

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1. Introduction

James D. Wolfensohn, the former president of the World Bank, stated that Tanzania files 2,400 reports to aid donors and hosts 1,000 aid missions from donor countries each year (Roodman 2006b).[1] Under such circumstances, the efficiency of official capital inflow can be undermined significantly. This is a situation of aid proliferation or aid bombardment where large numbers of donors and projects overwhelm the recipient government's capacity to manage and administer aid inflows. The immediate consequence of aid proliferation is an increase in the transaction costs for absorbing foreign aid that are incurred by recipient governments (Acharya et al. 2006). More than twenty years ago, Morss (1984) said that "[t]he most important feature distinguishing foreign aid in the 1970s from earlier programmes was the proliferation of donors and projects." Cassen et al. (1994) also pointed out that "aid projects are planted here and there in an almost haphazard way and in excessive numbers, with a variety of untoward consequences." (p.175) It seems that the issue has been worsening over the past decades: on average, the number of donors acting in aid recipient countries has continued to increase during the last thirty years (Figure 1).

Recently, studies have emerged which address the issue of aid proliferation such as Acharya et al. (2006), Knack and Rahman (2007), and Roodman (2006a, 2006b). Acharya et al. (2006) found that countries with the most extreme fragmentation of aid inflows are very likely to be aided by the worst proliferators among the donors. Given this environment, Knack and Rahman (2007) analyze the impact of donor fragmentation on the quality of government bureaucracy in aid recipient countries. Roodman (2006a)

[1] According to Roodman (2006b), these numbers are based on a misreading of van de Walle and Johnston (1996) and the reality was even worse.

theoretically argues the proliferation of aid projects and the associated administrative burden for recipients. There is, however, no study which investigates the effect of aid proliferation on the economic performance of a recipient country as far as we know. This paper aims to bridge this gap by augmenting a standard cross-country growth regression approach for the aid effectiveness by including an aid proliferation index as an independent variable.

Our research strategy is related to the copious existing studies on the aid and growth nexus spanning more than thirty years (Rajan and Subramanian 2005; Clemens 2005; Easterly, Levine and Roodman 2004; Roodman 2007a; Burnside and Dollar 2000). While the most influential work by Burnside and Dollar (2000) shows that foreign aid improves the income growth of the recipient country when the country is in a healthy policy environment, subsequent studies such as Hansen and Tarp (2001), Easterly, Levine and Roodman (2004), and Rajan and Subramanian (2005) find that the results of Burnside and Dollar (2000) are not robust to alternative specifications, extended data, or estimation methods.[2] An emerging consensus seems to be that, at best, there appears to be a small positive, but insignificant, impact of aid on growth (Bourguignon and Sundberg 2007). Yet, a common feature of these studies is their treatment of aid as being homogeneous regardless of its modality. Clemens (2005), which examines the effect of short term aid, is one of the few papers taking into account the heterogeneity of aid quality. Our study tries to mitigate a potential bias arising from this homogeneity assumption of foreign aid.

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[2] Since the GMM estimations of Rajan and Subramanian (2005) may have a problem of too many instruments because of unrestricted number of lags.

Our best empirical results are in favor of a hypothesis that aid proliferation involves a negative effect on economic growth of the recipient countries, using Roodman's (2004) data with proper correction for possible endogeneity bias. The effect of aid on economic growth taking into account the extent of aid concentration shows an inverted U-curve, indicating that there is an optimal level of aid proliferation. The results also indicate that the larger the magnitude of aid flows, the greater the impact on economic growth in countries with less proliferation but with diminishing returns.

The rest of the paper is organized as follows. Section 2 postulates a simple model which gives testable theoretical implications and then specifies the econometric model. In Section 3, we describe the data and variables including the aid proliferation index, which is followed by the estimation results and robustness checks. Finally, we state concluding remarks in Section 4 with some policy implications.

2. A Simple Model of Aid Proliferation

There are several possible modeling strategies in which aid proliferation undermines economic performance. First, aid proliferation induces competition for local experts or available local matching funds for aid and thus decreases the average bureaucratic quality and the effectiveness of aid projects, respectively, in aid recipient countries (Knack and Rahman 2007; Arimoto and Kono 2007). Largely speaking, aid proliferation increases transaction costs so that the effectiveness of aid is reduced significantly (Acharya et al. 2006). Another possibility we focus on in this paper is the free-rider problem arising from the fact that aid outcomes in recipient countries are a kind of joint production by a wide variety of resources provided by both donor and recipient countries.

Consider the team production model of Holmstrom (1982) to determine the degree of efforts of donor countries in a recipient country. There are N donors (agents) that jointly produce a single output, g, which is, for example, the growth effect of aid or "aid effectiveness" in the recipient country, i.e., the partial derivative of growth with respect to aid inflow. The effort level of the i-th donor is denoted by e_i. Therefore, the production technology of this group becomes:

$$g = g\,(e_1, e_2, e_3, \ldots.., e_N; X), \tag{1}$$

where X is a matrix of variable which is specific to the recipient country. Let us assume that a donor (agent) i's utility function is:

$$u_i = s_i - v_i(e_i), \tag{2}$$

where s_i is the output share of donor i and $v_i(e_i)$ indicates the convex disutility function of donor i's effort.

The efficiency regime of this economy can be solved as the following problem:

$$\underset{\{e_i\}}{Max}\; g(e_1, e_2, \cdots, e_N; X) - \sum_{i=1}^{N} v_i(e_i)\,. \tag{3}$$

The first-order condition of this problem is:

$$\frac{\partial g}{\partial e_i} = \frac{\partial v_i}{\partial e_i}\,. \tag{4}$$

Note that the Pareto optimal level of effort, e_i*, satisfies this FOC. On the other hand, a Nash equilibrium is derived by solving an individual donor's utility maximization:

$$\underset{\{e_i\}}{Max}\, s_i(g) - v_i(e_i)\,. \tag{5}$$

The first-order condition is:

$$\frac{\partial s_i}{\partial g}\frac{\partial g}{\partial e_i} = \frac{\partial v_i}{\partial e_i}\,, \tag{6}$$

where $\frac{\partial s_i}{\partial g}$ is a private benefit from enhancing economic growth and $\frac{\partial g}{\partial e_i}$ is the marginal contribution of aid effort to aggregate economic growth. Equation (6) gives an individually optimal effort level, $\hat{e}_i$. The main question is whether there is a way of fully allocating the joint output *g* so that the resulting non-cooperative game among the agents has a Pareto optimal Nash equilibrium. This requires finding allocation rule s_i which satisfies the Pareto optimality condition (4) and Nash equilibrium condition (6) at the same time. Mathematically, we need to show the feasibility of

$$\frac{\partial s_i}{\partial g} = 1, \forall\, i\,. \tag{7}$$

This feasibility depends on the characteristics of the output, *g*. If, for example, we assume that the individual donor's benefit from aid effectiveness is private goods, Equation (7) is infeasible, because by differentiating the balanced budget condition, i.e., $\sum_{1}^{N} s_i = g$, we have:

$$\sum_{i=1}^{N}\frac{\partial s_i}{\partial g} = 1\,. \tag{8}$$

We can easily see that the requirement of Pareto optimal Nash equilibrium (7) and the balanced budget condition (8) contradict each other if N>1. At the Nash equilibrium, an agent's effort level, $\hat{e}_i$, is smaller than that of social optimal, e_i*. This is a formal representation of moral hazard in team production. This result indicates that in closed (balanced-budget) organizations, free-rider problems are likely to lead to an insufficient supply of productive inputs.

On the other hand, if there is only one donor, i.e., N=1, equation (7) and (8) hold simultaneously. Moreover, as N increases, the gap between the Pareto optimal effort level and individually optimal effort level becomes wider. This result illustrates the inefficiency of aid proliferation.

Also, when donors are fully altruistic and the aid effectiveness becomes a pure public good, the individual solution becomes socially optimal. In other words, the free-rider problem arises when there are multiple donors who are motivated by self-interest.

3. Data, Variables, and Baseline Estimation

3.1 An Index of Aid Proliferation

Our hypothesis to be tested is that aid proliferation hinders aid effectiveness and economic growth. Before we proceed into detailed explanation, we need to clarify the definition of aid proliferation. In the literature, there is no standard definition of aid proliferation. In order to quantify the degree of aid proliferation, we follow Knack and Rahman (2007) to construct a Herfindahl Index of donor concentration by summing the squared shares of aid over all donor agencies. Suppose that the total amount of aid provided to a recipient country in a certain year is represented by Q. The amount of aid from a donor i to this recipient is represented by q_i. Then

$$HI = \sum_{i=1}^{N} s_i^2, \qquad (9)$$

where the donor i's aid share is defined as $s_i \equiv q_i / Q$. Let us denote the mean and variance of donor shares by μ and σ^2, respectively. Then, we have:

$$\mu \equiv \frac{\sum s_i}{N} = \frac{1}{N},$$

$$\sigma^2 \equiv \frac{\sum (s_i - \mu)^2}{N} = \frac{\sum s_i^{\,2} - N\mu^2}{N} = \frac{HI}{N} - \frac{1}{N^2}.$$

Therefore, the Herfindahl Index of donor concentration can be expressed by the following equation:

$$HI = N\sigma^2 + \frac{1}{N}. \qquad (10)$$

If all donors have identical shares, then the variance becomes zero and HI equals $1/N$. Alternatively, if the number of donors is held constant, a higher variance will result in a higher index value. Hence, this index decreases when the aid proliferation becomes serious.

We assume that an index of aid proliferation should be considered in the "gross aid" context because absolute gross amount of aid inflows affects efficient use of aid. Even small amounts of grants or concessional loans with a low grant element impose a burden on the absorptive capacity of recipient governments and may hinder government effectiveness. Similarly, net aid variables do not precisely depict the situation of aid proliferation. Therefore, based on the OECD's *Creditor Reporting System* (CRS) database, we compute the donor Herfindahl concentration index based on equation (9) as a proxy of aid proliferation in recipient countries.

CRS provides detailed information on each activity funded by foreign aid of OECD/DAC member countries.[3] We use the committed amount of bilateral and multilateral foreign aid by donor and year to calculate the index for each recipient.[4] The computed Herfindahl index ranges from 0 to 1 in which high values indicate greater donor concentration. As can be seen from Figure 2, the Herfindahl Index overall trend calculated by recipient country and denoted by regional average has been decreasing since 1973 and the Index for East Asian countries is found to be statistically higher than that of Sub-Saharan African countries.

Since aid proliferation is one of the center topics in the recent aid discussion, we depict the situation from two viewpoints; one from regional differences and the other from donor differences. Our data is mostly based on ODA data in the CRS. Figure 1, as mentioned in the Introduction, shows the upward trend in the average number of bilateral DAC donors per aid recipient country during the period 1973-2002. In reality, since not only bilateral DAC donors but also multilateral donors, non-DAC bilateral donors such as China and OPEC countries,[5] and numerous NGOs exist, actual aid proliferation is likely to be even worse. With the increase of donors, the number of projects naturally increases as well. Figure 3 shows the upward trend in the average number of bilateral

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[3] CRS contains detailed information on individual aid activities of most of the 23 members of the OECD's Development Assistance Committee (DAC) as well as those of multilateral development banks and UN agencies. The whole dataset is available at http://www.oecd.org/dataoecd/20/29/31753872.htm.

[4] We exclude aid activities coded as 900 in the CRS since this class of aid includes "administrative costs of donors" and "spending in the donor country for heightened awareness/interest in development co-operation" that are clearly not related to the aid proliferation of recipient countries. Unlike Roodman (2006a), we include aid activities for which the grant element is less than 25% since these aid activities bring similar administrative burden as aid activities with larger grant element.

[5] OPEC stands for Organization of the Petroleum Exporting Countries.

DAC donors' project per aid recipient country during the period of 1973-2002. The average size of the project as shown in Figure 4, which is calculated by the total aid and the number of projects, is consistently higher for the East Asia region compared to that of the Sub-Saharan Africa region. This is especially true after the mid 1980's when they both are on a downward trend due to heightened aid proliferation. Figures 5 and 6 show the aid share of major bilateral donors in East Asia and Sub-Saharan Africa. In East Asia, Japan seems to be the dominant donor all the time while the aid in Sub-Saharan Africa mostly equally shared by numerous donors. Figures 7A through 7D show the empirical cumulative distribution function of the Herfindahl Index of East Asia and Sub-Saharan Africa by decades. We then use the two-sample Kolmogorov-Smirnov test to determine if there are any differences in the distribution of Herfindahl Index for these two groups. The test results reveal that in the 1970's there was no difference in the Herfindahl Index between East Asia and Sub- Saharan Africa while there emerge significant differences afterwards suggesting that aid proliferation in Sub-Saharan Africa is more serious.

Figure 8 is the Herfindahl Index grasped from the donor differences and calculated by the number of recipients and the share of aid to each recipient country. They seem to be slightly on a downward trend. The hike of US aid in 1991 is due to the large provision of aid to Egypt after the Gulf War and the spike of German aid in 1992 is due to the large provision of aid to Poland after the collapse of Berlin Wall.[6] Figures 9A through 9E show the number of countries and the total amount of aid which each of the major five donors provides. All the donors have significantly increased the number of countries in which they provide aid.

[6] The US provided 51% of bilateral aid to Egypt in 1991 and Germany provided 52% of bilateral aid to Poland in 1992.

3.2 Empirical Strategy

Using the above-defined donor-concentration index, we employ the data set of Roodman (2007a) which is considered to be the most comprehensive dataset to investigate the aid and growth nexus using cross-country regression. Roodman (2007a) extends the data compiled by Burnside and Dollar (2000) and Easterly, Levine and Roodman (2004).[7] The resultant sample is composed of 440 observations across 67 countries for the period 1970-2001 (Appendix Table 1). Roodman (2007a) finds that the aid-policy nexus proves weakest, while the aid-tropics link is most robust among a wide variety of hypotheses tested by Burnside and Dollar (2000), Collier and Dehn (2001), Collier and Dollar (2002), Collier and Hoeffler (2002), Hansen and Tarp (2000), Hansen and Tarp (2001), Dalgaard, Hansen, and Tarp (2004), and Guaillaumont and Chauvet (2002). Roodman (2007a) also includes the variables of the proportion of tropical area (Tropicar) and the interaction term between aid and the tropic variable (Aid*Tropic) which were not included in the dataset of Burnside and Dollar (2000) and Easterly, Levine and Roodman (2004). The interaction term between aid and the fraction of tropical area (Aid*Tropicar) are found to be consistently negative and statistically significant in Roodman (2007a) indicating that, on average, aid works well outside the tropics but not in them. Taking the same empirical strategies, we add the HI-related variables to the Roodman's (2007) dataset and employ semi-parametric, OLS, and system GMM estimation methods.

Specifically, we postulate the following equation for the system GMM estimation:

$$Growth_{it} = (\alpha_1 + \alpha_2 HI_{it} + \alpha_3 HI_{it}^2) \times Aid_{it} + En_{it}\beta_{En} + Ex_{it}\beta_{Ex} + \alpha_i + \alpha_t + \varepsilon_{it} \quad (11)$$

[7] The published EDA data (Chang et al. 1998), which was used in Burnside and Dollar (2000), cover only 1975-'95. Roodman (2007a) extrapolate EDA to the rest of 1970-2001 via a regression of EDA on net ODA, which is available for the whole period.

where subscripts i and t denote the recipient country of foreign aid and the time period, respectively. The dependent variable, *Growth*, is per capita GDP growth rate as is employed by Roodman (2007a). On the right hand side, there are independent variables related to aid, *Aid*, and the Herfindahl Index, *HI*. The equation also includes other aid related variables such as aid*policy and aid*tropics. En_{it} denotes a matrix of other predetermined and endogenous variables such as initial GDP per capita, institutional quality, and so on and Ex_{it} represents a set of other exogenous variables such as regional dummy variables and ethnic fractionalization. Finally, α_i, α_t, and ε_{it} are country-specific fixed effects, year-specific effects, and a well-behaved error term, respectively.

Many existing studies estimating income-growth regression on foreign aid argue possible endogeneity biases that aid is provided to poorer countries, or to countries after poor performance and in fact find that OLS estimators are very different from estimators correcting for endogeneity (Rajan and Subramanian 2005; Roodman 2007a; Hansen and Tarp 2001; Burnside and Dollar 2000; Boone 1996). Therefore, in order to correct for biases arising from possible correlation between the error terms and explanatory variables as well as omitted variables, we employ the system generalized method of moments (GMM) estimation developed by Blundell and Bond (1998).[8] The system GMM estimation corrects for omitted variable bias by eliminating fixed effects through first-differencing and for endogeneity bias using lagged endogenous regressors as effective instruments.[9] We test whether instruments are orthogonal to the error term

[8] Note that using a fixed-effects model does not correct for endogeneity even if we use lagged variables as regressors. System GMM models are estimated by using a Stata command of xtabond2 developed by David Roodman.

[9] In the difference equations, predetermined and endogenous variables are instrumented with suitable lags of their own levels while in the levels equations they are instrumented with lags of their first differences. Predetermined variables are correlated with past errors and endogenous

using the Hansen *J* statistic and whether the error term is auto-correlated using the Arellano-Bond statistic.[10]

3.3 Variables

In the system GMM estimations applied to Roodman (2007a) data, we assume that regional dummy variables, year dummy variables, measure of tropical land (Tropic), and measure of ethnic fractionalization (Ethnic) are exogenous and the values of these variables do not change over time. Also, we assume that the logarithm of initial gross domestic product per capita (Log of initial GDP per capita), the rate of political assassinations (Assassinations), the interaction term between ethnic fractionalization and political assassinations (Ethnic*Assassinations), and a measure of financial depth (M2/GDP lagged) are considered to be predetermined. All other regressors such as HI, HI^2, the interaction terms between aid and HI (Aid*HI, Aid* HI^2, and Aid^2*HI), and other interaction terms of HI are considered to be endogenous.

One caveat of our empirical strategy is the exogeneity assumption of institutional quality (Institutional Quality). The index of institutional quality is based on the *International Country Risk Guide (ICRG) of PRS group* which is available since 1982. Burnside and Dollar (2000) use the fixed value of ICRG index assuming that institutional factors change slowly over time and Easterly, Levine and Roodman (2004) follow the same method though they found broader coverage from the original ICRG. Since ICRG varies over time, however, Roodman (2007a) assigns 1982 values to observations before 1982 and uses varying values to reflect the real changes for the observations after 1982. We

variables are correlated with past and present errors. See Blundell and Bond (1998).

[10] System GMM reports a test of over-identifying restrictions (Hansen J statistic) which tests whether the instruments, as a group, appear exogenous and is robust to heteroscedasticity and a test of autocorrelations.

basically consider that institutional quality is endogenous in the growth regression, but it is not possible to take differences in the system GMM estimation if their values do not change over time.[11] We therefore implemented both estimations; one included ICRG as an endogenous regressor and the other included ICRG as an exogenous regressor specifying that this would be used only in the estimations of level equation along with other exogenous variables such as regional dummies and ethnic fractionalization. Since the results do not differ much, our results are based on the endogenous institutional quality.

We limit the number of lags to one period in order to avoid a problem of excessive instruments in the system GMM estimations. According to Roodman (2007b), the rule of thumb is that the number of instruments should not exceed the number of countries in the regression. As the instruments become numerous relative to the sample size, they can overfit the instrumented variables, biasing the results toward those of OLS. It should be noted that the p value of the Hansen J statistic turns close to 1 when there are too many instruments.[12] We employ the one-step robust estimator of the system GMM.

3.4 Estimation Results

We start by semi-parametric estimation of the partial linear regression model by adding the interaction term of aid and HI (Aid*HI) as a non-parametric variable.[13] We include country and period dummy variables. The results are shown as Table 1 and Figure 10. The non-parametric regression line is drawn as slightly mountain-shaped, suggesting that there may be an optimal point of HI. The significance test of the variable (Aid*HI) that

[11] In this sense, ICRG in Roodman (2007a) is mixed with fixed values and changing values.
[12] See Roodman (2007b) for details about the system GMM
[13] The semi-parametric estimation of the partial linear regression is estimated by using a Stata command of plreg developed by Lokshin (2006).

enters the specification non-linearly indicates that the coefficient of Aid*HI is statistically significant (p-value of 0.02) in this specification.

Next, we investigate whether foreign aid interacted with the extent of aid proliferation promotes economic growth using OLS and GMM estimation methods by adding the interaction term of aid and HI and the interaction terms of HI with other control variables such as Policy, Institutional Quality, and regional dummies to see the combined effect of aid proliferation on growth. The estimation results by OLS are presented in columns 1-3 of Table 2. Coefficients of the following variables are found to be statistically significant at a 1% or 5% level and robust against specification change in the OLS; tropicar (negative), ssa (negative), easia (positive), icrge (positive), ram21 (negative), policy (positive), aid (positive), and Aid*Tropicar (negative) while the coefficients of the interaction terms of aid and HI turn out to all be insignificant.

The GMM results change the whole picture as shown in columns 4-11 of Table 2. The p values of the Hansen J statistic and the Arellano-Bond statistic shown in the last two rows indicate that the instruments are orthogonal to the error term and that the error term is not auto-correlated in the system GMM estimation.[14] Since this is the case for most of the system GMM estimations, our discussions will rely on the GMM results, rather than the OLS results. Columns 4-11 of Table 2 indicate that the interaction term between aid and HI (Aid*HI) has a positive and significant coefficient except column 8 suggesting that the aid provided in a more concentrated condition (meaning "in a less proliferated condition") positively impacts growth. Column 5 is our benchmark result and shows the interaction term between aid and squared HI (Aid*HI^2) has negative and significant

[14] We use a significance threshold of 0.05.

coefficient implying that the growth effect of aid using the HI function can be illustrated as an inverted U-shape which has an optimal point.

Using the estimated coefficients, we can compute the growth facilitation effect of aid working through HI. The effect can be computed by a formula: （the coefficient of Aid） × Aid + （the coefficient of Aid*HI） × Aid*HI + （the coefficient of Aid*HI^2） × Aid*HI^2. Figure 11 was drawn with the estimated coefficients of column 5 evaluated at the sample mean level of aid. The relationship between the growth facilitation effect and HI emerges as an inverted U-shape with the highest point at HI=0.5. Since HI is defined between zero and one, the effect of aid considering aid proliferation will bring the largest impact at around the mid point of HI. This parametric result coincides with the non-parametric regression of Figure 10. It should be noted that whether the overall effect on growth turns out to be positive depends on the coefficients of other variables. This result suggests that aid proliferation indicated by a low HI hinders growth possibly due to high transaction costs while aid concentration indicated by an excessively high HI also hinders growth possibly due to less competition among donors. This benchmark result holds when we exclude aid*policy and aid^2*policy from the regressors (column 7) and when we further add the aid^2 variable (column 10).

Another implication can be obtained from column 6 of Table 2. The interaction term of aid squared and HI has negative and significant coefficient suggesting that the larger the magnitude of aid flows, the greater the impact on economic growth in countries with less proliferation but with diminishing returns. But this result does not hold when we exclude aid*policy and aid^2*policy from the regressors (column 8) and when we further add the aid^2 variable (column 11).

3.5 Robustness Checks

To check the robustness of the results and to see the various effect of aid proliferation on growth, we experiment with several alternative specifications. Table 3 presents the GMM results of various estimations by adding the interaction terms of HI with other control variables such as Policy, Institutional Quality, and regional dummies. The coefficient of the interaction term between aid and HI (Aid*HI) is consistently positive and significant against the specification changes except for column 6 of Table 3 which is not very reliable since the *p* value of AR(2) is too low. These results are consistent with baseline estimations shown in Table 2 and stress the fact that aid proliferation involves a negative effect on the economic growth of the recipient countries.

As to the optimal level of HI, the interaction term of Aid*HI^2 has negative and significant coefficient in column 4 of Table 3 following the benchmark results while the coefficients of Aid*HI^2 in columns 5 and 6 are not statistically significant. Column 6 of Table 3 is not considered to be reliable due to the low *p* value of AR(2), but there may possibly be multicollinearity problems as well. On the other hand, the interaction term of aid squared and HI has consistently negative and significant coefficient in column 7, 8, and 9, suggesting an aid effect on growth with diminishing returns. We also find that the coefficient of the regional dummy variable of East Asia appears mostly positive and significant (column 2, 3, 4, 5, 7, and 8 in Table 3). The interaction term between aid and the fraction of tropical area (Aid*Tropic) turns out to be not very robust, which is different from the original estimation by Roodman (2007a).

We also perform estimations with the datasets of Burnside and Dollar (2000) and Easterly, Levine and Roodman (2004). The results based on these alternative datasets did not pass tests of statistical significance.[15] We suspect that these results based on smaller sample size suffer from sample selection bias because the datasets of Burnside and Dollar (2000) and Easterly, Levine and Roodman (2004) are smaller than that of Roodman (2007a), (Appendix Table A1). In order to check the degree of the sample selection bias, we run a probit model of a binary variable which takes 1 if the sample is in the Burnside and Dollar (2000) sample or Easterly, Levine and Roodman (2004) sample and takes zero otherwise. The independent vectors include GDP, population, institutional quality, regional dummy variables, interaction terms of these variables, and some of the squared and cubic variables. The results are shown in Table 4. As we can see, population, tropical, and institutional variables have statistically significant coefficients, suggesting sample selection bias in the Burnside and Dollar (2000) and Easterly, Levine and Roodman (2004) datasets.

4 Conclusion and Policy Implications

This paper investigates whether aid proliferation affects economic growth of recipient countries by incorporating a donor concentration index and related interaction terms to Burnside and Dollar (2000), Easterly, Levine, and Roodman (2004), and Roodman (2007a) which are the major growth regressions in the literature. Since the Roodman (2007a) data is the most comprehensive of the three datasets considered in this paper, we use it to derive baseline results. Our empirical results suggests that the effect of aid on economic growth taking into account the extent of aid concentration shows an inverted

[15] These results are not reported in this paper but are available from the corresponding author upon request.

U-curve, indicating that there is an optimal level of aid proliferation. The results also indicate that the larger the magnitude of aid flows, the greater the positive impact on economic growth in countries with less proliferation but with diminishing returns.

Aid coordination has become one of the most pressing issues in the current international aid community. As the contrast between the economic growth of East Asia and the stagnation of Sub-Saharan Africa emerges, public discussion regarding aid seems to focus on two points. On one hand, the increase of aid volume is still being emphasized, especially after the Monterrey consensus in 2002. However, without close examination of past aid effectiveness and aid modalities, it is difficult to arrive at a favorable consensus for increasing the amount of aid. On the other hand, the problems of aid proliferation and necessity of aid coordination among donors are recognized. The main point is that the lack of international aid coordination leads to the lack of ownership and lower capacities of aid recipients and hinders their growth potential.

The importance of aid coordination cannot be ignored since not only the current DAC donors, but also the emerging donors, who are currently operating outside the international aid coordination framework, are soon expected to play an important role in the aid community. Yet, the main finding of this paper — that more aid concentration is likely to be correlated with higher economic growth — may or may not be consistent with the logic behind aid coordination. If aid coordination may act as concentration of aid by reducing transaction costs, then it may promote economic growth. However, if the problem is a free-rider problem, aid coordination does not necessarily facilitate growth. In the future, it will be imperative to elaborate on careful analyses of the role of aid coordination.

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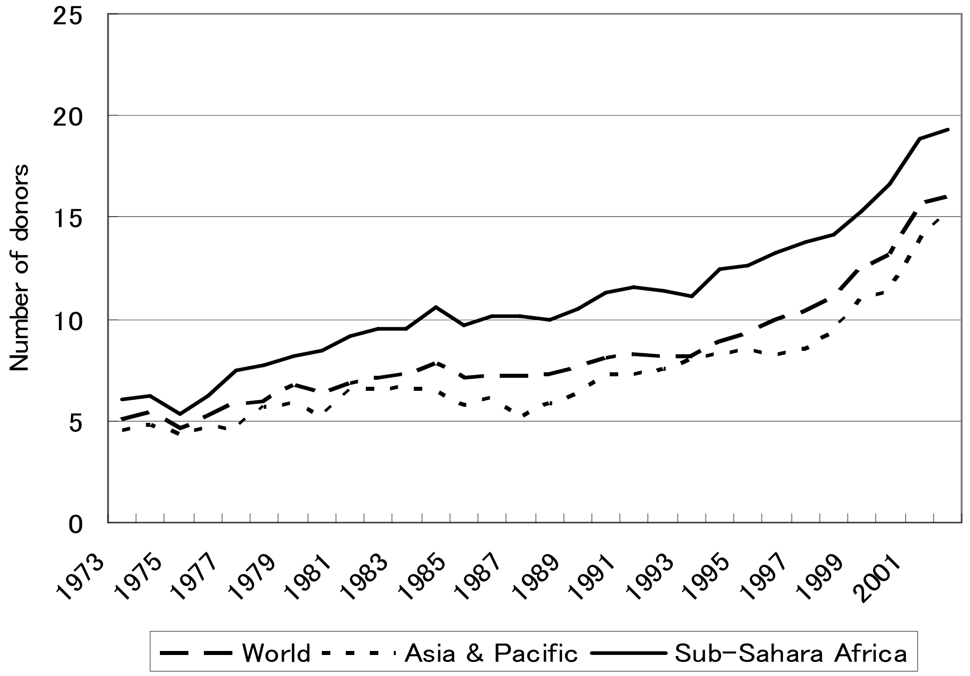
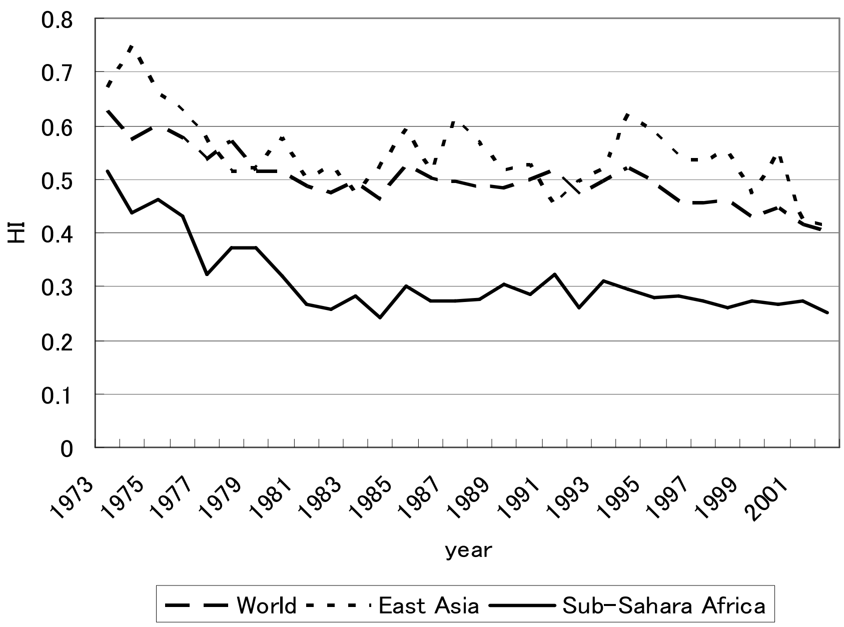
Figure 1 : Average Number of Bilateral DAC Donors (per country)



s

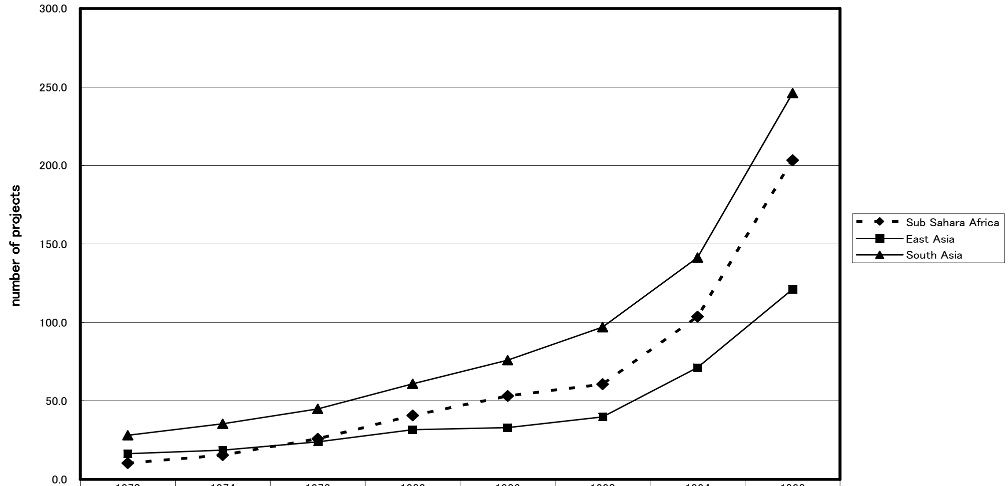
ource: CRS / OECD, Commitment Base

Figure 2: Trend of Herfindahl Index by Recipients



Source: CRS/OECD, Commitment Base. Calculated by recipient countries and shown as regional averages.

Figure 3：Average Number of Projects（Bilateral DAC Aid: per country）



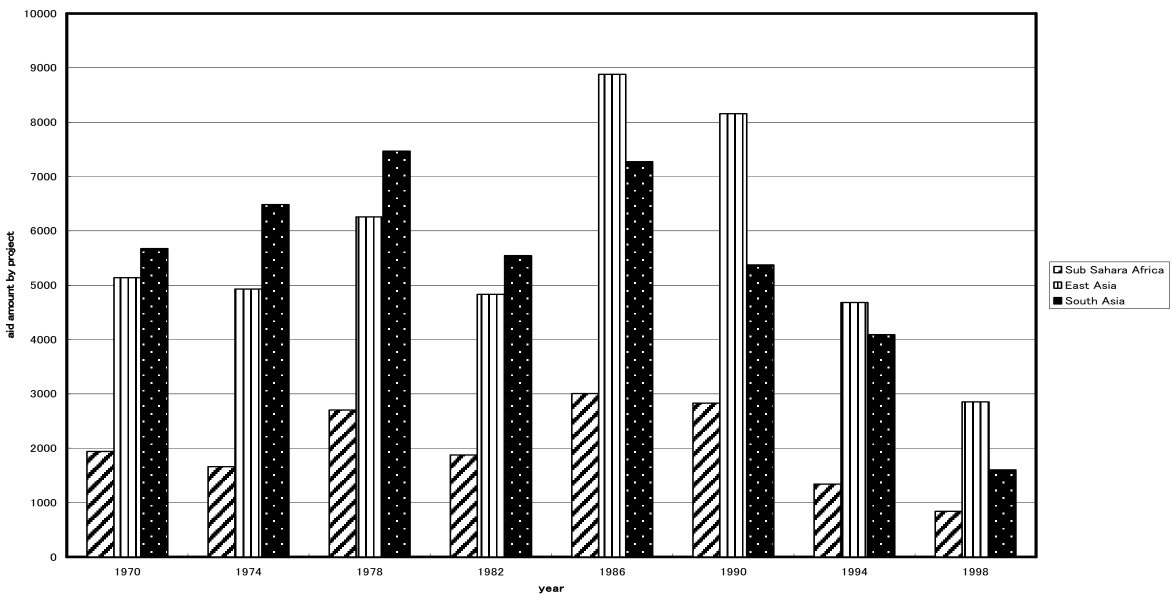
	1970	1974	1978	1982	1986	1990	1994	1998
Sub Sahara Africa	10.5	15.6	26.0	40.8	53.2	60.6	103.8	203.3
East Asia	16.5	18.6	24.0	31.6	33.1	40.0	71.4	121.1
South Asia	28.1	35.4	45.1	61.0	75.9	97.0	141.3	246.2

year

Source: CRS / OECD, Commitment Base

Note: The year shown in the table represents the starting year of four-year averages.

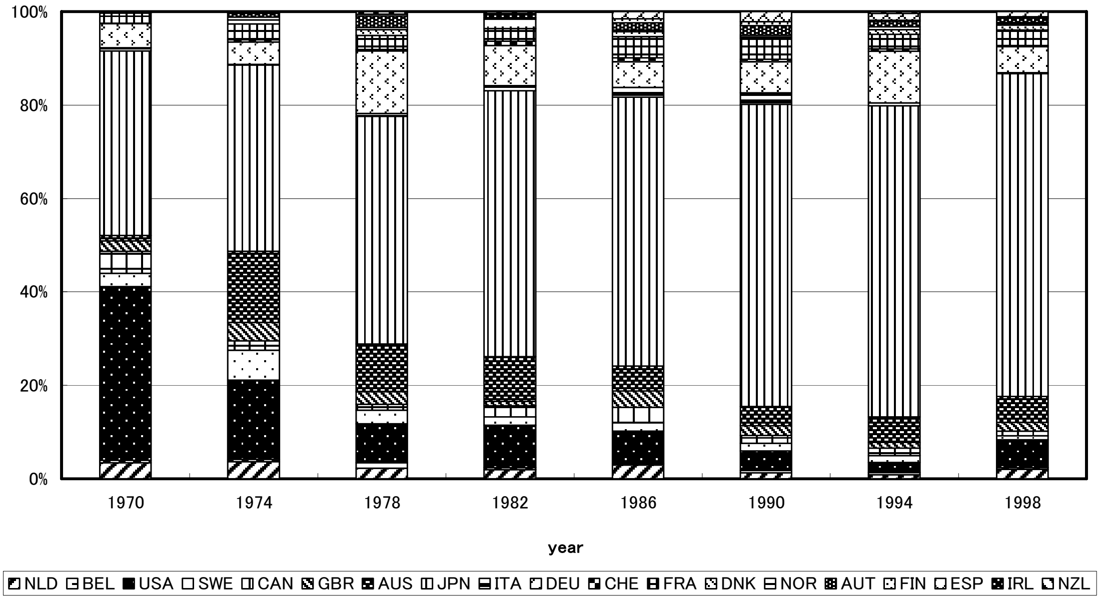
Figure 4: Average Size of Project (Bilateral DAC Aid)



Source: CRS / OECD, Commitment Base

Note: The year shown in the table represents the starting year of four-year averages.

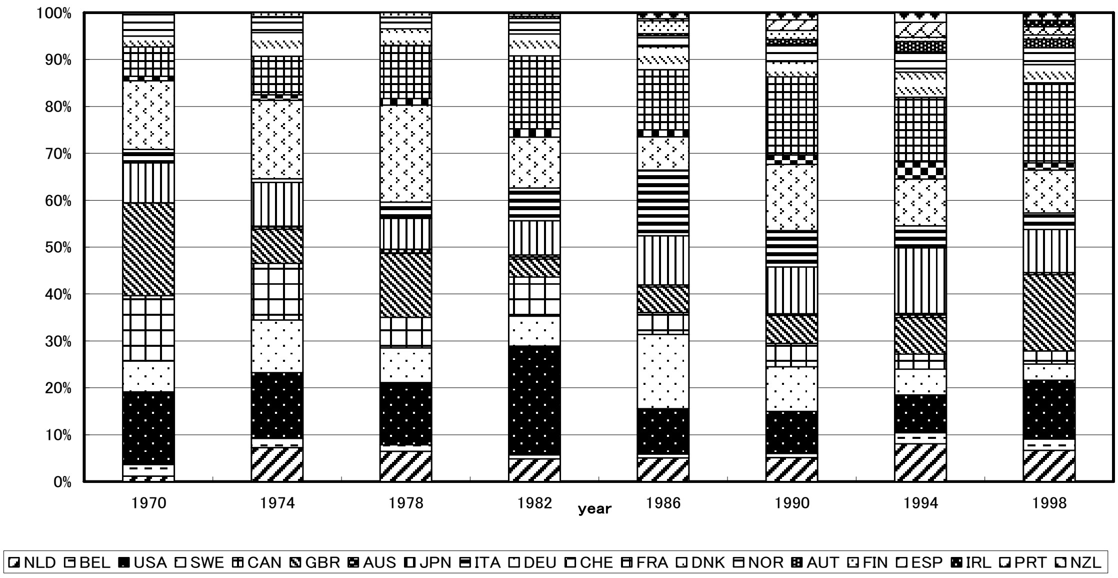
Figure 5: Bilateral DAC Aid Share by donors (East Asia)



Source: CRS / OECD, Commitment Base

Note: The year shown in the table represents the starting year of four-year averages.

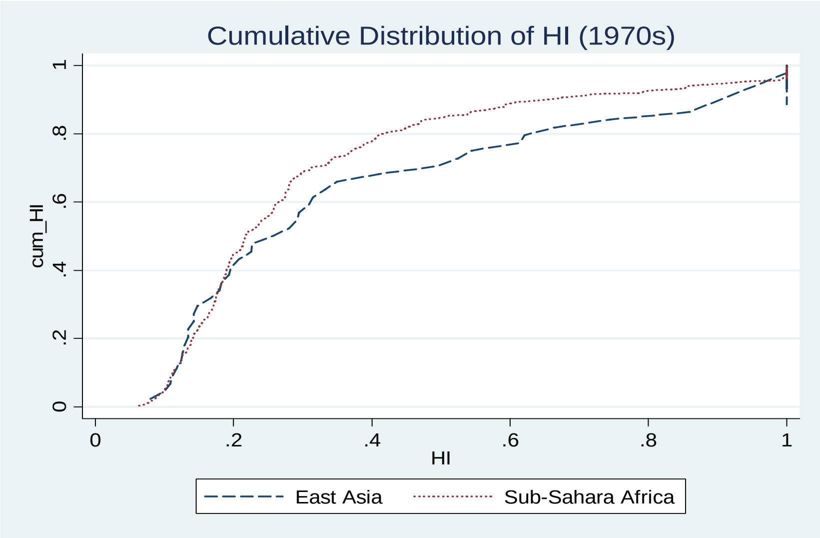
Figure 6: Bilateral DAC Aid Share by donors (Sub-Saharan Africa)



Source: CRS / OECD, Commitment Base

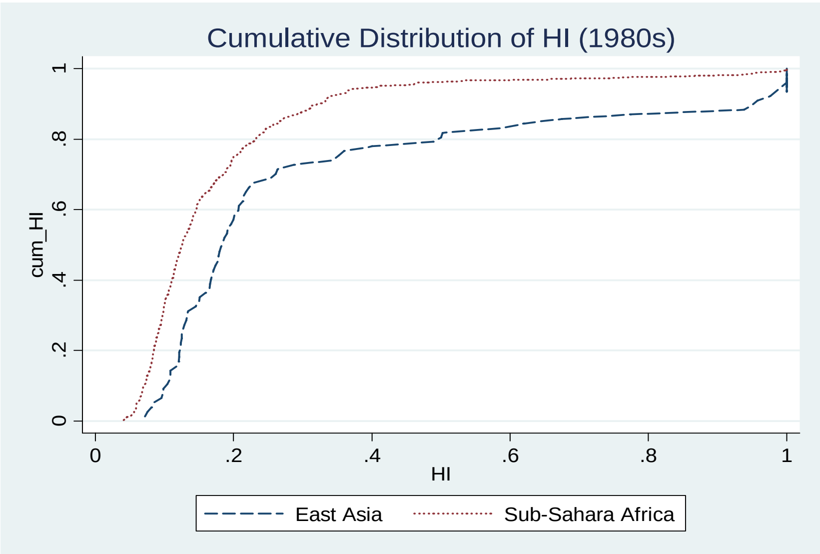
Note: The year shown in the table represents the starting year of four-year averages.

Figure 7-A: Cumulative Distribution of Herfindahl Index by region in 1970s



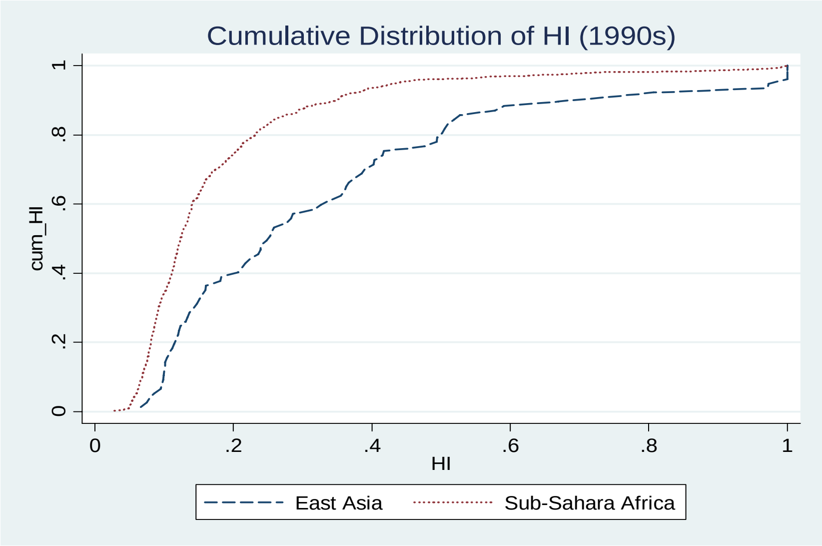
Note: The two-sample Kolmogorov-Smirnov tests of the equality of distributions cannot reject the equality between these two probability distributions of Herfindahl index (*p*-value is 0.277).

Figure 7-B: Cumulative Distribution of Herfindahl Index by region in 1980s



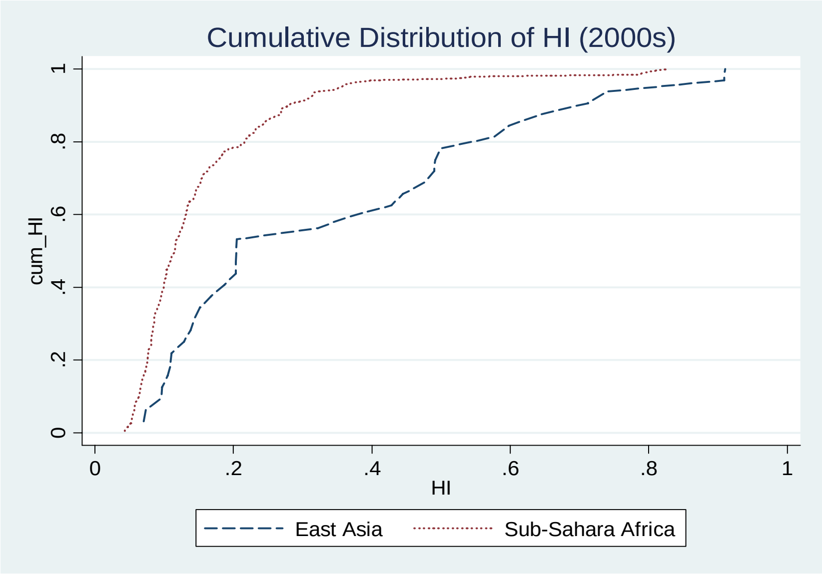
Note: The two-sample Kolmogorov-Smirnov tests of the equality of distributions reject the equality between these two probability distributions of Herfindahl index strongly (*p*-value is 0.000).

Figure 7-C: Cumulative Distribution of Herfindahl Index by region in 1990s



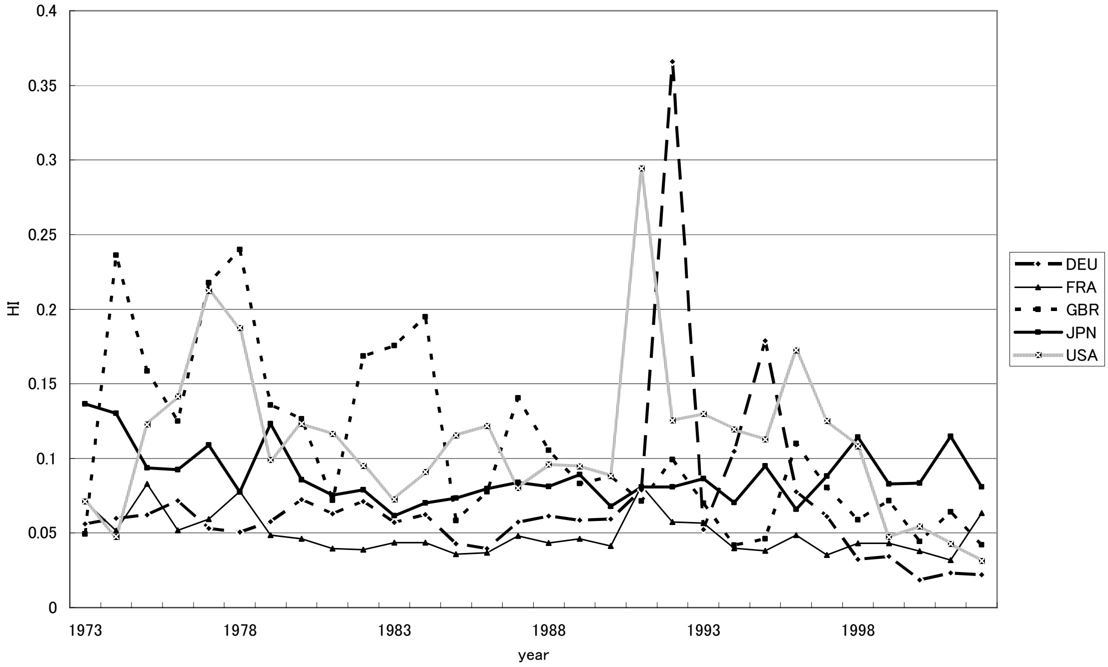
Note: The two-sample Kolmogorov-Smirnov tests of the equality of distributions reject the equality between these two probability distributions of Herfindahl index strongly (*p*-value is 0.000).

Figure 7-D: Cumulative Distribution of Herfindahl Index by region in 2000s



Note: The two-sample Kolmogorov-Smirnov tests of the equality of distributions reject the equality between these two probability distributions of Herfindahl index strongly (*p*-value is 0.000).

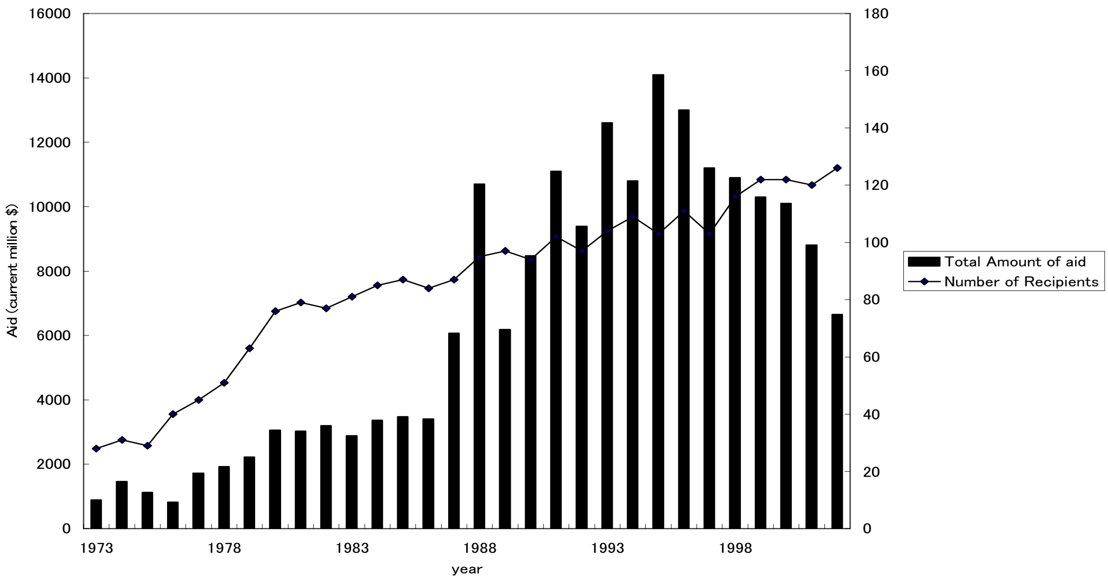
Figure 8: Trend of Herfindahl Index by donors



Source: CRS / OECD, Commitment Base. Calculated for five major donor countries.

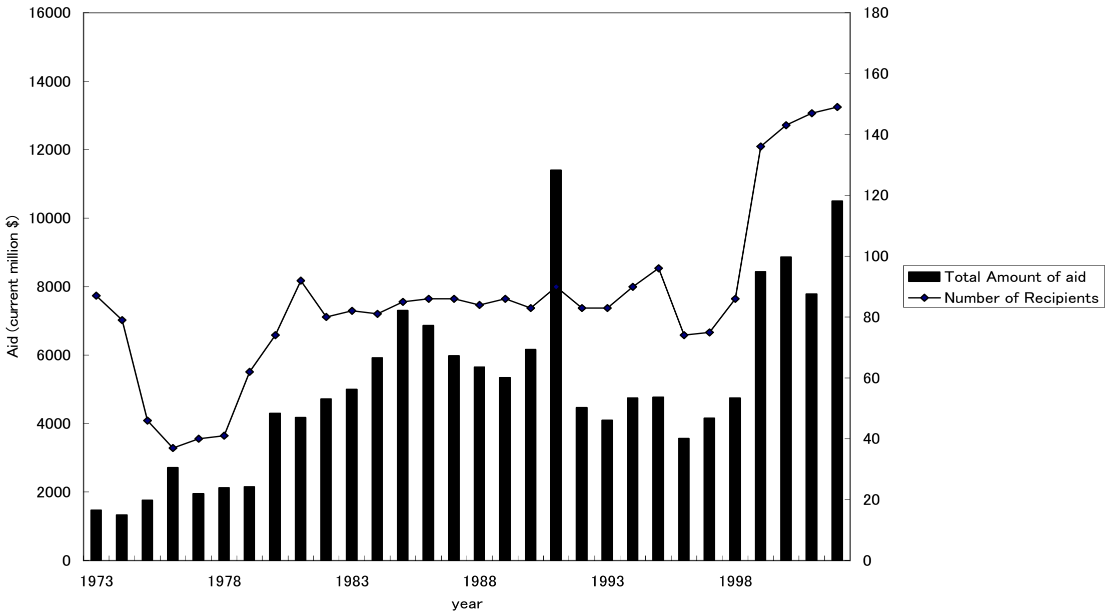
The hike for US in 1990 is due to the Gulf War and the provision of aid to Egypt. The spike for Germany in 1992 is due to the collapse of Berlin Wall and the provision of aid to Poland

Figure 9-A: Number of Recipient Countries and Total Amount of Aid (Japan)



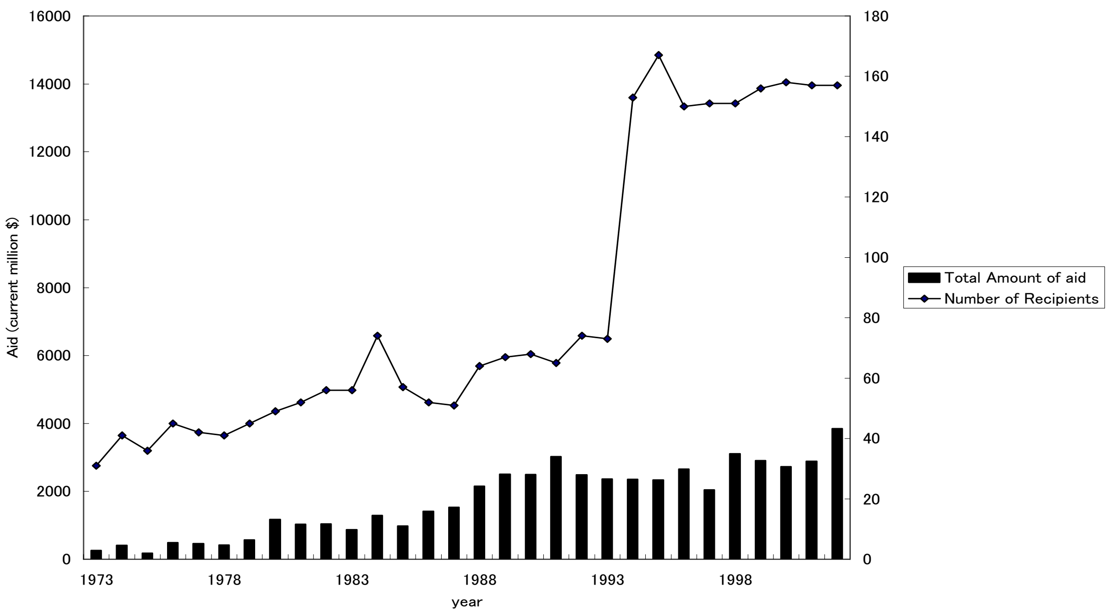
Source: CRS / OECD, Commitment Base.

Figure 9-B: Number of Recipient Countries and Total Amount of Aid (USA)



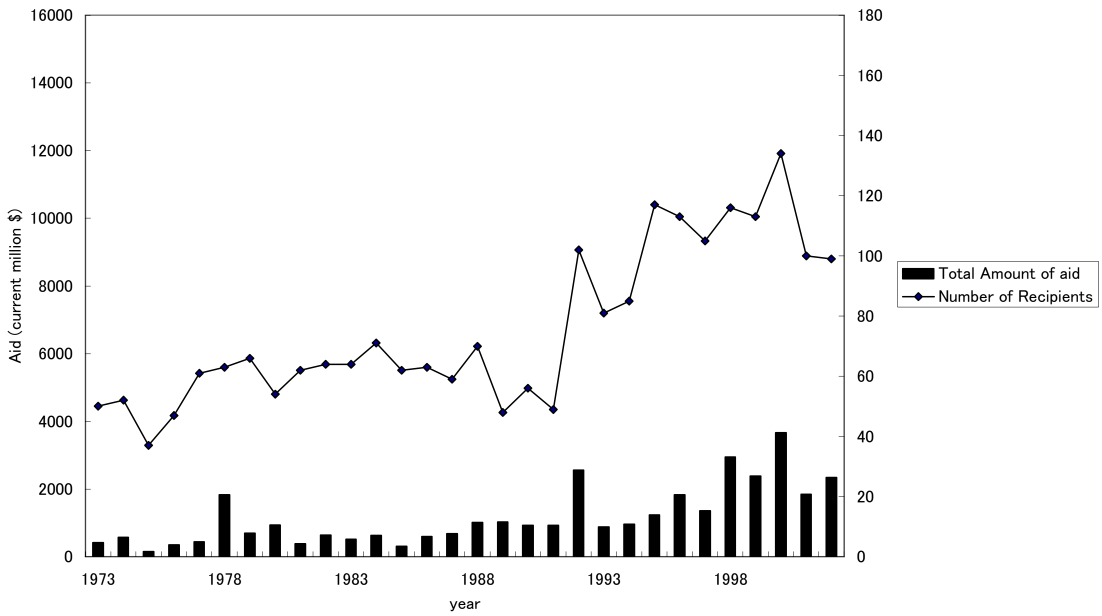
Source: CRS / OECD, Commitment Base.

Figure 9-C: Number of Recipient Countries and Total Amount of Aid (France)



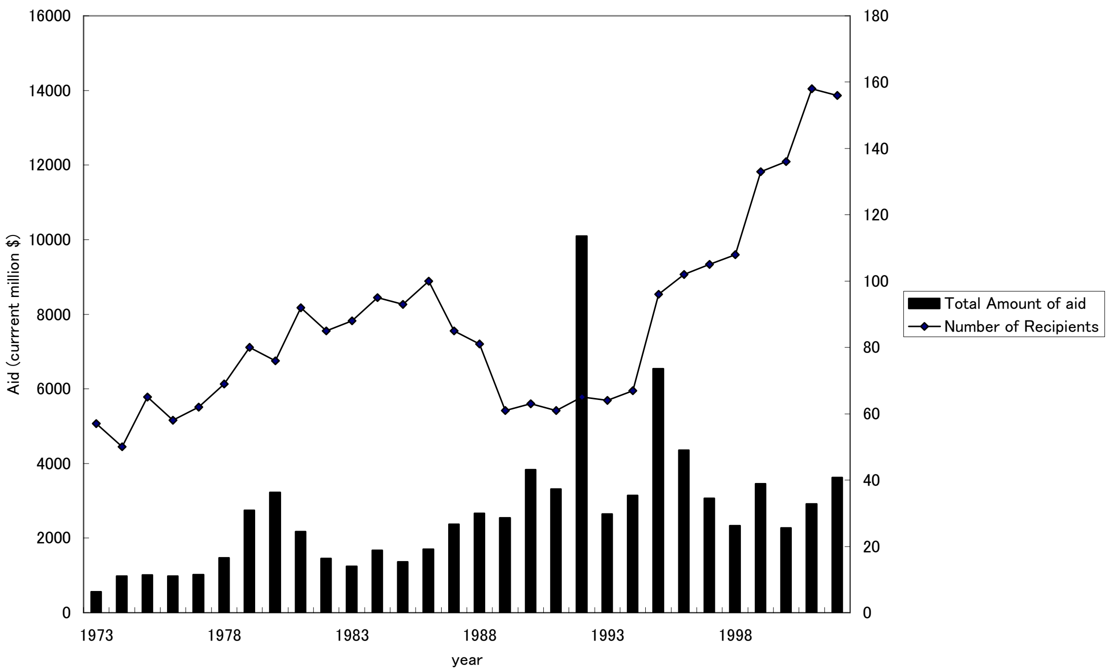
Source: CRS / OECD, Commitment Base.

Figure 9-D: Number of Recipient Countries and Total Amount of Aid (UK)



Source: CRS / OECD, Commitment Base.

Figure 9-E: Number of Recipient Countries and Total Amount of Aid (Germany)



Source: CRS / OECD, Commitment Base.

Table 1 : Extension of Roodman (2007a)
Semi-Parametric Estimation

Dependent Variable: per capita GDP growth

	semi-par
ralgdp	-0.518
	(0.930)
raethnf	0.93
	(1.911)
ratropicar	-1.167
	(1.748)
raassas	-0.02
	(0.281)
raethnfassas	-0.006
	(0.621)
raicrge	0.43
	(0.188)*
ram21	0.005
	(0.024)
rassa	1.506
	(2.868)
raeasia	7.346
	(2.975)*
rapolicy1	1.109
	(0.256)**
raaid	1.101
	(0.532)*
ratropaid	-0.938
	(0.467)*
raaidpolicy	-0.138
	(0.165)
raaid2policy	0.004
	(0.022)
HI	-3.857
	(4.938)
HI2	4.229
	(4.610)
Observations	439
R-squared	0.54
P value	0.02

Note: Standard errors are in parentheses. **, * and + signify statistical significance at the 1%, 5% and 10% levels respectively. All variables except HI are taken from Roodman's homepage [http://www.cgdev.org/content/experts/detail/2719/]. Variables including a HI index are constructed from CRS.

Figure 10 : Extension of Roodman (2007a)
Semi-Parametric Estimation

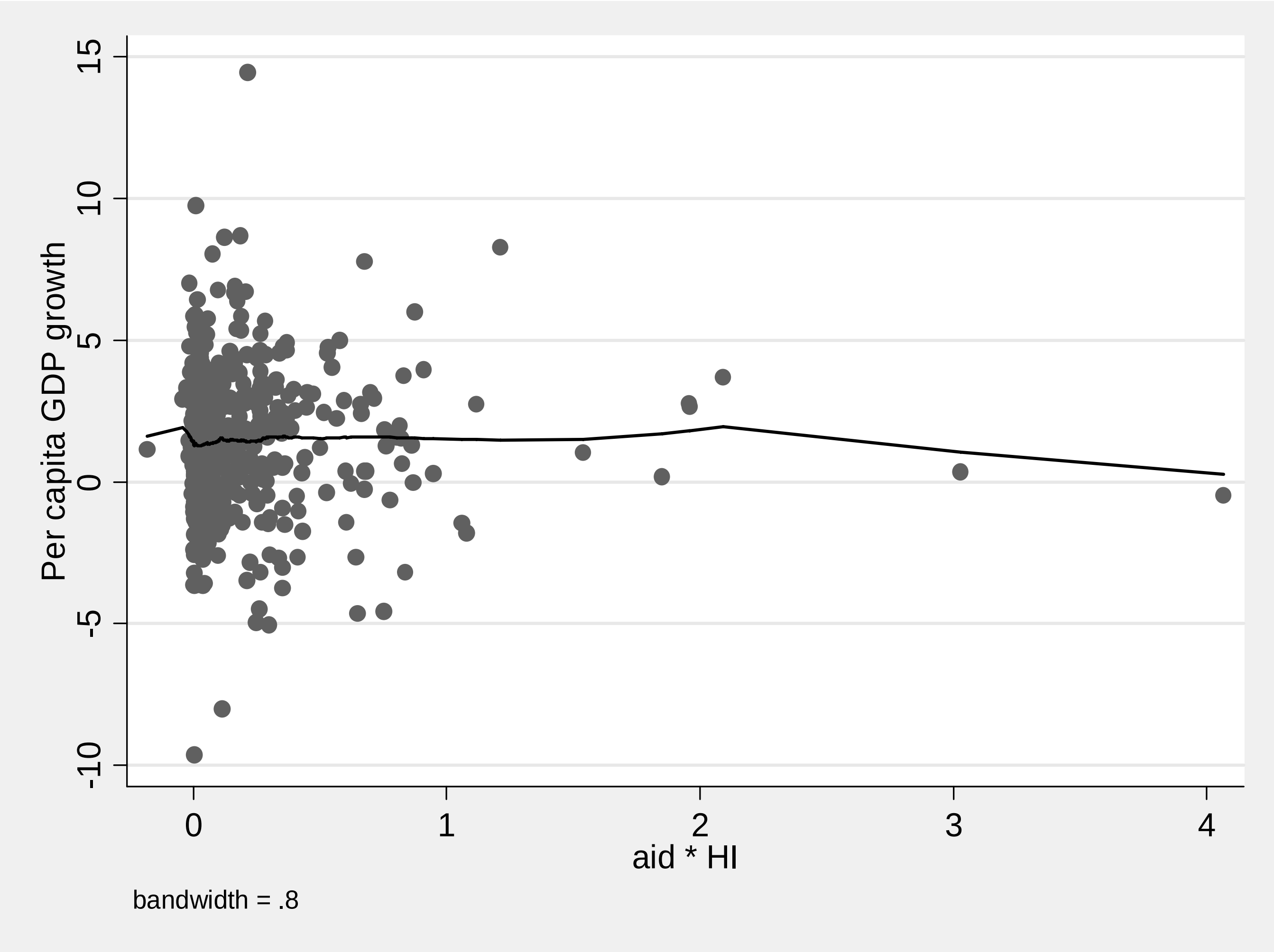


Table 2 : Extension of Roodman（2007a）(1)

Dependent Variable: per capita GDP growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	OLS	OLS	OLS	GMM	GMM	GMM	GMM	GMM	GMM	GMM	GMM
ralgdp (Pre)	−0.489	−0.49	−0.516	4.144	3.993	3.93	4.316	4.233	3.796	3.982	4.107
	(0.437)	(0.437)	(0.440)	(1.493)*	(1.357)*	(1.371)*	(1.074)**	(1.079)*	(1.092)*	(1.036)*	(1.060)*
raethnf (Ex)	−0.063	−0.063	−0.053	−2.522	−2.342	−1.136	0.083	−0.192	−1.161	−1.135	−0.618
	(0.701)	(0.703)	(0.703)	(2.266)	(1.963)	(2.460)	(1.945)	(1.925)	(1.968)	(1.850)	(2.040)
ratropicar (Ex)	−1.05	−1.015	−1.059	−0.37	−0.987	−1.191	−0.048	0.263	0.26	−0.291	0.439
	(0.389)*	(0.400)*	(0.389)*	(1.242)	(1.129)	(1.084)	(0.997)	(0.946)	(0.986)	(1.020)	(0.997)
raassas (Pre)	−0.192	−0.187	−0.185	−0.606	−0.587	−0.417	−0.387	−0.383	−0.403	−0.428	−0.322
	(0.210)	(0.212)	(0.212)	(0.417)	(0.400)	(0.472)	(0.373)	(0.374)	(0.371)	(0.369)	(0.394)
raethnfassas (Pre)	−0.088	−0.098	−0.094	0.754	0.726	0.556	0.353	0.388	0.463	0.491	0.322
	(0.614)	(0.615)	(0.612)	(1.298)	(1.285)	(1.362)	(1.175)	(1.142)	(1.115)	(1.180)	(1.192)
raicrge (En)	0.458	0.455	0.469	0.342	0.424	1.084	0.483	0.477	0.4	0.469	0.671
	(0.116)*	(0.116)*	(0.117)*	(0.454)	(0.422)	(0.427)*	(0.368)	(0.399)	(0.394)	(0.380)	(0.391)+
ram21 (Pre)	−0.031	−0.03	−0.031	−0.064	−0.064	−0.096	−0.037	−0.039	−0.017	−0.024	−0.036
	(0.011)*	(0.011)*	(0.011)*	(0.036)+	(0.031)*	(0.031)*	(0.034)	(0.035)	(0.032)	(0.030)	(0.030)
raeasia (Ex)	2.254	2.258	2.203	2.941	2.528	1.843	1.668	1.757	1.192	1.159	1.239
	(0.479)*	(0.480)*	(0.485)*	(1.724)+	(1.533)+	(1.242)	(1.203)	(1.285)	(1.305)	(1.220)	(1.197)
rassa (Ex)	−1.319	−1.314	−1.322	1.07	1.352	1.23	0.914	0.735	1.223	1.635	1.653
	(0.617)*	(0.619)*	(0.618)*	(1.704)	(1.605)	(1.720)	(1.218)	(1.368)	(1.387)	(1.379)	(1.408)
rapolicy1 (En)	1.02	1.011	1.072	−0.508	−0.076	0.898	0.402	0.338	0.483	0.525	0.386
	(0.192)*	(0.192)*	(0.205)*	(0.646)	(0.568)	(0.860)	(0.362)	(0.368)	(0.360)	(0.367)	(0.385)
raaid (En)	0.779	0.936	0.804	−0.571	−2.928	−0.502	−0.559	1.067	−0.412	−3.581	−2.045
	(0.319)*	(0.480)+	(0.307)*	(0.907)	(1.649)+	(0.939)	(0.960)	(0.902)	(1.270)	(1.897)+	(1.793)
ratropaid (En)	−0.879	−0.931	−0.873	−1.012	0.028	−0.364	−0.851	−1.522	−1.008	−0.032	−1.35
	(0.284)*	(0.310)*	(0.281)*	(0.755)	(0.923)	(0.745)	(0.490)+	(0.805)+	(0.675)	(0.794)	(0.729)+
raaidpolicy (En)	−0.006	0.004	−0.085	0.274	−0.12	−2.325					
	(0.111)	(0.111)	(0.155)	(0.378)	(0.362)	(0.934)*					
raaid2policy (En)	−0.008	−0.009	0.005	0.001	0.051	0.405					
	(0.017)	(0.017)	(0.023)	(0.052)	(0.055)	(0.158)*					
HI (En)	−3.194	−2.645	−3.265	−69.264	−72.231	−72.422	−46.301	−46.016	−49.375	−59.459	−56.661
	(3.160)	(3.320)	(3.138)	(22.074)	(19.283)	(21.664)	(17.511)**	(17.715)	(16.978)	(16.891)	(18.772)
HI2 (En)	2.989	2.368	3.089	53.634	59.085	60.084	35.897	33.591	34.517	47.147	43.023
	(3.200)	(3.483)	(3.178)	(20.437)	(19.254)	(21.596)	(17.628)*	(16.989)	(15.512)	(16.843)	(17.980)
raaidHI (En)	0.042	−1.034	0.496	3.168	17.231	24.937	11.201	2.691	2.204	19.447	14.887
	(0.509)	(2.675)	(0.652)	(1.350)*	(7.317)*	(9.826)*	(6.425)+	(3.347)	(1.059)*	(7.268)*	(8.587)+
raaidHI2 (En)		1.491			−17.335		−12.107			−20.668	
		(3.633)			(8.381)*		(7.215)+			(8.164)*	
raaid2HI (En)			−0.12			−4.02		−0.252			−2.284
			(0.099)			(1.761)*		(0.602)			(1.479)
raaid2 (En)									0.084	0.146	0.421
									(0.073)	(0.076)+	(0.246)+
Observations	440	440	440	440	440	440	440	440	440	440	440
R-squared	0.39	0.39	0.39								
Hansen				0.74	0.57	0.38	0.59	0.63	0.69	0.72	0.85
AR2				0.11	0.1	0.23	0.1	0.1	0.07	0.08	0.12

Note: Standard errors are in parentheses. **, * and + denote statistical significance at the 1%, 5% and 10% levels respectively. All variables except HI are taken from Roodman's homepage [http://www.cgdev.org/content/experts/detail/2719/]. The HI index is constructed by committed amounts of aid by bilateral donors and multilateral donors recorded in the CRS data of the OECD. Variables labeled (Pre) are considered to be predetermined in the system GMM estimations. Likewise variables labeled (EX) are considered to be exogenous and variables labeled (En) are considered to be endogenous in the system GMM estimations.

Figure 11: Effect of aid through HI
(Based on Table 2 (5) : Roodman (2007a)'s extension)

Growth facilitation effect of aid through HI = (the coefficient of Aid) ×Aid + (the coefficient of Aid*HI) ×Aid*HI+ (the coefficient of Aid*HI²) × Aid*HI²
(Mean aid = 1.204, Low 25%=0.105, High 25%=1.575)

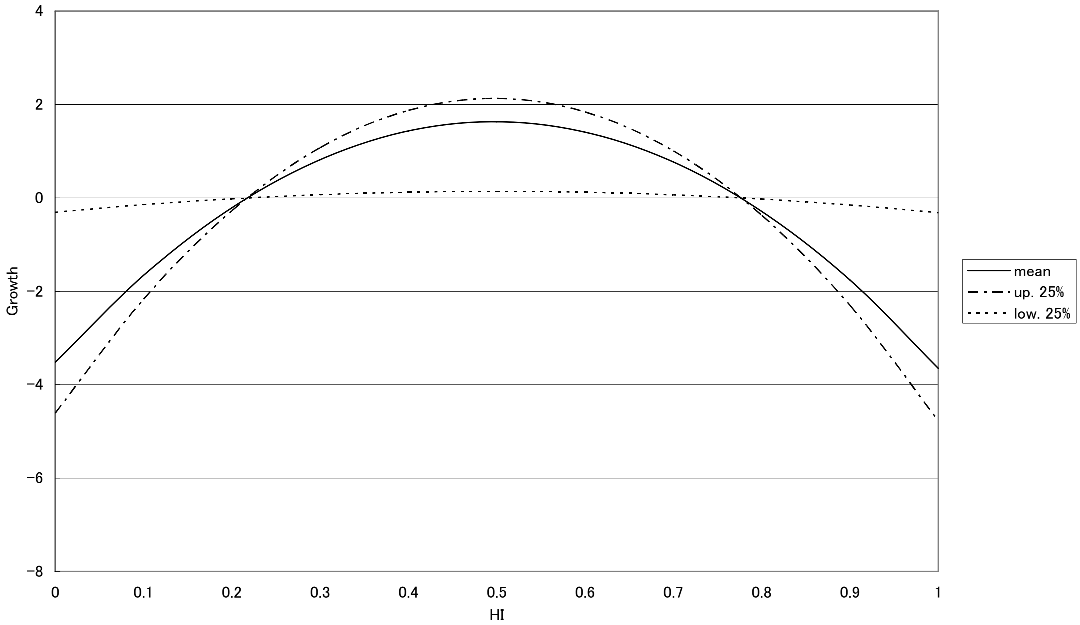


Table 3 : Extension of Roodman（2007a）(2)

Dependent Variable: per capita GDP growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	GMM	GMM	GMM	GMM	GMM	GMM	GMM	GMM	GMM
ralgdp (Pre)	2.128	4.415	4.144	3.054	2.818	0.676	2.724	2.721	0.443
	(1.101)+	(1.496)**	(1.493)**	(1.229)*	(1.250)*	(1.241)	(1.422)+	(1.294)*	(1.270)
raethnf (Ex)	−0.987	−2.447	−2.522	−1.774	−1.516	−1.437	−0.425	−0.639	−0.423
	(1.650)	(2.269)	(2.266)	(1.855)	(1.723)	(1.646)	(2.392)	(2.057)	(1.750)
ratropicar (Ex)	−0.416	−0.139	−0.37	−1.122	−1.336	−1.557	−1.324	−1.525	−1.685
	(0.868)	(1.246)	(1.242)	(0.977)	(0.828)	(0.720)*	(0.984)	(0.881)+	(0.733)*
raassas (Pre)	−0.648	−0.517	−0.606	−0.559	−0.551	−0.595	−0.375	−0.464	−0.529
	(0.337)+	(0.418)	(0.417)	(0.376)	(0.356)	(0.356)+	(0.486)	(0.408)	(0.387)
raethnfassas	0.743	0.608	0.754	0.556	0.475	0.494	0.308	0.404	0.458
	(0.947)	(1.308)	(1.298)	(1.249)	(1.227)	(1.174)	(1.390)	(1.290)	(1.173)
raicrge (En)	0.414	0.286	0.342	1.103	0.882	1.436	2.32	1.531	1.872
	(0.365)	(0.465)	(0.454)	(0.868)	(0.909)	(0.810)+	(1.240)+	(0.920)+	(0.806)*
ram21 (Pre)	−0.042	−0.062	−0.064	−0.08	−0.07	−0.057	−0.122	−0.1	−0.078
	(0.032)	(0.039)	(0.036)+	(0.033)*	(0.033)*	(0.029)+	(0.039)**	(0.033)**	(0.031)*
raeasia (Ex)	2.072	2.862	2.941	3.218	2.702	−4.691	3.204	2.436	−4.117
	(1.431)	(1.711)+	(1.724)+	(1.514)*	(1.333)*	(4.505)	(1.652)+	(1.346)+	(4.170)
rassa (Ex)	−0.09	1.079	1.07	0.469	0.434	−0.559	0.153	0.354	0.255
	(1.168)	(1.721)	(1.704)	(1.433)	(1.415)	(2.596)	(1.437)	(1.393)	(2.495)
rapolicy1 (En)	0.447	−0.596	−0.508	0.117	−0.657	0.077	1.142	0.215	1.193
	(0.488)	(0.640)	(0.646)	(0.534)	(1.395)	(1.418)	(0.861)	(1.626)	(1.732)
raaid (En)	0.15	0.223	−0.571	−2.512	−2.244	−1.794	−0.449	−0.339	−0.334
	(0.685)	(0.713)	(0.907)	(1.536)	(1.525)	(1.555)	(1.015)	(0.822)	(0.681)
ratropaid (En)	−0.907	−1.307	−1.012	−0.041	−0.111	−0.269	−0.353	−0.456	−0.494
	(0.608)	(0.737)+	(0.755)	(0.857)	(0.856)	(0.788)	(0.752)	(0.624)	(0.497)
raaidpolicy (En)	0.035	0.306	0.274	−0.14	−0.034	−0.263	−2.337	−1.858	−1.904
	(0.369)	(0.369)	(0.378)	(0.335)	(0.354)	(0.361)	(0.857)**	(1.000)+	(0.989)+
raaid2policy	0.012	−0.014	0.001	0.051	0.044	0.06	0.405	0.333	0.31
	(0.053)	(0.050)	(0.052)	(0.051)	(0.052)	(0.051)	(0.146)**	(0.160)*	(0.153)*
HI (En)	−18.435	−70.17	−69.264	−51.528	−53.942	−28.717	−40.858	−53.189	−23.757
	(5.288)**	(21.005)**	(22.074)**	(19.639)**	(16.696)**	(17.499)	(27.558)	(18.282)**	(16.772)
HI2 (En)		56.047	53.634	47.201	45.534	33.961	46.141	49.711	32
		(20.365)**	(20.437)**	(17.297)**	(14.720)**	(14.872)*	(19.794)*	(16.266)**	(13.754)*
raaidHI (En)			3.168	15.111	12.999	9.835	24.354	20.544	18.436
			(1.350)*	(6.812)*	(6.953)+	(6.883)	(8.869)**	(9.532)*	(8.698)*
raaidHI2 (En)				−14.657	−12.725	−8.132			
				(8.094)+	(8.284)	(8.175)			
raaid2HI (En)							−3.915	−3.291	−2.839
							(1.634)*	(1.747)+	(1.560)+
raicrgeHI (En)				−1.75	−1.438	−3.81	−3.524	−2.028	−3.757
				(2.001)	(2.174)	(2.171)+	(2.995)	(2.265)	(2.122)+
rapolicyHI (En)					3.421	1.498		3.411	0.999
					(5.443)	(5.203)		(5.511)	(5.606)
raeasiaHI (En)						29.698			25.364
						(18.391)			(16.499)
rassaHI (En)						−1.276			−5.718
						(11.199)			(11.675)
Observations	440	440	440	440	440	440	440	440	440
Hansen	0.4	0.72	0.74	0.38	0.55	0.51	0.61	0.57	0.62
AR2	0.1	0.1	0.11	0.09	0.1	0.06	0.25	0.19	0.14

Note: Standard errors are in parentheses. **, * and + denote statistical significance at the 1%, 5% and 10% levels respectively. All variables except HI are taken from Roodman's homepage [http://www.cgdev.org/content/experts/detail/2719/]. The HI index is constructed by committed amounts of aid by bilateral donors and multilateral donors recorded in the CRS data of the OECD. Variables labeled (Pre) are considered to be predetermined in the system GMM estimations. Likewise variables labeled (EX) are considered to be exogenous and variables labeled (En) are considered to be endogenous in the system GMM estimations.

Table 4 : Probit Estimation of Sample Selection

	(1)	(2)
	Probit	Probit
Dep. Variable	BD=1	ELR=1
ralgdp	14.219	-23.734
	(23.556)	(31.609)
ralpop	-13.633	-61.258
	(11.628)	(21.085)**
rassa	0.288	-0.399
	(0.288)	(0.424)
raeasia	-0.115	-0.35
	(0.356)	(0.430)
ratropicar	1.189	0.825
	(0.281)**	(0.345)*
raicrge	-0.22	-0.364
	(0.063)**	(0.092)**
ralgdp2	-1.494	3.782
	(3.144)	(4.274)
ralpop2	0.777	3.736
	(0.698)	(1.265)**
ralgdp pop	0.096	-0.162
	(0.102)	(0.165)
ralgdp3	0.043	-0.178
	(0.140)	(0.188)
ralpop3	-0.015	-0.074
	(0.014)	(0.025)**
Observations	319	382
Pseudo R2	0.20	0.32

Note: Standard errors are in parentheses. **, * and + denote statistical significance at the 1%, 5% and 10% levels respectively.

Appendix Table 1 : Summary of three extensions we estimate

Estimation	Countries	period	Number of observations
(1) BD	56	70-93	275
(2) ELR	62	70-97	356
(3) Roodman	67	70-02	440

Appendix Table2 : Summary Statistics

	Variable	Obs	Mean	Std. Dev	Min	Max
BD	bdgdpg	275	1.173	3.599	−12.204	12.270
	bdaid	275	1.625	2.069	−0.008	12.724
	bdaidpolicy	275	1.616	4.867	−26.569	39.940
	bdaid2policy	275	7.780	45.773	−224.543	508.196
	HI_all	275	0.267	0.181	0.049	1
	bdaidHI	275	0.295	0.361	−0.003	2.970
	bdaid2HI	275	1.074	2.924	0.000	35.370
	bdpolicyHI	275	0.302	0.376	−1.185	1.759
	bdicrgeHI	275	1.244	0.972	0.171	6.089
	bdssaHI	275	0.060	0.116	0	0.850
	bdeasiaHI	275	0.023	0.076	0	0.533
	bdlgdp	275	7.514	0.702	5.743	9.339
	bdethnf	275	0.464	0.301	0	0.930
	bdassas	275	0.432	1.235	0	11.500
	bdethnfassas	275	0.171	0.605	0	7.360
	bdssa	275	0.305	0.461	0	1
	bdeasia	275	0.109	0.312	0	1
	bdicrge	275	4.563	1.237	2.271	7
	bdm21	275	28.664	13.278	7.235	98.387
	bdpolicy	275	1.173	1.262	−4.504	4.525
ELR	elrgdpg	356	1.395	3.592	−12.693	16.550
	elraid	356	1.308	1.864	−4.591	12.745
	elraid2policy	356	1.753	3.947	−18.556	27.808
	elraidpolicy	356	7.265	30.604	−117.040	354.415
	HI_all	356	0.263	0.180	0.064	1.000
	elraidHI	356	0.232	0.429	−2.511	4.106
	elraid2HI	356	0.905	2.807	0.000	25.251
	elrpolicyHI	356	0.348	0.367	−1.246	1.604
	elricrgeHI	356	1.162	0.958	0.174	6.033
	elrssaHI	356	0.059	0.112	0	0.850
	elreasiaHI	356	0.022	0.076	0	0.533
	elrlgdp	356	7.510	0.754	5.598	9.339
	elrethnf	356	0.467	0.298	0	0.9
	elrassas	356	0.483	1.255	0	11.5
	elrethnfas~s	356	0.185	0.596	0	7.36
	elrssa	356	0.309	0.463	0	1
	elreasia	356	0.098	0.298	0	1
	elricrge	356	4.326	1.553	1.58	8.233
	elrm21	356	26.394	14.620	4.580	120.308
	elrpolicy	356	1.374	1.167	−5.345	3.725
ROODMAN	ragdpg	440	1.428	3.549	−12.742	16.487
	raaid	440	1.204	1.781	−4.545	12.608
	raaidpolicy	440	1.637	3.524	−20.842	23.529
	raaid2policy	440	6.205	25.488	−140.671	296.644
	HI_all	440	0.260	0.181	0.064	1
	raaidHI	440	0.206	0.388	−2.486	4.064
	raaid2HI	440	0.765	2.514	0.000	24.709
	raicrgeHI	440	1.212	1.170	0	8.414
	rassaHI	440	0.056	0.109	0	0.850
	raeasiaHI	440	0.033	0.116	0	0.952
	ralgdp	440	7.528	0.785	5.224	9.711
	raethnf	440	0.457	0.299	0	0.9
	raassas	440	0.429	1.161	0	11.5
	raethnfassas	440	0.162	0.543	0	7.36
	rassa	440	0.307	0.462	0	1
	raeasia	440	0.116	0.320	0	1
	raicrge	440	4.435	1.749	0	10
	ram21	440	28.535	16.665	4.183	120.308
	rapolicy1	440	1.496	1.101	−6.021	3.607
	ratropaid	440	0.993	1.590	−4.545	11.370
	ratropicar	440	0.727	0.415	0	1

Appendix Table 3: List of Countries

code	countryname	Freq. in the Obs. BD	ELR	RO	List of countries BD	ELR	RO
ARG	Argentina	6	7	8	Y	Y	Y
BFA	Burkina Faso		4	8		Y	Y
BGR	Bulgaria			2			Y
BOL	Bolivia	6	7	8	Y	Y	Y
BRA	Brazil	6	5	8	Y	Y	Y
BWA	Botswana	3	6	7	Y	Y	Y
CHL	Chile	6	7	8	Y	Y	Y
CHN	China			4			Y
CIV	Cote d'Ivoire	1	5	6	Y	Y	Y
CMR	Cameroon	5	6	7	Y	Y	Y
COG	Congo, Rep.		2	3		Y	Y
COL	Colombia	6	7	8	Y	Y	Y
CRI	Costa Rica	6	7	8	Y	Y	Y
DOM	Dominican Republic	6	7	8	Y	Y	Y
DZA	Algeria	2	1	2	Y	Y	Y
ECU	Ecuador	6	7	8	Y	Y	Y
EGY	Egypt, Arab Rep.	5	6	7	Y	Y	Y
ETH	Ethiopia	2	4	5	Y	Y	Y
GAB	Gabon	6	6	6	Y	Y	Y
GHA	Ghana	6	7	7	Y	Y	Y
GMB	Gambia, The	6	5	5	Y	Y	Y
GTM	Guatemala	6	7	8	Y	Y	Y
GUY	Guyana	6	1		Y	Y	
HND	Honduras	6	7	8	Y	Y	Y
HTI	Haiti	5	7	8	Y	Y	Y
HUN	Hungary			3			Y
IDN	Indonesia	6	7	8	Y	Y	Y
IND	India	6	7	8	Y	Y	Y
IRN	Iran, Islamic Rep.		5	6		Y	Y
JAM	Jamaica	3	5	6	Y	Y	Y
JOR	Jordan		6	7		Y	Y
KEN	Kenya	6	7	8	Y	Y	Y
KOR	Korea, Rep.	6	7	7	Y	Y	Y
LKA	Sri Lanka	6	7	8	Y	Y	Y
MAR	Morocco	6	7	8	Y	Y	Y
MDG	Madagascar	4	5	6	Y	Y	Y
MEX	Mexico	6	7	8	Y	Y	Y
MLI	Mali	1	3	4	Y	Y	Y
MMR	Myanmar		7	8		Y	Y
MWI	Malawi	4	4	4	Y	Y	Y
MYS	Malaysia	6	7	8	Y	Y	Y
NER	Niger	2	2	2	Y	Y	Y
NGA	Nigeria	6	7	8	Y	Y	Y
NIC	Nicaragua	6	7	8	Y	Y	Y
PAK	Pakistan	6	7	8	Y	Y	Y
PER	Peru	6	7	8	Y	Y	Y
PHL	Philippines	6	7	8	Y	Y	Y
PNG	Papua New Guinea		5	6		Y	Y
POL	Poland			2			Y
PRY	Paraguay	6	6	8	Y	Y	Y
ROM	Romania			2			Y
SEN	Senegal	4	4	6	Y	Y	Y
SGP	Singapore			8			Y
SLE	Sierra Leone	6	7	8	Y	Y	Y
SLV	El Salvador	6	7	8	Y	Y	Y
SOM	Somalia	2			Y		
SYR	Syrian Arab Republic	5	6	7	Y	Y	Y
TGO	Togo	4	6	7	Y	Y	Y
THA	Thailand	6	7	8	Y	Y	Y
TTO	Trinidad and Tobago	5	7	4	Y	Y	Y
TUN	Tunisia	3	4	8	Y	Y	Y
TUR	Turkey	1	7	8	Y	Y	Y
TZA	Tanzania	2			Y		
UGA	Uganda		4	5		Y	Y
URY	Uruguay	6	7	8	Y	Y	Y
VEN	Venezuela, RB	6	7	8	Y	Y	Y
ZAF	South Africa		1	3		Y	Y
ZAR	Congo, Dem. Rep.	5	7	8	Y	Y	Y
ZMB	Zambia	6	3	7	Y	Y	Y
ZWE	Zimbabwe	3	5	5	Y	Y	Y
Total		275	356	440	56	62	67

Appendix Table 4 : Description of Variables

Variable	Code	Original data source	Notes
Per-capita GDP growth	gdpg	World Bank, 2003	
Initial GDP per capita	lgdp	Summers and Heston, 1991	Natural logarithm of GDP/capita for first year of period; constant 1985 dollars
Ethno-linguistic fractionalization	ethnf	Roeder, 2001	Probability that two individuals will belong to different ethnic groups
Tropical area fraction	tropicar	Gallup abd Sachs, 1999	
Assassinations/capita	assas	Banks, 2002	
Institutional quality	icrg	PRS Group's IRIS Ⅲdataset (see Knack and Keefer, 1995)	Revised version of variable. Computed as the average of the three components still reported after 1997
M2/GDP, lagged one period	m21	World Bank, 2003	
Sub-Saharan Africa	ssa	World Bank, 2003	
East Asia	easia	Burnside and Dollar (2000)	Dummy for China, Indonesia, South Korea, Malaysia, Philippines, and Thailand, following Burnside and Dollar
Aid (Effective Development Assistance)/PPP GDP	aid	Chang et al., 1998; DAC, 2002; IMF, 2003; World Bank, 2003; Summer and Heston, 1991	Available values for 1975-95 from Chang et al. Missing values extrapolated based on the regression of EDA on Net ODA. Converted to 1985 dollars with World Import Unit Value index from IMF, series 75. GDP computed like LGDP above
Policy index	policy	Roodman, 2004	
Population	lpop	World Bank, 2003	Natural logarithm
Herfindahl index	HI	CRS	

Note: All variables except HI are taken from Roodman's homepage [http://www.cgdev.org/content/experts/detail/2719/]. The HI index is constructed by committed amounts of aid by bilateral donors and multilateral donors recorded in the CRS data of the OECD. Prefixes, such as bd-, elr-, and ra- are added to codes corresponding dataset of Burnside and Dollar (2000), Easterly, Levine and Roodman (2004), Roodman (2007a) respectively.