THE IMPACT OF SECTORAL AIDS ON POVERTY REDUCTION IN LATIN AMERICA

By

JEONG, So Jeong

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

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Committee in charge:

Professor Kye-Woo LEE, Supervisor

Professor Baran HAN

Professor Booyuel KIM

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Abstract

The Impact of Sectoral Aids on Poverty Reduction in Latin America

By

Sojeong Jeong

This study aims to analyze the impacts of sectoral aids on poverty in order to provide an empirical demonstration on whether it is reasonable to continue allocating over half of aid budget on social sector in most developing countries[1] and identify if there is a more effective way of aid allocation for achieving the goal of 'ending poverty' in Sustainable Development Goals (SDGs) that has been initiated since 2016.

This paper deals with 16 developing countries in Latin America from 2005 to 2015, and conducts panel data analyses with OLS, fixed effects, and random effects regression models. First, the each year analysis shows that economic infrastructure aid and production aid have statistically significant impacts on poverty reduction. However, the result is not robust in the 3-year time lag analysis which finds that economic infrastructure aid is the only effective aid for poverty reduction. Therefore, this paper recommends to allocate aid funds for both production sector and economic infrastructure according to the size of the coefficient of each variable with the period of time taken into account.

[1] OECD Statistics - Creditor Reporting System (Date last updated 15 June 2017)

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I. Introduction

1.1.Purpose of study

The purpose of this study is to analyze the impacts of sectoral aids on poverty. It aims to provide an empirical demonstration on the rationality of allocating over half of aid budget on social infrastructure and service and to propose a better way of aid fund allocation to achieve the goal of 'ending poverty' in Sustainable Development Goals (SDGs) which was initiated in 2016.

1.2. Statement of problem

'Eradication of extreme poverty and hunger' was the first Millennium Development Goal (MDG) established by United Nations in 2000. As a result, the global number of extreme poor had shrunk from 1.75 billion in 1999 to 836 million in 2015[2]. Following the remarkable progress in poverty reduction by more than half during the MDGs period, the goal has been prolonged to the SDGs with two separate goals in the names of 'no poverty' and 'zero hunger.' Holding the continued importance and concerns on poverty eradication, strategic allocation of aid would be necessary to achieve the zero poverty target within the SDGs period by 2030.

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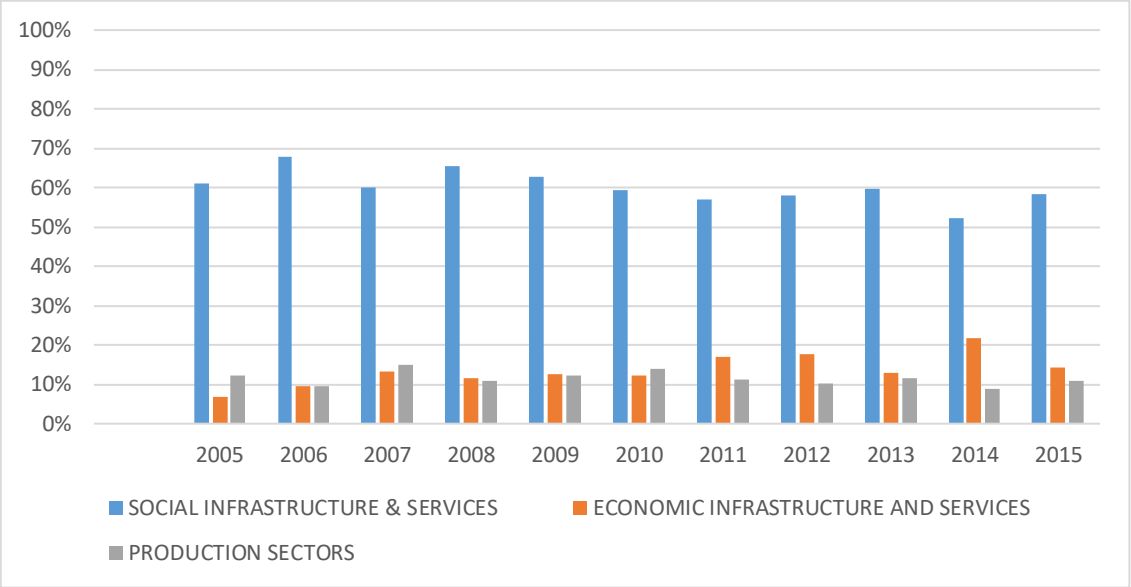
[2] The Millennium Development Goals Report 2015, United Nations

<Figure 1> Aid by sector in Latin America and Caribbean countries (2005-2015)

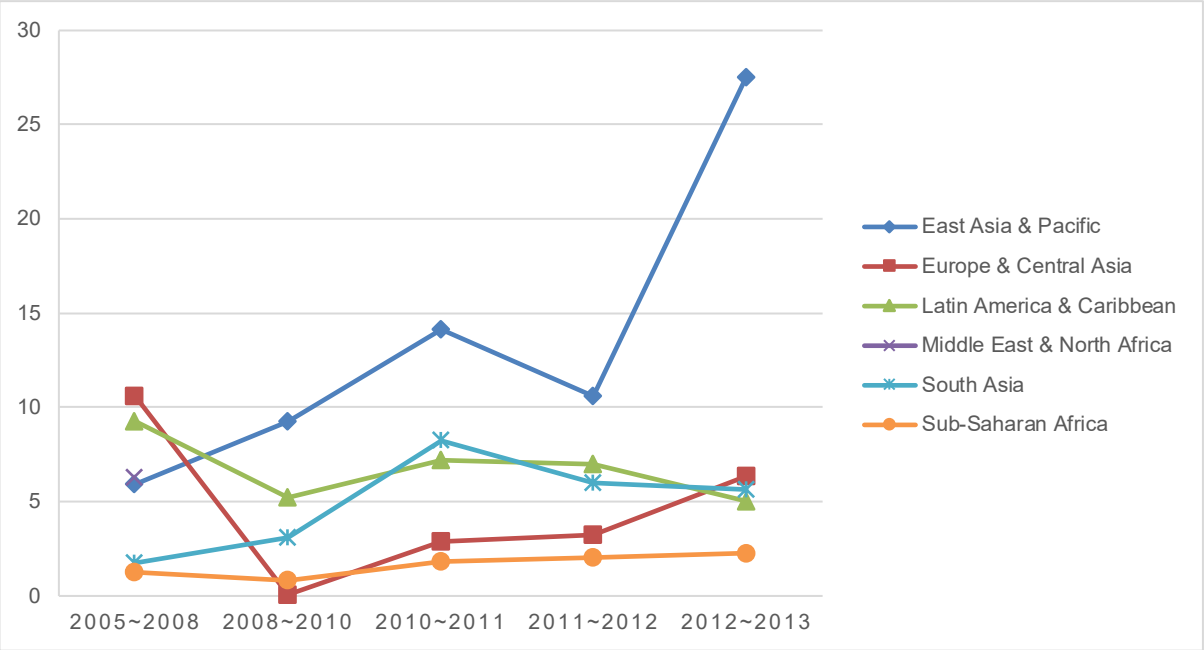


Source: OECD Statistics (GeoBook: ODA by sector – bilateral commitments by donor and recipient)

During the last decade, as seen in the Figure 1, half of the bilateral official development assistance (ODA) in Latin America and Caribbean countries have been allocated to social infrastructure and service sector. However, it has not yet been empirically proven if it is the most effective way of distributing aid fund for poverty eradication. Therefore, this study aims to figure out which sectoral aid has a statistically significant impact on poverty reduction and to suggest increasing the weight of aid fund to the relatively more effective sector.

More specifically, this study deals with the developing countries of Latin America and Caribbean region because for the last 10 years, the poverty reduction rate of the region did not progress compared to other regions, especially East Asia and Pacific as one can see in the Figure 2. So it is necessary to have a closer look at the efficiency of aid allocation in Latin America and Caribbean region.

<Figure 2> Average annual poverty reduction rate of developing countries by region



Source: World Bank, Development Research Group

1.3. Significance of the issue

The international society began to pay attention to poverty alleviation when Robert McNamara, former president of the World Bank, declared it as a key priority for the Bank's activities (Bodenstein and Kemmerling 2015) in his Nairobi speech in 1973. Although the focus aid had been diverted following the two oil shocks, debt crisis, and Asian financial crisis (Lee 2011), the issue was brought up again in 1990s by the World Bank and OECD, henceforth became a global task since 2000 when United Nations set the MDGs. To achieve the common goals, each country's government planned and implemented ODA projects. Furthermore, it also gave rise to proliferation of civil society organizations (CSOs) and non-governmental organizations (NGOs) aiming for poverty eradication.

The global effort brought a successful result of halving extreme poverty. However, the population of the world's poor still remains over 800 million. For this reason, it is necessary not only to raise the aid fund but also to find out the most effective way of

distributing aid for poverty eradication. Moreover, the OECD report on aid effectiveness (2011) highlighted the necessity of further research on the relationship between aid, growth, and poverty reduction for better allocation of aid resources, thus for increase of aid effectiveness.

1.4. Research question

Does social infrastructure aid reduce poverty more effectively than all other sectoral aids? In a theoretical perspective, we can build a positive hypothesis because it is presumed to be most directly targeted at the poor rather than the entire population. The previous literatures examined the effects of aggregated aid on poverty reduction but none of them elaborated on the partial effect of each sectoral. Therefore, the aforementioned hypothesis has to be empirically tested.

II. Literature Review

2.1. Studies on the relationship of foreign aid and poverty

Until now, the impact of aid on economic growth has been the major issue among the development studies and discussed in many previous studies (Burnside and Dollar 2000; Hansen and Tarp 2001; Easterly, Levine, and Roodman 2003, etc). Also, the impact of economic growth on poverty reduction has been studied (Roemer and Gugerty 1997; Klasen 2008, etc).

However, there have been much less research conducted on the direct relationship between aid and poverty reduction, even less dealing with disaggregated aid. Despite contradicting results, the studies that support the positive relationship between aid and poverty reduction outnumber those against it.

2.2.Studies on negative relationship

Bane and Ellwood (1983) point out that pro-poor aid programs might be helpful to relieve short-term poverty, but in terms of chronic poverty, it could bring another serious problem, which is aid dependency.

Besley and Burgess (2003) show a negative view towards the impact of foreign aid on poverty alleviation. They suggest that domestic reforms play a major role in reducing poverty rather than international actions.

2.3. Studies on positive relationship

Alvi and Aberra (2012) demonstrated that aid has a significantly positive effect on poverty reduction even after controlling for average income. The result is robust using three different poverty index: poverty rate, poverty gap index, and squared poverty gap index. In addition, they found that multilateral aid and grants are more effective in poverty alleviation than bilateral aid and loans.

On the other hand, there are studies which found positive relationship between aid and poverty reduction under certain circumstances. Burnside and Dollar (1998) suggested that aid is effective in reducing infant mortality rate, used as a proxy for poverty, only in countries with good policy environments. Collier and Dollar (1999, 2000) also figured out that aid can reduce absolute poverty of which effect is greater in the countries that are poorer and that have better policies and institutions.

Based on these studies, Lee, Seon, and Park (2012) empirically tested whether foreign aid was efficiently allocated in Latin America according to the two criteria of Collier and Dollar (2002) as the economic growth rate and poverty reduction rate had been lagging behind in the region compared to developing countries in Asia. They found that aid allocation among the countries of the region in practice does not correspond with

the optimal allocation but it still reflects in a large part the economic interests of donor countries.

On the other hand, assuming that the improvement in Human Development Index (HDI)[3] includes poverty reduction, it is also interesting to look at the study of Masud and Yontcheva (2005), which investigated the impact of foreign aid on HDI with the evolution of aid objectives from intensive industrialization programs to more poverty-reducing objectives such as the MDGs. Their results showed that aid has a positive impact on reducing infant mortality in general but point out that aid provided by NGOs is more effective than bilateral aid.

Bahmani-Oskooee and Oyolola (2009) also contributed to reaffirm the positive effects of foreign aid on poverty reduction controlling for donors' interests, population, and infant mortality, using pooled time-series and cross sectional data from 49 developing countries over the period of 20 years. However, they found that the impact of foreign aid on poverty reduction is not as robust as that of inequality or growth.

Alvi and Senbeta (2012) examined the effect of foreign aid on poverty reduction using dynamic panel estimation techniques. Their results suggested that aid has a significant and positive impact on poverty reduction even after controlling for average income. They found out that foreign aid is associated with a decline in poverty as measured by the poverty rate, poverty gap index, and squared poverty gap index.

2.4. Studies on insignificant relationship

Arvin and Barillas (2002) examined causality between foreign aid and poverty using the method of Granger causality. They tested whether aid flows impact poverty, whether

[3] HDI is a composite index of life expectancy index, education index, and GNI index.

poverty influences aid flows, or whether they have simultaneous causality. Their result suggest that given a country's state of democracy, aid does not have a significant impact on poverty nor does poverty affect the level of aid given.

Chong et al (2009) tested the effect of foreign aid on income inequality and poverty reduction for the period 1971-2002 using dynamic panel data techniques. They found that aid does not have a statistically significant impact on income distribution or poverty reduction even when institutional quality is taken into account.

The literature review reveals that while most of the previous researches measured the impact of total aid on poverty reduction, it needs to be followed by further studies in order to estimate the effects of sectoral aids on poverty alleviation. It would help the policy makers in both donor and recipient countries to allocate and use aid more efficiently.

III. Methodology and Data

So this paper estimates the impact of sectoral aids on poverty reduction by running a regression using panel data. In order to explain it in more detail, this part of the study consists of four sub-parts: model specification, data, variables, and analysis methodology.

3.1. Model specification

The model for the effect of disaggregated aids on poverty can be expressed as follows.

$$Y_{it} = \alpha + AID'_{it}\beta + X'_{it}\gamma + \varepsilon_{it}$$

where,

i stands for country and t stands for year,

Y is a measure of poverty reduction rate[4],

AID is the vector of the sectoral aids which are the core independent variables,

X is the vector of other independent variables (GDP per capita, GDP growth rate, trade, FDI, personal remittances, national investment, government expenditure, public health expenditure, inflation, CPIA, population growth rate, and rural population)

ε denotes error term.

3.2. Data

This study uses panel data of 16 Latin American developing countries during 2005-2015[5]. The type and source of data are illustrated in Annex1.

In addition, since aid projects usually take at least 3 years to take effect, this study also conducts 3-year time lag analysis with four time periods (2005-2007, 2008-2010, 2011-2013, and 2014-2015[6]). For this, all independent variables are averaged into 3 years except the last period which was averaged into 2 years. The dependent variable is calculated to see the annual average poverty reduction rate as following:

$$Y = \frac{\left\{\frac{Y_{t3} - Y_{t0}}{Y_{t0}}\right\}}{3}$$

---

[4] Poverty reduction rate is derived from poverty headcount ratio and the method of calculation is described in the data part.

[5] There were two limitations in selecting the sample and the period. At first, all 140 developing countries categorized as low and middle income countries by World Bank Development Indicators were to be taken into account, but after omitting the countries with no or few data in order to have the strongly balanced panel data, finally 25 countries left, of which the majority were Latin American countries, so the countries from other regions were also excluded from this study. Moreover, it was more desirable to take the entire MDG period (2000-2015) to observe the impact of promoting pro-poor aids on poverty reduction rate, but due to the limitation of availability of sectoral aids data, this paper takes the time period during 2005-2015.

[6] The last period consists of two years as the year 2015 is the latest available data and the number of years taken in this study is 11, therefore, one period has to by two years.

The purpose of using both time-lag and each-year panel data is to compare the instant and gradual effect of aid. The type and source of data are indicated in Annex1.

3.3. Variables

3.3.1. Dependent variable

The dependent variable is a poverty reduction rate measured with poverty headcount ratio at national poverty line[7] as a proxy. According to the World Bank's definition, it is the percentage of the population living below the national poverty lines. National estimates are based on population-weighted subgroup estimates from household surveys.

Poverty could be absolute or relative but this paper uses the concept of absolute poverty, thus the paper defines individuals as poor if they are unable to attain a minimum standard of living. In this paper, national poverty line is the proxy of the minimum standard of living.

3.3.2. Independent Variables

The core independent variables are sectoral bilateral ODA sectoral aids (social infrastructure aid, economic infrastructure aid, production aid). The data is from OECD Credit Reporting System.

The other independent variables that are presumed to affect poverty reduction rate are GDP per capita, GDP growth rate, trade, FDI, personal remittances, national investment, government expenditure, public health expenditure, inflation, CPIA,

[7] World Bank indicates that national poverty lines are defined according to each country's specific economic and social circumstances. The national poverty lines are typically lower in low-income countries and higher in countries with higher average income, which allows to reflect the real value of percentage of poor, taking into account the national economic level.

population growth rate, and rural population. And the control variable is the initial poverty rate. All of them are retrieved from World Bank Development Indicators.

3.4. Analysis Methodology

This study uses panel data to run OLS (Ordinary Least Squares), fixed effects, and random effects regression. The predictor variables are to be added and dropped to maximize the adjusted R-square, the change in coefficient of the dependent variable explained by all independent variables, adjusted for the number of variables. In order to figure out which model fits better between the fixed and random effects model, this paper runs Hausman test.

IV. Empirical Results and Findings

This study conducts panel data OLS regression analyses using 16 Latin American developing countries including low and middle income countries for the period of 11 years from 2005 to 2015, but with two different models.

First, the panel data regression analysis with each year data shows the effects of sectoral aid on poverty reduction in the same year. Table 1 is the statistical summary of variables for the each year data analysis. Second, regression analysis with the three-year time lag data takes into consideration the time for longer term projects. Table 2 summarizes the variables used in the three-year time lag analysis. The two separate analyses show interesting results.

For both models, some of the independent variables are dropped from the equation either because they lack sufficient number of observations or because they have high multicollinearity. For example, the variables with small number of observations such as CPIA and GINI index were excluded from the regression model, even though they are expected to be important, in order to ensure the minimum required number of observations to have

reliability of the empirical results. And finally, the adjusted R-square was taken into account to maximize

4.1. Each year analysis

<Table 1> Sample statistics: each year

Variable (unit)	Observation	Mean	Std. Dev.	Min	Max
Poverty reduction rate (%)	130	3.445894	0.467286	2.00148	4.197202
Initial poverty reduction rate (%)	143	3.771017	0.363452	2.904713	4.168214
Social infrastructure aid (%)	176	4.02214	0.370182	2.168433	4.526729
Economic infrastructure aid (%)	176	2.080069	1.311557	-2.550616	4.409995
Production aid (%)	176	2.105939	0.833798	-0.564534	3.775649
GDP per capita ($1,000)	174	9.04485	0.438199	8.09923	9.813628
GDP per capita growth (%)	149	1.03471	0.782758	-2.099671	2.626853
Trade (%)	174	4.186575	0.397855	3.095847	4.91625
FDI (%)	172	1.07407	0.92609	-2.515128	2.915449
Remittances (%)	176	21.34264	1.185548	18.4599	24.01464
National investment (%)	163	3.07468	0.244456	2.566952	3.58535
Government expenditure (%)	174	2.551778	0.274905	1.902075	3.25341
Public health expenditure (%)	160	1.139436	0.392849	0.190909	1.967072
Inflation (%)	172	1.698245	0.747667	-0.232551	4.697577
CPIA (1=low, 6=high)	42	1.322275	0.073476	1.197955	1.473236
Population growth (%)	165	0.201402	0.441972	-1.068687	0.842659
Rural population ratio (%)	176	3.431742	0.423303	2.398804	3.967041
GINI (Income disparity) index (0=perfect equality, 1=perfect inequality)	119	3.895734	0.095825	3.681603	4.086144

Table 1a shows the regression results with different models, OLS, fixed effects, and random effects. In order to find more appropriate model, this paper runs a Hausman test where the null hypothesis is that random effects model is preferred to fixed effects as difference in coefficients are not systematic.

<Table 1a> Regression results: Dependent variable: average annual poverty reduction rate (%), each year

Variable	OLS	Fixed effects	Random effects
Initial poverty	.88165807***	(omitted)	.88165807***
Social infrastructure aid	-.45997233*	-0.09633173	-.45997233*
Economic infrastructure aid	-0.01984084	-.040206*	-0.01984084
Production aid	-0.07529731	-.12655359***	-0.07529731
GDP per capita growth	0.0079909	-0.0338679	0.0079909
Trade	-0.03965182	0.50141628	-0.03965182
FDI	-0.00053527	-0.00107131	-0.00053527
National investment	-.67369056***	-1.0170826***	-.67369056***
Public health expenditure	0.23657859	-0.13727562	0.23657859
Inflation	.18567346*	0.04885291	.18567346**
Population growth	0.04165657	-0.26897737	0.04165657
Rural population ratio	.33507048*	3.6375486***	.33507048*
_cons	-0.85064506	-8.3652986***	-0.85064506
N	54	54	54
r2	0.85908608	0.92699897	
r2_a	0.81328906	0.87103152	
legend:	* p<0.05; ** p<0.01; *** p<0.001		

<Table 1b> Result from Hausman test: each year

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	Fixed	Random	Difference	S.E.
Social infrastructure aid	-0.096332	-0.459972	0.363641	0.044946
Economic infrastructure aid	-0.040206	-0.019841	-0.020365	0.0109241
Production aid	-0.126554	-0.075297	-0.051256	0.0203742
GDP per capita growth	-0.033868	0.007991	-0.041859	0.0225878
Trade	0.501416	-0.039652	0.541068	0.2663536
FDI	-0.001071	-0.000535	-0.000536	0.0221769
National investment	-1.017083	-0.673691	-0.343392	0.1576512
Public health expenditure	-0.137276	0.236579	-0.373854	0.1254085
Inflation	0.048853	0.185674	-0.136821	0.0239535
Population growth	-0.268977	0.041657	-0.310634	0.2247963
Rural population ratio	3.637549	0.335071	3.302478	0.4505968

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

```
chi2(10) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                 =
288.67
Prob>chi2 =      0.0000
(V_b-V_B is not positive definite)
```

Since the p-value is less than 0.05, we can reject Ho and conclude that fixed effect estimates are more preferred. The main difference between the two models lies in their assumptions. First, the fixed effects model assumes that the variation across entities, in this case countries, is correlated with one or more independent variables in the model, whereas the random effects model assumes it to be random.

Given that the fixed effects model is preferred, we can conclude that production sector aid has a statistically significant impact on poverty reduction rate at 0.001 significance level and economic infrastructure aid is significant at 0.05 significance level.

Therefore, from the each year analysis, we can conclude that 1% increase in production sector aid reduces poverty by 0.12% and 1% increase in economic infrastructure aid reduces poverty headcount ratio by 0.4% while social infrastructure aid is statistically insignificant on poverty reduction. In addition, national investment also has a positive impact on poverty reduction whereas rural population has negative impact.

4.2. 3-year time lag analysis

<Table 2> Sample statistics: 3-year time lag

Variable (unit)	Observation	Mean	Std. Dev.	Min	Max
Poverty reduction rate (%)	41	-0.012423	0.01682	-0.056152	0.034022
Initial poverty reduction rate (%)	52	3.771017	0.365713	2.904713	4.168214
Social infrastructure aid (%)	64	4.01198	0.295069	2.885568	4.512804
Economic infrastructure aid (%)	64	2.080198	1.040564	-1.296171	3.942588

Production aid (%)	64	2.085889	0.703738	0.398963	3.199679
GDP per capita ($1,000)	63	9.056994	0.437171	8.168278	9.783958
GDP per capita growth (%)	43	1.010657	0.650368	-0.765113	2.469608
Trade (%)	63	4.184552	0.395162	3.171822	4.904462
FDI (%)	60	1.12702	0.770751	-0.729113	2.52877
Remittances (%)	64	21.35376	1.187893	18.51879	23.96224
National investment (%)	59	3.07524	0.232697	2.61486	3.469349
Government expenditure (%)	63	2.55654	0.270218	2.008553	3.166135
Public health expenditure (%)	48	1.125113	0.381449	0.32191	1.948876
Inflation (%)	62	1.680687	0.671795	0.459963	4.413714
CPIA (1=low, 6=high)	15	1.318213	0.072995	1.235425	1.470937
Population growth (%)	60	0.193838	0.445082	-1.045412	0.821337
Rural population ratio (%)	64	3.426578	0.426501	2.401024	3.958987
GINI (Income disparity) index (0=perfect equality, 1=perfect inequality)	30	3.898261	0.098712	3.694238	4.054914

First of all, the variables with small number of observations were automatically omitted from the regression analysis (CPIA and GINI index). After that, through multicollinearity test, several other variables were also dropped to avoid independent variables from being correlated to each other. The test result is in the Table 2a.

<Table 2a> Multicollinearity test result: 3-year time lag

Variable	VIF	1/VIF
Trade	57.46	0.017404
GDP per capita	43.24	0.023128
Population growth	24.28	0.04118
Initial poverty	19.04	0.052524
Inflation	18.83	0.053118
Economic infrastructure aid	17.37	0.057563
Investment	17.26	0.057938
Rural population ratio	14.31	0.069869
Government expenditure	13.89	0.071979
Remittances	11.81	0.084639
Public health expenditure	10.1	0.098997
Mean VIF	18.42	

Multicollinearity test shows how much one or more variables affect the other independent variables. When the variance inflation factor (VIF) of a variable is greater than 10, it is recommended to delete the variable from the equation. As a result, trade, GDP per capita, and population growth should be excluded from the regression equation due to high multicollinearity. After deleting the three variables, there is no variable of which VIF is greater than 10 and the mean VIF decreases to 4.02 so the multiple regression equation becomes appropriate for the analysis.

<Table 2b> Regression result: Dependent variable: average annual poverty reduction rate (%), 3-year time lag model

Variable	OLS
Initial poverty	0.01845368
Social infrastructure aid	-0.02567864
Economic infrastructure aid	-.01164583*
Production aid	-0.00400618
GDP per capita growth	-0.00304937
FDI	0.00058468
Remittances	0.00845099
National investment	-0.00444399
Government expenditure	-.0459327**
Public health expenditure	0.02058624
Inflation	0.01443352
Rural population ratio	.02760962**
_cons	-0.13996058
N	20
r2	0.93195309
r2_a	0.81530124
legend:	* p<0.05; ** p<0.01; *** p<0.001

Unfortunately, we cannot run fixed effects or random effects regression with the 3-year time lag data because the number of observation is only 20. Given that we delete the

public health expenditure variable as it decreases the total number of observation, we have 5 more observations but the adjusted R square sharply drops to 0.5771. So this paper takes the simple OLS regression results despite its potential limitations.

According to the result, economic infrastructure aid is the only statistically significant aid for poverty reduction. When economic infrastructure aid increases by 1%, poverty reduction rate also increases by 0.01%. An interesting point is that production aid is not significant anymore in the longer term. In fact this could be explained by intuition. Production aid increases the income of households directly while the economic infrastructure aid takes more time to take effect. So in the short term, the positive impact of economic infrastructure aid on poverty reduction does not appear to its full extent but is continued in the following years.

Another astonishing aspect is that social infrastructure aid is statistically significant neither in the short term nor in the long term. This result is contradictory to the current practice of allocating more than half of the aid funds to developing social infrastructure and providing social services. This point will be further discussed in the policy implication.

In addition, there are two other factors that are significant for poverty alleviation. As one might have expected, when the government expenditure increases, poverty is reduced. It means that in the Latin American countries dealt in this paper, government expenditure is spent for pro-poor welfare services which directly or indirectly helps them to be lifted out of poverty. On the other hand, as rural population out of the total population increases, poverty also increases. It is related to the difference of income levels between rural and urban areas.

V. Conclusion and Policy Implication

'Eradication of extreme poverty and hunger' was the first goal of the Millennium Development Goals (MDGs) from 2000 to 2015. Following the remarkable progress in poverty reduction during the MDG period, the goal has been prolonged to the Sustainable Development Goals (SDGs). Holding the continued importance and concerns on poverty eradication, strategic allocation of aid would be necessary to achieve the goal within the SDG period.

Currently, half of the bilateral Official Development Assistance (ODA) provided by OECD Development Assistance Committee (DAC) donors is distributed to social sector. However, it has not yet been proven if it is the most effective and efficient way of aid allocation for poverty eradication. Therefore, this study conducted regression analyses with two models to figure out which sectoral aid has the greatest impact on poverty reduction.

While both models showed the common result for the effect of other independent variables on poverty reduction rate, they showed opposite results for the effect of sectoral aids, the core predictors. In the each-year model, economic infrastructure aid and production sector aid turned out to be the effective aid among the three sectoral aids. However, the three-year average model showed that only the economic infrastructure aid is effective for poverty reduction rate.

Although it needs to be studied in more detail about the cause of the contradicting results, but this paper assumes that the difference comes from the time period that different sectors of aid take. Production sector aid has greater impact on poverty reduction in the short term as it directly increases the income of households but in the meantime, the economic infrastructure aid has rather a gradual effect as it takes more time to have direct effects to the households.

Theoretically we can think of two channels for aid to make any impact on poverty. The first channel is to use aid fund directly for creation and strengthening of social safety nets targeted on the extremely poor. The second channel is to use aid fund in supplementation of domestic resources for investment aiming at economic growth. Dollar and Kraay (2002) pointed out that once the economic growth results in improvement of average income of all population, the poorer also benefit from the economic growth indirectly and at the national average growth rate.

However, the empirical result shows us that pro-poor aid is not effective to lift the poor out of poverty but rather pro-growth aid has a statistically significant impact on poverty reduction both in the short term and long term. So to reconstruct the two channels, one could imagine the first channel be using aid fund in promoting production and the second channel be supporting the first channel by enhancing the economic infrastructure.

As for the creation and rehabilitation of economic infrastructure, implementation of investment programs and projects would normally require more than one year. This is why the impact of economic infrastructure aid on poverty reduction is more trivial than that of production aid in the short term but remains significant until longer term.

Since poverty is the major obstacle for individuals' personal development and national economic growth in developing countries, it should be eradicated as soon as possible and the international society needs to find the most effective way to allocate aid. This study suggests policy makers to distribute more aid to economic infrastructure than current practice in order to achieve the goal of poverty eradication more effectively and in a sustainable way.

So if we want to maximize the effectiveness of aid on poverty reduction, therefore, we will have to seriously reconsider the current practice of allocating significant amount of

aid fund in the social sector and utilize the new channels allowing for an adequate time-lag between aid and poverty reduction. The critical question is what should be optimum allocation of aid funds to each channel. For this question, the answer can be found from the relative magnitude of the coefficient of two variables: production aid variable and economic infrastructure aid variable at a ratio of approximately 75% vs. 25% in the short-term but practically more in the economic infrastructure taking into account the longer term effect.

VI. Limitation of This Study and Suggestions for Future Studies

This study uses two models, each year and three-year time lag. Both analyses are meaningful in consideration of the time periods that different types of projects take. However, the problem is that, when it comes to the three-year time lag analysis, the number of observation is less than 30.

First, the data of the predictor (aid by sector) is only available since 2005. Therefore, even though we have the data of the dependent variable and other independent variables from the World Bank Development Indicators since 1950, we cannot use the data before 2005 without the data of the predictor. Moreover, usually the panel data analysis with poverty index is very limited as there is a lack of data availability. That is, majority of developing countries do not report poverty headcount ratio every year, and each country reports not regularly and in different years respectively. For example, between 2005 and 2015, Afghanistan reported its poverty headcount ratio at the national poverty line in 2007 and 2011, and Zambia in 2010.

The previous literature adopted a longer period for panel data analysis to compensate the missing data problem (See Burnside and Dollar 2000). However, this study takes only eleven years so the missing data in the poverty index leaves the number of observation as a

limitation. Therefore, it is suggested for future studies to accumulate more data and increase the number of observation in order to reaffirm the credibility of the empirical results of this study.

Another limitation of this study is that there could be two-way traffic (endogeneity) problem between aid and poverty meaning that aid could be correlated with the error term. The empirical result in this paper shows that as social and economic infrastructure aid increase, poverty is reduced. However, there is also a possibility of simultaneous causality, for example, that countries where poverty reduction rate is higher tend to receive more of their aid fund to social and economic infrastructure. Therefore, future studies would need to take this into account.

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Annex 1: Data sources and definitions

Variable	Source	Format	Definition
Poverty reduction rate: (poverty headcount ratio)	World Bank Development Indicator	percentage of population	Poverty headcount ratio: the percentage of the population living below the national poverty lines. National estimates are based on population-weighted subgroup estimates from household surveys.
Social Infrastructure & Services Aid	OECD Credit Reporting System	percentage of GDP	It covers efforts to develop the human resource potential and ameliorate living conditions in aid recipient countries. It includes, but is not exhausted by: - Education: educational infrastructure, services and investment in all areas. Specialized education in particular fields such as agriculture or energy is reported against the sector concerned. - Health and Population: assistance to hospitals and clinics, including specialized institutions such as those for tuberculosis, maternal and child care; other medical and dental services, including disease and epidemic control, vaccination programs, nursing, provision of drugs, health demonstration, etc.; public health administration and medical insurance programs; reproductive health and family planning. - Water Supply, Sanitation and Sewerage: all assistance given for water supply, use and sanitation; river development, but excluding irrigation systems for agriculture.
Economic Infrastructure & Services Aid	OECD Credit Reporting System	percentage of GDP	It covers assistance for networks, utilities and services that facilitate economic activity. It includes, but is not exhausted by: - Energy: production and distribution of energy, including peaceful use of nuclear energy. - Transportation and Communications: essentially equipment or infrastructure for road, rail, water and air transport, and for television, radio and electronic information networks.
Production Sectors Aid	OECD Credit Reporting System	percentage of GDP	All directly productive sectors. It comprises: - Agriculture, Fishing and Forestry: crop and livestock development, provision of production requisites such as farm machinery and fertilizer, irrigation, pest control, veterinary services; services to the agricultural sector, fishing and forestry (including tree crops); conservation and extension, land reclamation; land and soil surveys, land and water use; agricultural construction; storage and transport facilities. Agricultural development banks are included under this heading. - Industry, Mining and Construction: assistance to extractive and manufacturing industries of all kinds, including prospecting and geological surveys, development and refining of petroleum and ores, processing of food and other agricultural products, manufacture of fertilizers and farm machinery, cottage industry and handicrafts and non-agricultural storage and warehousing. Trade and Tourism: export promotion, trade, commerce and distribution; banking (including industrial development banks) and hotel and other tourist facilities.

GDP per capita	World Bank Development Indicator	PPP (current international $)	GDP per capita based on purchasing power parity (PPP)
GDP growth rate	World Bank Development Indicator	Annual percent	Annual percentage growth rate of GDP per capita based on constant local currency.
Trade	World Bank Development Indicator	percentage of GDP	Sum of exports and imports of goods and services measured as a share of gross domestic product.
FDI	World Bank Development Indicator	percentage of GDP	Net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors, divided by GDP.
Remittance	World Bank Development Indicator	constant US Dollar	Personal remittances comprise personal transfers and compensation of employees. Personal transfers consist of all current transfers in cash or in kind made or received by resident households to or from nonresident households.
Governance	World Bank Development Indicator	CPIA index (1=low, 6=high)	Rating of countries against a set of 16 criteria grouped in four clusters: economic management, structural policies, policies for social inclusion and equity, and public sector management and institutions.
Inflation	World Bank Development Indicator	percent	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly.
National investment	World Bank Development Indicator	percent of GDP	Gross capital formation (formerly gross domestic investment) consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. Fixed assets include land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings.
Government expenditure	World Bank Development Indicator	percent of GDP	General government final consumption expenditure (formerly general government consumption) includes all government current expenditures for purchases of goods and services (including compensation of employees).
Public expenditure on health	World Bank Development Indicator	percent of GDP	Public health expenditure consists of recurrent and capital spending from government (central and local) budgets, external borrowings and grants (including donations from international agencies and nongovernmental organizations), and social (or compulsory) health insurance funds.
Rural population	World Bank Development Indicator	percent of population	Rural population refers to people living in rural areas as defined by national statistical offices. It is calculated as the difference between total population and urban population.
Population growth	World Bank Development Indicator	percent of population	Annual population growth rate for year t is the exponential rate of growth of midyear population from year t-1 to t, expressed as a percentage. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship.

GINI (inequality)	World Bank Development Indicator	0 to 1 (0=perfect equality, 1=perfect inequality)	Gini index measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution. A Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.

Annex 2: List of countries

Argentina	Guatemala
Bolivia	Honduras
Brazil	Jamaica
Colombia	Mexico
Costa Rica	Nicaragua
Dominican Republic	Paraguay
Ecuador	Peru
El Salvador	Venezuela, RB