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Aid Fragmentation and Effectiveness for Infant and Child Mortality and Primary School Completion

Mitsuaki Furukawa[*]

Abstract

This paper examined empirically the overall effect of the project aid fragmentation in the health and education sectors. It focused on the infant and child mortality rate for the health sector and the primary school completion rate for the education sector because they are flagged as important indicators of the MDGs. The research questions in this paper are whether the mitigation of project aid fragmentation leads to the improvement of the two indicators and whether the result differs between health and education. The major findings are the followings: Even if project aid fragmentation is reduced, there may be no reduction in infant and child mortality rates. On the contrary, The rate will be the worst at the mid-range of fragmentation. On the other hand, the reduction of aid fragmentation in countries which receive relatively high external aid will positively impact the primary school completion rate. These findings lead to the conclusion that the effectiveness of aid-fragmentation reduction differs from one sector to another and depends on the degree of aid dependence.

Keywords: aid effectiveness, aid fragmentation, health sector, education sector, MDGs

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Introduction

Aid fragmentation, which allegedly raises transaction costs by imposing administrative burdens on recipient countries and harming their governance, has been regarded as one of the central issues to be overcome by the international aid community. In 2005, the necessity to tackle the aid fragmentation problem was unanimously agreed upon in the "Paris Aid Effectiveness Declaration." Six years later, at the Busan High Level Forum, aid fragmentation was still a central problem to be redressed.

However, most of prior studies discuss the burden of transaction costs as if they were uniform across the whole government. The aid fragmentation at the sector level has only recently been brought to light, and the effect of aid fragmentation on sector-level outcomes has not yet been sufficiently clarified. This paper attempts to examine such effects in two social sectors: health and education.

The rest of the paper is organized as follows: The next section will review literatures and present the research question. Section 2 will identify variables and data, and Section 3 will analyze the data and show the results. The final section will summarize the paper.

The major findings of this analysis show that the relationship between aid fragmentation and the infant and child mortality rate takes the form of an inverted U curve. This means that, even if aid fragmentation is reduced, there may be no reduction in infant and child mortality rates. On the contrary, reducing such fragmentation by half could make a situation worse. On the other hand, the reduction of aid fragmentation in countries which receive relatively high external aid will positively impact the primary school completion rate. These findings lead to the conclusion that the effectiveness of aid-fragmentation reduction differs from one sector to another and depends on the degree of aid dependence.

1. Literature review and research question

The phenomenon of aid fragmentation is described in the statement by the OECD Chairman and the DAC Chairman at the 2005 High-Level Forum (HLF) in Paris. According to this statement, there are more than 60,000 aid projects in recipient countries, and the donor-led approach in those projects reduces the impact of development aid, not only by imposing different implementation processes determined by each donor, but also by obstructing efforts on the parts of recipient countries to build their own implementation systems.

Much of the existing literature argues that aid fragmentation is in fact happening rapidly, and that this fragmentation imposes a heavy burden and strain on the recipient governments (Cassen 1994, 175; Frot and Santiso 2010; Kharas 2007 etc.). This phenomenon has been termed "recipient fragmentation" (Acharya et al. 2006, 8; Kihara 2012), "project proliferation" (Morss 1984, 465; Cassen 1994, 175; Kimura et al. 2007, 2012; Knack and Rahman 2008[1]), "fragmentation of aid delivery" (Steinwand 2013), "fragmentation of aid" (Kharas 2007, 5), and "proliferation of aid project" (Roodman 2006a).

On the other hand, aid fragmentation is sometimes defined as the proliferation of aid by a donor in a given partner country. This phenomenon is called "donor fragmentation" (Bürcky 2011) or "donor proliferation" (Acharya et al. 2006; Kihara 2012). The aid fragmentation examined in this paper is not "donor proliferation," but the one described by the OECD Chairman in 2005. To avoid confusion, this paper will use the term "project aid fragmentation" or simply "aid fragmentation" to indicate the

[1] Knack and Rahman (2008) and Steinwand (2013) use "project proliferation" or "fragmentation of aid delivery" when the proliferation is calculated on the basis of the number of projects, but "donor fragmentation" when it is measured by the amount of aid.

latter.

Numerous attempts have been made to address the issue of aid fragmentation. O'Connell and Soludo (2001) find that the transaction cost of aid in Africa was comparatively high as compared with other regions. Acharya et al. (2006) estimate the degree of donor proliferation and the degree of project aid fragmentation in each recipient country and show that the worst proliferators are likely to be suppliers of aid to the recipients which suffer most from aid fragmentation.

Knack and Rahman (2007) regress the 2001 Bureaucratic Quality ratings of the International Country Risk Guide (ICRG) to explanatory variables such as the project aid fragmentation, the ODA/GDP ratio, population growth, per capita GDP growth, and the share of aid from international organizations and “like-minded” groups to demonstrate that project aid fragmentation has a negative and significant influence on bureaucratic quality. However, Kihara (2012) points out that Knack and Rahman’s study (2007) is just a “point” estimate for the 2001 rating. To assess the long-term effect of aid fragmentation, Kihara (2012) uses the Government Effectiveness Index in “Aggregate Governance Indicators” (Kaufmann, Kraay, and Mastruzzi 2008) which offers panel data for 85 countries. His explanatory variables include the index of project aid fragmentation (the inverse of Herfindahl-Hirschman index), the index of donor proliferation (Theil Index for total ODA), ODA/GNI ratio, GNI per capita, GDP growth rate, population size, multilateral and bilateral aid, and a dummy variable indicating civil wars. His estimates show that project aid fragmentation has a negative impact on bureaucratic quality.

There is also work that attempts to examine socio-economic impact of the aid fragmentation. Kimura et al. (2007, 2012) and Djankov et al. (2009) try to verify the impact of aid on economic growth in recipient countries which suffer project aid fragmentation. Kimura et al. (2007, 2012) apply the Roodman model (2007a) to their data. They use the database available at the OECD/DAC International Development Statistics (IDS) Creditor Reporting System (CRS)[2] to gain information on the amount of aid committed by donors between 1970 and 2001. On the basis of this information, they calculate the Herfindahl-Hirschman Index (HHI) of project aid fragmentation and use it, together with interaction terms between HHI and the amount of aid, to estimate the impact on the growth rate. The result suggests that the project aid fragmentation has a negative impact on economic growth in recipient countries. Djankov et al. (2009) also measure the HHI on the basis of the DAC CRS data for 1960-99 and find a similar result.

Although a great deal of effort has been made to examine the impact of project aid fragmentation on government effectiveness and economic growth, little is known about its impact on sectoral performance. Prior empirical studies discuss the burden of transaction costs as if they were uniform across the whole government sectors, when actually they may differ from one sector to another. Since there has been a strong tendency for donors to focus on social sectors, especially health and education, since the adoption of MDGs, the level of the transaction cost is expectedly higher in these sectors (Frot and Santiso 2010; Bürcky 2011).

This paper will therefore look into the impact of aid fragmentation in the health and education sectors. It will focus for the health sector on the infant and child mortality rate and for the education sector on the primary school completion rate because they have been flagged as important indicators of the MDGs. This research paper asks whether the mitigation of project aid fragmentation leads to the improvement of the two indicators and whether the result differs between health and education.

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

2. Variables and data

2.1 Project Aid Fragmentation Index

To quantify the extent of the project aid fragmentation, the existing studies (Acharya, Fuzzo de Lima and Moore 2006; Knack and Rahman 2007; Kimura et al. 2007; Kihara 2012; Annen and Moers 2012 etc.) use the Herfindahl-Hirschman Index (HHI), which indicates the degree of aid concentration.

Suppose that q_i denotes the number of projects offered by donor i for a specific sector of a specific recipient country in a specific year, and that Q indicates the total number of aid projects provided by all donors in the same sector of the same recipient country. The project share of donor i is defined as $s_i = q_i/Q$. Then, the Herfindahl-Hirschman Index (HHI) is constructed by summing the squared project shares as follows:

$$HHI = \sum_{i=1}^{N} s_i^2$$

N above indicates the total number of the donors offering aid to the sector concerned. If μ is the average share of the number of projects and $\boldsymbol{\sigma}^2$ is variance, then we have the following equations:

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

$$\sigma^2 \equiv \frac{\Sigma(s_i - \mu)^2}{N} = \frac{\Sigma s_i^{\,2} - N\mu^2}{N} = \frac{HHI}{N} - \frac{1}{N^2}$$

Therefore, the Herfindahl-Hirschman Index can be expressed by the following equation:

$$HHI = N\sigma^2 + \frac{1}{N}$$

If the number of donors at the sector is constant, a higher variance will result in a higher HHI value. If all donors for the sector have identical shares, the variance is zero and HHI equals 1/*N*. The index increases as the difference in donors' shares ($s_i - \mu$) widens, which indicates that aid is more concentrated (less fragmented) in the hands of a smaller number of donors (Kimura et al. 2007). For example, when five donors implement 10 projects each in a developing country, HHI will be 0.2. If three of them reduce the number of projects from 10 to 5, the fourth donor increases it from 10 to 15 and if the fifth donor increases the number from 10 to 20, the total numbers of projects are still 50 but HHI will be 0.28. The burden for the recipient government is expectedly smaller in this case because it can use its administrative resources to coordinate with a smaller number of big donors.

Table 1 shows the 2002-10 average of HHI in the health and education sectors in Sub-Sahara Africa, East Asia, and all regions. It indicates that the project aid fragmentation is greater in East Asia than in Sub-Sahara Africa but both have smaller HHIs than the world average.

Table 1: HHI on Health and Education projects (2002-2010 average)

Region	Health	Education
Sub-Saharan Africa	0.179	0.174
East Asia	0.126	0.137
All Regions	0.257	0.223

Source: Calculate from the DAC CRS data.

2.2 Other variables

Before discussing independent variables besides HHI, it is necessary to check if any linearity is observed between HHI and the dependent variables: the infant and child mortality rate and the primary school completion rate. Figure 1 and Figure 2 illustrate such relationships. Figure 1 demonstrates that the infant and child mortality rate moves on a gentle U curve as HHI goes up (indicating a decline in aid fragmentation). For the primary school completion rate, the curve is a gently inverted U curve. These results indicate the possibility that a higher HHI (a lower fragmentation) does not necessarily improve sectoral performance. The reduction of aid fragmentation may exert a negative influence differently in different sectors.

Since the diagrams below suggest that there is non-linear relationship between the project aid fragmentation and both the infant/child mortality rate and the primary school completion rate, the author includes not only HHI but also squared HHI (HHI^2) for the polynomial model.[3] In addition, the interaction terms have been set between the sum total of all aid by all donors on the one hand and HHI and HHI^2 on the other.

[3] Panel data, which this paper relies on, are more informative, provide more variability but less multicollinearity among the variables, and offer a greater degree of freedom and more efficiency (Baltagi 2005, 5; Kitamura 2005). Nevertheless, it is not possible to eliminate the problem of multicollinearity completely.

Fig. 1 Infant and child mortality rate and health project HHI (2002-2010)

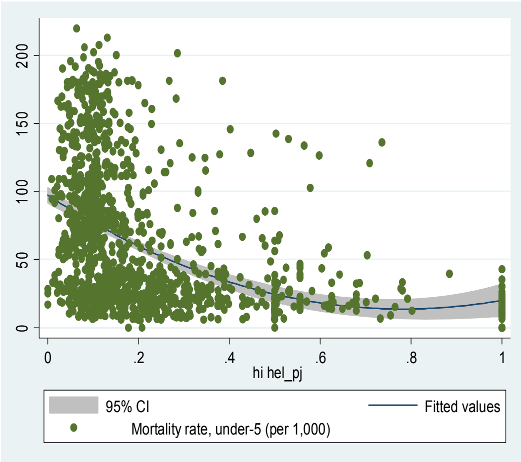
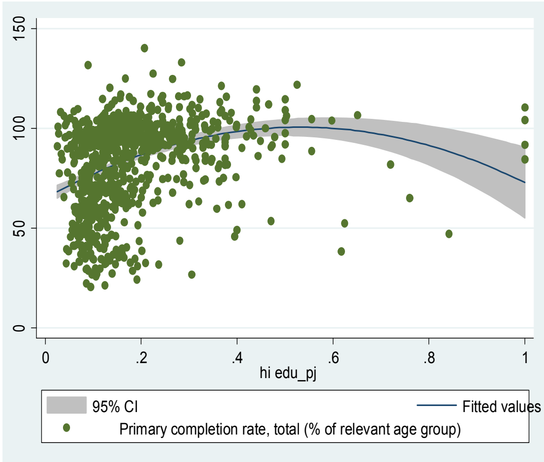


Fig. 2 Primary school completion rate and education project HHI (2002-2010)



Source：Measured based on 2007 DAC CRS data

With regard to the infant/child mortality rate, the author has added to the basic model the amount of government expenditure for health as a percentage of GDP, GDP per capita (logarithm), and the population growth rate. In addition, to check robustness, the control variables such as voice and accountability,[4] government effectiveness, regulatory quality,[5] and investment and financial deepening (M2/GDP) are added.

Since aid generally flows to the countries whose development indicators are lower, instrument variables for foreign aid will be needed to solve the reverse causality problem (Dkankov et al. 2009). Following the examples of Burnside and Dollar (2000), Easterly et al. (2004) and Dkankov et al. (2009), the author uses a variable that captures donors' "strategic interests." Since the late 1990s, "the Nordic plus" countries have been clearly and strongly committed to poverty reduction and the "aid effectiveness"

[4] Baez-Camargo and Jacobs (2011) show that voice and accountability (i.e., the extent to which citizens of a country can participate in choosing their own government, and attitudes toward freedom of expression, freedom of association, and a free media) have a positive impact on health indicators.

[5] Quantitative data for all these public-sector indicators are adopted from The Worldwide Governance Indicators 2012, Aggregate Indicators of Governance 1996-2011 (http://www.govindicators.org).

principles of the Paris declaration.[6] They have applied the "selection and concentration" principle to the selection of their target countries, while other donors did not show a clear priority. Furthermore, the volume of aid from the Nordic Plus countries collectively is considerably higher than aid from either the U.S. or Japan. In 2007 they supplied approximately 30 billion US dollars, surpassing the United States as the greatest donor in the world and accounting for nearly four times the Japanese ODA. For this reason, the author uses a dummy variable for the Nordic Plus focus countries as the instrument variable showing donors' "strategic interest."

The same independent and instrument variables are used for our analysis of primary school completion rates. The only exclusion is the amount of government expenditure on education as a percentage of GDP. This omission is due to many missing values. However, the estimation method will be designed to correct the bias.

2.3 Data

In this paper, HHI will be calculated on the basis of the number of projects which have been carried out in the recipient countries. Many of the prior works use the committed amount of project aid available at the DAC CRS (Clemens, Radelet, and Bhavnani 2004; Acharya et al. 2006; Knack and Rahman 2007; Fielding and Mavrotas 2008; Neanidis and Varvarigos 2009; Aldasoro et al. 2009; Dkankov et al. 2009; Frot and Santiso 2010; Bürcky 2011; Kihara 2012; etc.) In this paper, the disbursed amount of aid and the number of actual projects will be used for the analysis. This means that the data the author use will be limited to information from 2002 and later. This is because the DAC Secretariat recommends that CRS data should not be used for a serious

[6] The Nordic Plus countries consist of Denmark, Finland, Norway, Sweden, Ireland, the Netherlands, and the United Kingdom. Until 2002, the group covered only four Nordic countries (Denmark, Finland, Norway, and Sweden). After 2002, the group expanded to include Ireland, the Netherlands and the United Kingdom and adopted the name Nordic Plus.

analysis if the coverage ratio is not high enough.[7] It reveals that the completeness of the ODA disbursement data was below 60% before 2002, went up to above 90% in 2002, and improved to nearly 100% by 2007.

Furthermore, aid activities not directly conducted in the recipient countries are not counted as aid in this author's calculation of the project aid fragmentation. Kimura et al. (2007, 2012) exclude all aid activities with the 900 code in the DAC CRS classification because this category includes "Administrative Costs of Donors" and "Spending in donor country for heightened awareness/interest in development cooperation," which clearly have no relation to the project aid fragmentation in the recipient countries. Frot and Santiso (2010) also exclude humanitarian aid, food aid, emergency response, debt relief, budget support to NGOs, donor administrative costs, and any other aid that is not directly reflected in the projects in the field. They call the actual aid to the recipient countries Country Programmable Aid (CPA). The CPA idea was also used by the OECD (2008c) to analyze the aid fragmentation.

This paper applies the same approach to the use of data. However, for higher rigor, the author additionally excludes the 500 code items (Commodity and General Program Assistance) and limits his analysis to the projects up to the 400 codes[8] because General Budget Support and other program assistance categorized in the 500 codes were created with the aim of lowering the project aid fragmentation. The categories expectedly most responsible for the aid fragmentation are the ones coded as 400 or lower.[9]

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7 http://www.oecd.org/dac/stats/usersguidetothecreditorreportingsystemcrsaidactivitiesdatabase.htm. Hudson (2012,1) believes that on a panel data basis, it is possible to conduct a meaningful analysis using data from 2002 onwards.

8 By comparing data sets, we have been able to confirm the approximation between our data set and the OECD DAC (2010) data set.

9 To count the number of projects, we used the same method that Frot and Santiso (2008) did. The DAC CRS database assign an identification number to each aid project. Two different projects from the same donor have different ID numbers. So, it is easy to count the number of projects for each donor. There are some data deficiencies, though. Some projects reportedly transferred zero or negative financial resources and therefore need to be removed from our dataset. In addition, it must be noted that there are cases where an individual project is implemented in several locations and requires coordination among the sub-projects. The real

To calculate HHI, the principal independent variable of this paper, the author uses the number of projects classified as 400 or lower codes for 2002 in the DAC CRS database. He uses the aid amount of these projects to calculate the total amount of a donor's assistance, the donor's health aid, and education aid in a recipient country. The data from the World Development Indicator (WDI) are used for GDP growth rate per capita, the infant and child mortality rate, the primary school completion rate, population, investment, a measure of financial depth (M2/GDP), and the amount of government expenditure for health. The governance indicators are from Aggregate Governance Indicators in Kaufmann, Kraay and Mastruzzi (2010). However, since it was not possible to obtain the data for every year for every country, the author has carried out an unbalanced panel analysis. Table 2 lists the descriptive statistics used in the present analysis.

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transaction cost may be underestimated by counting the number of projects. The analysis is limited by these data inadequacies.

Table 2: Descriptive Statistics

Variable	Observations	Average	Standard deviation	Minimum value	Maximum value
Infant & child mortality rate	1289	61.30	51.70	0.00	219.60
Primary school completion rate	877	83.42	22.21	20.55	140.17
Health project HHI	1334	0.26	0.26	0.00	1.00
Health project HHI^2	1334	0.13	0.26	0.00	1.00
Education project HHI	1366	0.22	0.19	0.00	1.00
Education project HHI^2	1366	0.09	0.18	0.00	1.00
Health aid as % of GDP	1244	0.55	1.25	0.00	27.25
Education aid as % of GDP	1244	0.79	1.50	0.00	15.82
Gov't health expenditure as % of GDP	1253	3.50	2.71	0.03	21.11
Health aid * Health HHI	1220	0.13	0.48	0.00	10.22
Health aid * Health HHI^2	1220	0.05	0.22	0.00	3.83
Education aid * Education HHI	1240	0.18	0.55	0.00	7.27
Education aid * Education HHI^2	1240	0.06	0.23	0.00	3.34
Population growth rate	1049	2.33	1.55	-0.69	7.20
GDP per capita (logarithm)	1244	7.43	1.19	4.65	10.23
M2 (Financial Deepening)	1160	49.34	34.34	4.89	247.82
Investment	1230	5.18	7.94	-37.62	161.80
Government Effectiveness	1272	-0.50	0.66	-2.45	1.59
Regulatory Quality	1272	-0.49	0.72	-2.68	1.54
Voice and Accountability	1281	-0.39	0.86	-2.28	1.34
Nordic Plus focus countries dummy	1388	0.39	0.49	0	1
Countries	1379	87.62	56.15	1.00	182

3. Analysis

3.1 Basic model

In designing a regression analysis of aid effectiveness, many of the existing studies discuss the need to consider the problem of endogeneity. The dynamic panel GMM (Generalized Method of Moments) recommended by Hansen and Tarp (2001) include the techniques of the Difference GMM and the System GMM. First, to correct the possibility of correlation between the independent variable and the disturbance term caused by missing variables, the author considered introducing the Arellano-Bond (1991) test, which is based on a method first proposed by Holtz-Eakin, Newey and Rosen (1988). However, it is equivalent to the Difference GMM estimation. Difference

GMM is used to correct for bias stemming from fixed effects by taking first differences. It also corrects for endogeneity by using the lag between predetermined variables and endogenous variables as the instrumental variable. However, as Arellano and Bover (1995) warn, when the coefficient for a lagged dependent variable is close to one, the probability of proximity to random walk is high, and in that case, the lagged level is a weak instrumental variable for first differences. Arellano and Bover (1995) and Blundell and Bond (1998) developed the System GMM estimation to mitigate this problem.[10] The System GMM conducts an analysis by levels before taking the differences into account. This paper uses the System GMM uniformly since the coefficient for the lagged dependent variable for the infant and child mortality rate and the primary school completion rate is higher than 0.8 according to our estimation. The author postulates the following equation for the System GMM.

$$y_{it} = \beta_1 y_{i,t-1} + \beta_2 HHI_{it} + \beta_3 HHI^2{}_{it} + (\beta_2 HHI_{it} + \beta_3 HHI^2{}_{it}) \times Aid_{it} + \beta_{En} En_{it} + \beta_{\mathrm{Ex}} Ex_{it} + \alpha_i + \alpha_t + \varepsilon_{it}$$

The indices i and t represent the aid recipient country and the aid given period respectively. y is the dependent variable which is the infant and child mortality rate and the primary school completion rate. On the right-hand side, the equation uses *HHI* and HHI^{2} (square of HHI) as indicators of project aid fragmentation (concentration), as well as their respective interaction terms with the amount of aid as percentage of GDP (*Aid*) for health and education.

En_{it} indicates the matrix of predetermined variables and endogenous variables. For the infant and child mortality rate, these variables cover government health expenditure as a percentage of GDP, GDP growth rate per capita (logarithm), voice and accountability, government effectiveness, regulatory quality, investment, and M2. For the primary school completion rate, they cover the same as for the infant and child

[10] However, the "weak instruments" problem continues to be discussed in the works such as Bun and Windmeijer (2010).

mortality rate except for government education expenditure as a percentage of GDP, which is excluded because many values are missing. Ex_{it} indicates the exogenous variables such as a time dummy and the population growth rate. The author also uses the "Nordic Plus focus" dummy as the instrumental variable. Finally, α_i、α_t、and ε_{it} are country-specific fixed effects, year-specific effects, and a well-behaved error term, respectively.

For each of the abovementioned System GMM estimations, the author uses the Hansen's J test to examine whether the instrumental variable fulfills the disturbance term and orthogonal conditions, while he uses the Arellano-Bond test to check autocorrelation in the disturbance term.[11] The author also employs a one-step estimation with robust standard error.

3.2 Estimation results

First, the author looks at the relationship between project aid fragmentation and the infant and child mortality rate. The infant and child mortality rate, indicating the probability of a child dying between birth and five years of age, is expressed in a mortality rate per 1000 live births. Therefore, we need to bear in mind that the increase of the numerical value indicates the worsening of infant and child mortality. Table 3 summarizes the results of the System GMM estimation on the rate.

[11] It is possible to estimate Difference GMM with the xtabond2 Stata command created by David Roodman.

Table 3: Project Fragmentation and Infant and Child Mortality Rate

Dependent variable	Infant & Child Mortality					
	(1)	(2)	(3)	(4)	(5)	(6)
Infant and child mortality rate (t-1)	0.976***	0.978***	0.981***	0.977***	0.980***	0.982***
	(0.00851)	(0.00928)	(0.00940)	(0.00910)	(0.0101)	(0.0108)
Health project concentration index (HHI) (endogenous)	7.690**	8.408**	10.67**	8.277**	8.837***	6.236**
	(3.067)	(3.368)	(4.376)	(3.598)	(3.043)	(2.745)
HHI squared (HHI^2) (endogenous)	−4.192*	−7.479***	−8.423**	−6.185**	−4.954*	−4.233*
	(2.513)	(2.843)	(3.876)	(2.840)	(2.588)	(2.328)
Amount of health aid as % of GDP * HHI (endogenous)	5.319	8.115*	8.106*	7.786*	5.936**	5.112*
	(3.456)	(4.351)	(4.369)	(4.210)	(2.986)	(2.881)
Amount of health aid as % of GDP * HHI^2 (endogenous)	−6.974	−9.606*	−9.840*	−9.467*	−7.774**	−6.387*
	(4.417)	(5.273)	(5.331)	(5.159)	(3.881)	(3.623)
Amount of health aid as % of GDP (endogenous)	−0.818	−1.097	−1.066	−1.033	−0.933	−0.867
	(0.696)	(0.889)	(0.926)	(0.931)	(0.580)	(0.571)
Government health expenditure as % of GDP (endogenous)	−0.164**	−0.523**	−0.443***	−0.388***	−0.176**	−0.203**
	(0.0793)	(0.204)	(0.142)	(0.141)	(0.0748)	(0.0972)
GDP growth rate per capita (logarithm) (endogenous)	−0.0333	0.0887	−0.0406	−0.125	−0.0435	0.310
	(0.402)	(0.423)	(0.409)	(0.401)	(0.412)	(0.510)
Population growth rate (exogenous)	0.260	0.360	0.0233	0.194	0.193	0.403**
	(0.206)	(0.255)	(0.182)	(0.211)	(0.191)	(0.190)
Voice and accountability (endogenous)		0.856				0.747
		(0.938)				(0.580)
Government effectiveness (endogenous)			−0.437			
			(0.982)			
Regulatory quality (endogenous)				0.355		
				(1.216)		
M2/GDP (endogenous)		0.000381	0.0126	−0.00161		
		(0.0103)	(0.0108)	(0.0119)		
Investment (endogenous)					−0.0147	−0.0151
					(0.0474)	(0.0446)
yr2003 (exogenous)	−1.414	−1.206	−1.727	0.114	−1.563	−3.654
	(3.053)	(3.191)	(3.086)	(2.970)	(3.429)	(4.025)
yr2004 (exogenous)	−1.401	−1.266	−1.761	0.0822	−1.522	−3.695
	(3.113)	(3.226)	(3.141)	(3.040)	(3.457)	(4.063)
yr2005 (exogenous)	−1.630	−1.362	−1.890	−0.0245	−1.774	−3.890
	(3.133)	(3.255)	(3.169)	(3.061)	(3.493)	(4.086)
yr2006 (exogenous)	−1.010	−0.716	−1.094	0.683	−1.056	−3.404
	(3.265)	(3.385)	(3.348)	(3.257)	(3.578)	(4.223)
yr2007 (exogenous)	−1.095	−0.731	−1.147	0.661	−1.134	−3.478
	(3.305)	(3.427)	(3.386)	(3.303)	(3.628)	(4.276)
yr2008 (exogenous)	−1.182	−0.825	−1.251	0.587	−1.224	−3.568
	(3.363)	(3.479)	(3.425)	(3.344)	(3.689)	(4.335)
yr2009 (exogenous)	−1.118	−0.780	−1.250	0.636	−1.172	−3.520
	(3.342)	(3.451)	(3.408)	(3.311)	(3.651)	(4.295)
yr2010 (exogenous)	−0.0710	0.400	−0.0704	1.827	−0.118	−2.492
	(3.348)	(3.509)	(3.632)	(3.782)	(3.604)	(3.987)
Arellano-Bond test AR (1)	0.043	0.04	0.039	0.044	0.04	0.056
Arellano-Bond test AR (2)	0.632	0.665	0.572	0.569	0.613	0.65
Hansen test	0.276	0.326	0.28	0.361	0.155	0.255
lag(difference)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)
Number of observations	1,058	985	984	984	1,050	1,050
Number of countries	137	130	130	130	137	137
Number of instruments	104	128	128	128	116	128

Note: All values in parentheses indicate robust standard error. Three stars (***), two stars (**), and one star (*) refer to a significance level of 1%, 5%, or 10% respectively, and indicate statistically significant differences from zero. The instrumental variable is the dummy of Nordic Plus focus countries.

As can be seen in Table 3, the infant and child mortality rate is positively and significantly correlated with the health project concentration index (HHI). Similarly, it is significantly correlated with HHI^2 but the direction of correlations is negative. This indicates that the effect of "project aid fragmentation" on the infant and child mortality rate is an inverted-U relationship. When the health project concentration index (HHI) is very small, or conversely very high, the infant and child mortality rate will improve. The rate will be the worst at the mid-range of fragmentation.

Both the “amount of health aid as % of GDP” and the “Government health expenditure as % of GDP” have negative coefficients with the aid fragmentation, which means that the scale of health aid and government health expenditure can contribute to reducing the infant and child mortality rate. However, the correlation is not statistically significant in the case of health aid. Only when the amount of health aid as a percentage of GDP is interacted with HHI and HHI^2, does the coefficient turns statistically significant except for model (1). The direction of the correlation is positive for HHI and negative for HHI^2. This result is the same in the case in which HHI and HHI^2 are regressed independently. However, the coefficient is persistently greater for the interaction terms between aid amount and HHI^2 than for HHI^2 alone, which suggests that the positive impact of the project aid concentration goes up as the amount of health aid as a percentage of GDP increases.

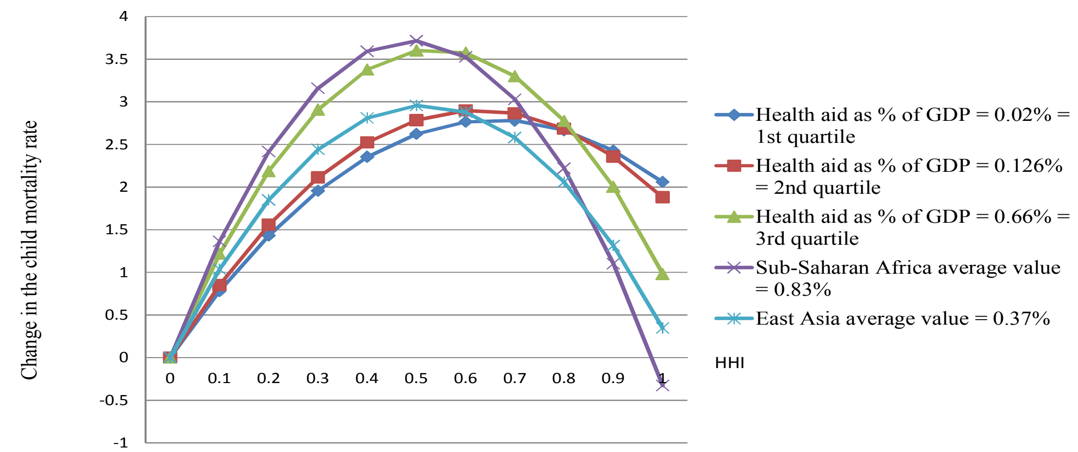
As for the other control variables, only the “population growth” in the model (6) shows statistically significant and negative correlations with the infant and child mortality rate. The variables for economics and governance are not statistically significant.

The results of our estimation are generally robust and do not change even when different models are applied. Furthermore, for all the models used, both the Arellano-Bond test that checks auto-correlations in the disturbance term and the Hansen’s J test that checks whether the instrumental variable fulfills the disturbance term and orthogonal conditions show reasonable values, which indicates that the models are suitable. In addition, as the last column of Table 3 indicates, the number of instruments does not exceed the number of countries in the regression.[12]

Nevertheless, the above mentioned evaluation based only on coefficients for each of the variables has limitations in interpreting the overall effect of HHI. The author therefore decided to visualize the effect by applying specific values to the model (4) in which results look most significant for the major independent variables. For this purpose, the author first identified the first, second, and the third quartile groups with regard to the amount of health aid as a percentage of GDP. In addition, the author calculated the average values of aid amounts as a percentage of GDP for Sub-Sahara Africa and East Asia. Then, the author input these values into the following equation and shows the result in Figure 3.

Overall effect of HHI on the infant and child mortality rate = (HHI coefficient + Aid * Coefficient of the interaction term between HHI and aid) x HHI + (HHI^2 coefficient + Aid * Coefficient of the interaction term between HHI^2 and aid) x HHI^2

Fig. 3: Overall HHI effect for the infant and child mortality rate among different groups



All the cases in Figure 3 demonstrate inverted U curves, suggesting that the

[12] Roodman (2007b) points out that the number of instruments should not exceed the number of countries in the regression.

infant and child mortality rate worsens as the HHI goes up and reaches the peak when HHI is between 0.5 and 0.7. Although the rise of the mortality rate slows down as HHI further increases, it never turns negative except for the case of Sub-Saharan Africa where the rate of health aid to GDP is as high as 0.83%. Even in Africa, such phenomenon would happen in an exceptional case where the aid concentration is close to 100%. As a whole, no reduction in the infant and child mortality rate can be expected from the decline of the project aid fragmentation.

Table 4 summarizes the results of the System GMM estimation of the impact of the project aid fragmentation on the primary school completion rate. The coefficient for the completion performance shows the pattern opposite to the one for the mortality-rate increase. The improvement of the primary school completion rate correlates significantly but negatively with the aid concentration (HHI) in all the models except (2) and (5). Meanwhile, the correlation between HHI^2 and the aid concentration is significantly positive. These results indicate that the primary school completion rate declines as the aid concentration goes up, although the decline is mitigated as the concentration further increases.

Table 4: Project Fragmentation and Primary School Completion Rate

Dependent Variable	Primary School Completion Rate						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Primary school completion rate (t-1)	0.849*** (0.0368)	0.848*** (0.0376)	0.847*** (0.0358)	0.858*** (0.0345)	0.834*** (0.0407)	0.838*** (0.0377)	0.850*** (0.0362)
Education project concentration index (HHI) (endogenous)	−18.11* (10.36)	−16.63 (10.75)	−19.02* (11.34)	−20.31** (10.06)	−17.11 (11.09)	−19.97* (11.13)	−21.55** (10.16)
HHI squared (HHI^2) (endogenous)	34.10** (13.93)	32.78** (13.71)	36.36** (16.37)	35.72** (14.22)	33.72** (14.67)	37.30** (16.44)	37.88** (14.77)
Amount of education aid as % of GDP*HHI (endogenous)	23.84** (11.40)	21.51** (9.344)	24.26** (10.92)	21.94* (11.66)	18.80* (9.761)	23.08** (11.38)	21.07* (12.38)
Amount of education aid as % of GDP*HHI^2 (endogenous)	−32.00** (15.15)	−29.10** (12.49)	−32.78** (14.57)	−29.08* (16.04)	−26.26** (13.02)	−31.96** (15.29)	−28.65* (17.07)
Amount of education aid as % of GDP (endogenous)	−4.157* (2.134)	−3.676** (1.749)	−4.219** (2.031)	−3.856* (2.076)	−3.038* (1.814)	−3.854* (2.078)	−3.560 (2.184)
GDP growth rate per capita (logarithm) (endogenous)	−0.0912 (0.987)	0.0329 (0.873)	−0.111 (0.990)	0.0388 (0.843)	0.545 (0.826)	0.283 (0.930)	0.333 (0.852)
Population growth rate (exogenous)	−0.871* (0.456)	−0.898* (0.457)	−0.970** (0.457)	−0.780* (0.441)	−0.884* (0.459)	−0.855* (0.436)	−0.689 (0.429)
Voice and accountability (endogenous)		−0.219 (0.647)			−0.311 (0.677)		
Government effectiveness (endogenous)			−0.289 (0.996)			0.0217 (0.990)	
Regulatory quality (endogenous)				0.0491 (1.105)			0.425 (1.107)
Investment (endogenous)					0.0147 (0.0701)	0.00346 (0.0662)	0.0141 (0.0704)
yr2003 (exogenous)	17.50*** (6.629)	16.31*** (5.389)	17.84*** (6.536)	15.99*** (5.822)	13.55*** (5.100)	15.71** (6.200)	14.49** (5.861)
yr2004 (exogenous)	18.81*** (6.783)	17.59*** (5.617)	19.16*** (6.740)	17.28*** (6.063)	14.76*** (5.344)	16.98*** (6.420)	15.73** (6.115)
yr2005 (exogenous)	18.44*** (6.616)	17.26*** (5.445)	18.87*** (6.517)	16.97*** (5.812)	14.43*** (5.156)	16.70*** (6.179)	15.45*** (5.831)
yr2006 (exogenous)	18.44** (7.201)	17.22*** (5.898)	18.81*** (7.112)	16.78*** (6.382)	14.25** (5.599)	16.55** (6.774)	15.17** (6.481)
yr2007 (exogenous)	18.70** (7.159)	17.46*** (5.828)	19.07*** (7.071)	17.04*** (6.367)	14.45** (5.536)	16.77** (6.723)	15.40** (6.463)
yr2008 (exogenous)	18.41** (7.212)	17.18*** (5.874)	18.81*** (7.090)	16.80*** (6.345)	14.14** (5.538)	16.49** (6.721)	15.16** (6.413)
yr2009 (exogenous)	18.22** (7.183)	16.99*** (5.903)	18.59** (7.131)	16.60** (6.363)	13.93** (5.565)	16.24** (6.748)	14.92** (6.409)
yr2010 (exogenous)	18.38** (7.320)	17.11*** (6.005)	18.76** (7.224)	16.73** (6.425)	14.05** (5.648)	16.41** (6.832)	15.05** (6.460)
Arellano-Bond test AR (1)	0	0	0	0	0	0	0
Arellano-Bond test AR (2)	0.964	0.953	0.967	0.965	0.947	0.977	0.971
Hansen test	0.702	0.805	0.884	0.694	0.705	0.786	0.697
lag(difference)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)
Number of observations	664	664	664	664	664	664	664
Number of countries	123	123	123	123	123	123	123
Number of instruments	92	104	104	104	116	116	116

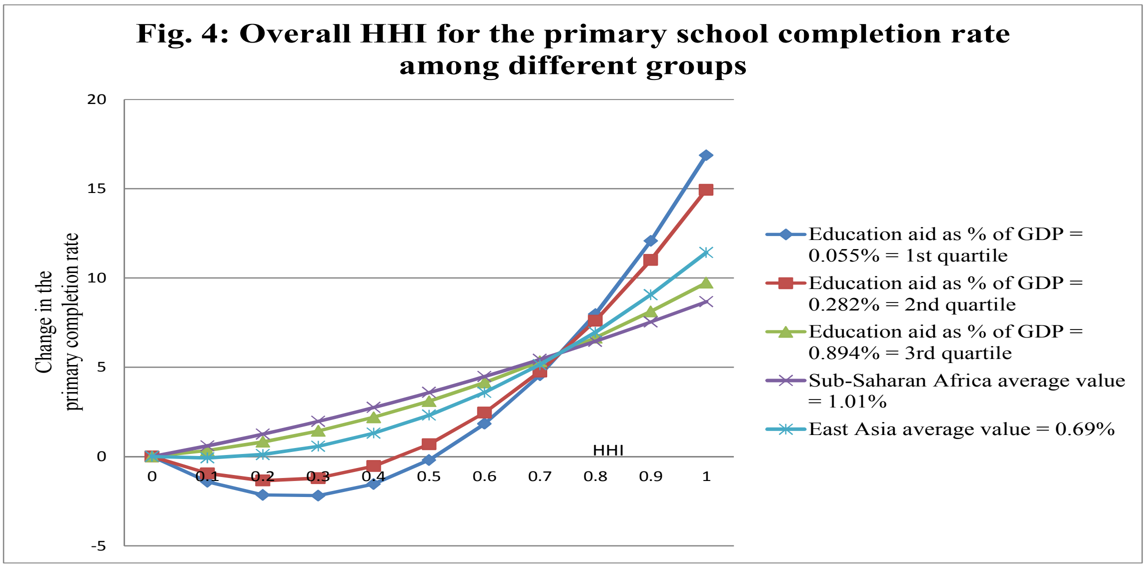
Note: All values in parentheses indicate robust standard error. Three stars (***), two stars (**), and one star (*) refer to a significance level of 1%, 5%, or 10% respectively, and indicate statistically significant differences from zero. The instrumental variable is the dummy of Nordic Plus focus countries.The result on M2 is not shown here because it is not statistically significant.

Table 4 also shows that the amount of education aid as a percentage of GDP is negatively correlated with the improvement of the primary school completion rate. The same table, however, demonstrates that the interaction terms between the amount of aid as a percentage of GDP and HHI correlates positively and significantly with improvements in the completion rate. This means that when the amount of education aid as percentage of GDP is high, aid concentration helps improve the primary school completion rate.

The author found no statistically significant result for control variables except for the "population growth rate."

These results are robust across the different models. For all the models, both the Arellano-Bond test and the Hansen's J test show reasonable values while the number of instruments does not exceed the number of countries in the regression.

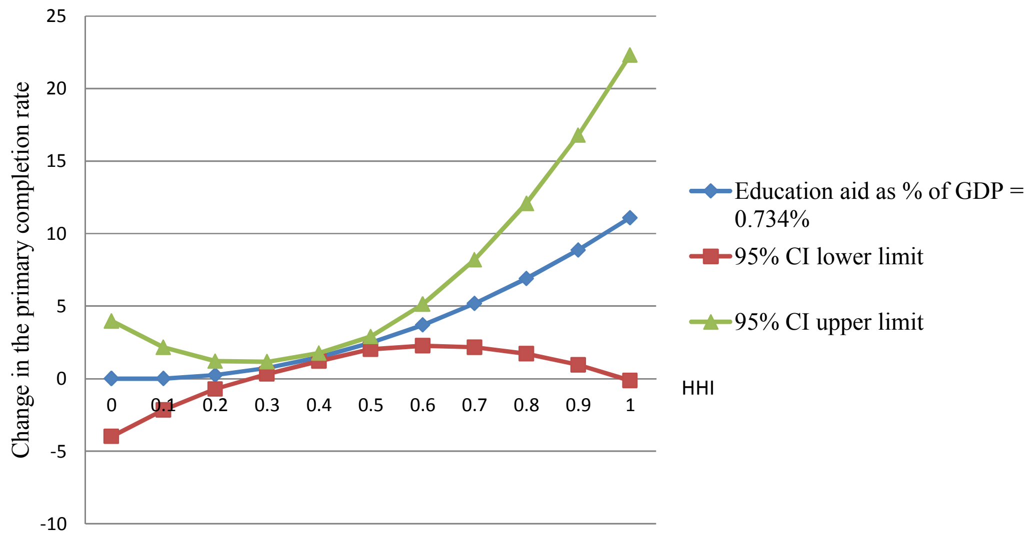
Figure 4 below shows the visualized simulation of the overall effect of HHI on the primary school completion rate, similar to the one for the infant and child mortality rate. The author input the values for the three quartile groups and the two regions using the model (3) of Table 4, where the results look most statistically significant.



As shown in this figure, when the amount of aid as percentage of GDP is relatively low (0.055% in the first quartile and 0.282% in the second quartile), the rate of primary school completion declines as HHI increases from 0 to 0.45 or 0.5 with the lowest point reached at 0.2 or 0.3. It starts to improve after HHI reaches 0.45 or 0.5. When the amount of aid as percentage of GDP is relatively high as in the third quartile (with 0.894%) and in Sub-Sahara Africa (with 1.01%), the primary school completion rate goes up constantly as the aid concentration increases. East Asia (with 0.69%) is somewhere in between these two cases. The completion rate starts to improve only after the HHI reaches 0.2 there.

To make the estimate more credible, the author carried out an additional simulation by varying the values for the amount of education aid as percentage of GDP with 95% confidence interval (CI). Figure 5 displays the finding that the threshold of positive effects for the primary school completion rate exists at around 0.734% aid amount as percentage of GDP. Beyond this threshold, aid concentration gives consistently positive impacts on the completion rate.

Fig. 5. Threshold case for primary school completion (education aid as % of GDP = 0.734)



4. Conclusion

This paper has empirically examined the overall effect of project aid fragmentation on the infant and child mortality rate and the primary school completion rate. Project aid fragmentation is a situation in which a large number of fragmented and non-coordinated donor projects are introduced in a recipient country raising the transaction costs of the recipient government. To measure project aid fragmentation, this paper used the DAC CRS disbursement data on the projects directly integrated into the programs of recipient countries. To quantify the extent of the project aid fragmentation, the author calculated the Herfindahl-Hirschman Index (HHI), not by the usual method which relies on the amount of aid, but on the basis of the number of projects.

Since there is non-linear relationship between project aid fragmentation and the infant and child mortality rate or the primary school completion rate, the author included not only HHI but also squared HHI (HHI^2) as the polynomial model. The author estimated the impact of each variable, controlling for the influence of other variables, and found that the result differs from one sector to another. The relationship between the project aid fragmentation and the infant and child mortality rate shows an inverted U curve suggesting that the infant and child mortality rate worsens as HHI increases up to a certain point. Furthermore, even if the project aid fragmentation declines beyond such a point, the effect is no greater than lowering the rate at which the mortality rate worsens. The infant and child mortality rate improves only in the case where the recipient country is heavily dependent on health aid and the HHI is exceptionally high.

The reduction of project aid fragmentation has a better chance to contribute to improving the primary school completion rate. Especially in the countries whose dependence on aid is relatively high in education, consistently positive impacts from the concentration of project aid can be expected.

It is clear that the effect of aid concentration (the reduction of aid fragmentation) varies among different sectors and depends on the level of dependence on aid of each recipient country in each sector. In the future discussion of aid effectiveness, sectoral variations should be seriously taken into account.

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Abstract (in Japanese)

要約

本稿は、欧米ドナー間で「援助の氾濫」に対する批判がある中で、プロジェクト援助の集中度と援助の有効性との関係を実証分析によって示すことを目的としている。これまでの「援助の氾濫」と援助の有効性との関係にかかる先行研究の問題点は、本来限定的であるプロジェクト援助の効果を国レベルでみていたことである。これに対して、本稿では、特定のセクター――保健及び教育セクター――に限定して、それぞれのセクターに対して、プロジェクト援助の集中度と援助の有効性の関係を、途上国の援助依存度も考慮に入れつつ示した。その結果、乳幼児死亡率に関しては、「援助の氾濫」を改善しても、それにより乳幼児死亡率への悪影響が小さくなるかは判断できない結果となった。つまり、保健プロジェクト援助の集中の程度を高めても乳幼児死亡率を軽減しない可能性があることが示された。また、中途半端なプロジェクトの氾濫の改善はかえって悪化を示すことが認められた。一方、初等教育修了率に関しては、おおむね、プロジェクト援助を集中させることにより、一貫して正の影響を与えることが示された。

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