Assessing the causes of aid fungibility: Does institutional quality really matter?

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Summary

Traditionally, aid fungibility has been considered a threat for effective development cooperation, because it implies partner countries allocate aid resources for different purposes than donors' intentions. A stream of aid literature has attributed this phenomenon to low institutional quality in developing countries. By contrast, other scholars claim that aid fungibility does not necessarily worsen aid's outcomes, rather reflects preferences' divergence between donors and partner countries. Nonetheless, empirical evidence of the determinants of aid fungibility is scarce to support either of these positions.

The aim of this research is to contribute to closing this gap, addressing the causes of aid fungibility in the education sector with special focus on the role of institutional capacity. In order to do so, time-series cross-section analysis is applied with information from 47 developing countries for the period 2000-2016. For first time in the literature, this study assesses the effects of different aid modalities on fungibility of sectorial ODA disbursements, and applies a Panel Coefficient Variable Model to identify the determinants of aid fungibility.

The results demonstrate that total aid targeted to education is almost fully fungible, and that the degree of aid fungibility is highly variable across countries, but it has decreased slightly over time. In contrast with the literature on macro fungibility, bilateral aid is less fungible than multilateral aid, suggesting that the same aid modality can have different degrees of aid fungibility among sectors. The research also found that low levels of government effectiveness and rule of law increase aid fungibility, but the effect of corruption is insignificant. These results suggest that aid fungibility does not necessarily represent a consequence of "bad policy environment", but rather weak planning and budgeting systems in partner countries, and lack of preference's convergence between donors and partner governments about aid purposes.

Based on these results, the study recommends that donors must implement development projects that are tailored to country-specific needs, in order to ensure the ownership of development priorities by developing countries, especially those with low institutional quality. In addition, if donors want their aid flows to be used according to their preferences, they should be aware about the quality of public management systems in the partner country, and make more efforts to reduce aid fragmentation in order to continue to align their preferences and development priorities with partner countries.

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Chapter 1 Introduction

1.1 The importance of aid fungibility

Since 1969 the Development Assistance Committee (DAC) adopted the Official Development Assistance (ODA) as the "gold standard" of foreign aid and since then it represents the main source of cooperation for development (OECD, 2019a). According to the OECD, "the Official Development Assistance is defined as government aid designed to promote the economic development and welfare of developing countries" (OECD, 2019a). These resources can be provided either bilaterally or through multilateral organizations to governments and private agencies of the partner country. Since the beginning of the new millennium, ODA flows have constantly increased worldwide[1], and for the low income countries they represent 8.2% of their Gross Domestic Product nowadays (OECD, 2019; World Bank, 2019).

Not only does the size of aid matter, but also its effectiveness, i.e. the way how it is delivered in order to "maximize its impact on development and achieve value for aid money" (Killen, 2011, p. 2). Indeed, from the signing of the Millennium Declaration, the international community set up specific mechanisms and commitments to improve cooperation for effective development. Among the most important milestones, there are the Paris Declaration of Aid Effectiveness (2005), the Busan Partnership Agreement (2011) and the creation of the Global Partnership for Effective Development Cooperation (2011), which forthcoming first senior level meeting will be held in New York (13-14 July 2019).

The causes, consequences, and how to improve aid effectiveness have been extensively explored by scholars. Overall, aid effectiveness depends primarily on how the implementing agencies (public or private) of the partner country use these inflows for

[1] The total Net Official Development Assistance by the DAC countries increased from US$ 72.94 billion in 2000 to US$ 147.16 billion in 2017 (OECD, 2019).

development purposes. According to the literature on aid effectiveness, aid fungibility arises as one factor that indirectly can influence the cooperation for effective development, as well as the "Dutch Disease" effect and aid volatility (Vathis, 2013).

Foreign aid becomes fungible when partner countries[2] allocate these resources for different purposes than what was originally intended by the donors. According to this definition, it is possible to distinguish four levels of fungibility of aid, which will be explained more in depth in Chapter 2: "Macro fungibility", "General fungibility", "Categorical/sectorial fungibility" and "Micro fungibility" (McGillivray & Morrissey, 2004; Jones, 2005; Marc, 2017).

The different types of fungibility and their consequences regarding aid effectiveness have been studied extensively over the years. In mid-80s, fungibility was signaled as one of the reasons why aid projects show positive return rates based on their own goals (micro level) while, showing no effect on foreign aid as a whole in terms of economic growth (macro level); the so-called "macro-micro paradox" of foreign aid (Mosley, 1986). Since then, aid fungibility has been stigmatized because it implies that aid resources are not used for the donor's originally intended activities, while productive state expenditures are replaced by aid and at the margin, and domestic resources are liberated and used for non-productive sectors (e.g. military expenditure) by partner countries (Picciotto, 2009).

However, it was not until mid-90s that academia started to pay more attention to the study of this phenomenon, after the World Bank (WB) published a report on aid effectiveness (World Bank, 1998). This publication, in conjunction with other findings from some literature regarding categorical fungibility, demonstrates that development cooperation inflows displace public expenditures in development sectors and therefore, true aid impacts not only in targeted sectors by donors, and therefore it is necessary to promote overall "good governance". In the same way, some scholars hypothesize that the existence of fungibility is one of the main reasons why project-level performance focus is irrelevant to increase aid effectiveness (Collier, 2002). In addition, other studies analyze negative impacts of fungibility in small open economies (Byron, 2012).

[2] The term "partner country" or "partner government" refers to the country/government that receives the aid from DAC donors by bilateral or multilateral modalities.

After the publication of the WB report, several studies were conducted in order to bring more evidence regarding what type of aid is fungible, the consequences of this phenomenon, and how to address and measure more precisely the existence of fungibility. One of the most relevant studies that criticized the WB report, concludes that fungibility, per se, has not had an adverse effect on growth (McGillivray and Morrissey, 2000). Furthermore, other studies have found that fungible and non-fungible aid have similar effects on growth (Pettersson, 2007), while others show that the use of foreign aid to finance current expenditure can improve the delivery of public services to poor people (Jones, 2005), which demonstrate that fungibility does not worsen aid effectiveness. Furthermore, in his critique to the book "The Great Escape: Health, Wealth, and the Origin of Inequality" (Deaton, 2013), Martin Ravallion argues that if aid is consumed instead of invested it is not necessarily a bad thing, as partner governments may have a better idea than donors on how aid should be spent in order to satisfy their needs; hence, "there can be no presumption that fungibility reduces the gains to poor people from aid" (Ravallion, 2014, p. 976).

Despite these opposite positions, numerous empirical studies have focused on testing to what extent foreign aid is fungible, rather than exploring the causes of this phenomenon, and specially for a particular sector. In addition, there is mixed evidence about the effect of aid on public expenditures at the aggregate level across aid modalities, namely bilateral versus multilateral aid, concessional loans versus grants, "off-budget aid" versus "on-budget aid" (Cashel-Cordo & Craig, 1990; Gang & Khan, 1990; Gupta et al, 2003; Van de Sijpe, 2013; Marc, 2017).

This research will assess aid fungibility in a specific sector, because the degree of aid fungibility differs from one sector to others, and because the analysis of aid fungibility between bilateral and multilateral modalities in a specific social area has never been studied before. Identifying the effects of different aid modalities on public expenditure would be helpful for the donor and partner countries to be aware about the consequences of selecting each modality for sectorial aid, especially if both parties have different and unknown preferences.

1.2 Research objective

The overall objective of this thesis is to assess the determinants of aid fungibility in order to explain the differences found by previous studies. More specifically, this research is centered on the potential impact of the institutional capacity of partner countries and aid modalities that could lead to different degrees of fungibility of sectorial aid among countries.

1.3 Research question

According to the above objective, the research question is: **What is the effect of institutional capacity and different aid modalities on categorical fungibility of foreign aid in developing countries?** In order to answer this question, it is important that the thesis addresses the following sub-questions:

1. According to the literature, what are the causes of aid fungibility?
2. What is the extent of categorical fungibility aid in developing countries? Is there any difference among aid modalities?
3. What is the empirical impact of institutional capacity on aid fungibility?

1.4 Research approach

The research design consists of two parts. Firstly, the analysis of the literature review, which starts with the conceptual framework of aid fungibility and previous empirical evidence. In addition, it includes the analysis of the possible causes of aid fungibility identified by previous studies. This will allow for the selection and development of a theoretical framework which explains how aid fungibility arises and especially the role of institutional capacity of governments. Also, it will help to identify which control variables will be used in the quantitative analysis.

Secondly, the empirical analysis will follow a non-experimental design with a large sample of developing countries. More specifically, this thesis applies three panel-data

models. First, a panel-data model with fixed effects is used to quantify the effects of aid on public expenditure and identify if it varies among aid modalities. Second, a panel variable coefficient model is used to calculate country-specific and year-specific measures for the degree of aid fungibility. Using three estimates as the dependent variable, a third panel data model with random effects is applied to find whether institutional capacity is a determinant of aid fungibility, after controlling for other factors identified in the literature review.

In order to narrow the analysis, this thesis will focus on aid resources and public expenditure specifically in the education sector. First, because educational outcomes are incorporated with specific goals and targets in international agreements of cooperation for development, like the Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs). Second, during the period of 2000-2016, education aid has amounted to 10.7% of total sector allocable aid flows, and has become the third largest sector that receives foreign aid in the world[3].

1.5 Relevance

1.5.1 Academic relevance

The academic relevance relies on three main features. First, as most of the previous studies focus on identifying whether aid is fungible or not, there is very limited empirical evidence about the determinants of aid fungibility, especially for sectorial aid, which is a gap that this thesis aims to close.

Second, from a theoretical perspective, scholars are divided about the role of aid fungibility. From one side, some scholars argue that fungibility is one of the mechanisms of how aid effectiveness can deteriorate by "bad governance". From the other side, other studies suggest that aid fungibility is not pernicious and it only reflects a divergence among donors and partner countries preferences. However, the evidence for empirically testing the influence of institutional capacity on aid fungibility is scarce.

[3] The first sector is "Government & Civil Society" (14.9%), followed by "Transport & Storage" (10.8%).

Third, although the use of panel data to address the existence of fungibility of aid in the literature is not new (see Feyziouglu, Swaroop and Zhu, 1998; Berens, 2016; Marc, 2017), none of them have used it to empirically identify the causes of such phenomenon. In addition, this research would be the first to address this issue through the Panel Variable Coefficient (PVC) model, which allows to quantify country-specific effects of aid on public expenditure.

1.5.2 Societal relevance

The societal relevance of the research is threefold. First, studying the determinants of aid fungibility is important because this phenomenon has been stigmatized by some influential literature as one of the most important causes of lower effectiveness of aid at the aggregate level (World Bank, 1998; Mosley, 1986). However, recent studies have shown that fungible aid has similar impacts on welfare as does non-fungible aid in specific contexts (Pettersson, 2007; Wagstaff, 2011; Morrissey, 2015). In this context, assessing the effect of institutional capacity of governments allows to validate (or dismiss) the common perception that countries with low quality of institutional capacity lead to a decrease in aid effectiveness on development objectives through fungibility.

Second, the identification of which aid modalities are more fungible will be useful for the international donor community to adapt their development cooperation policy.

Finally, the Busan Partnership Agreement for Effective Development Cooperation (OECD, 2011) and the SDG 17 “Strengthens the means of implementation and revitalizes the global partnership for sustainable development" (United Nations, 2015). They also recognize that aid allocation from the donors has to be aligned with the interests and priorities of partner countries to strengthen the ownership and inclusive development partnership. Under this framework, this research can contribute to identifying the institutional capacities of developing countries which restrict the fungibility of aid and therefore, could reflect a better alignment of preferences for partner and donor countries on aid allocation.

1.6 Outline

The thesis's structure is as follows. Chapter 2 presents the literature review on the causes of aid fungibility, especially the linkage of institutional capacity in partner countries with aid fungibility and aid effectiveness. Chapter 3 describes the research design, which includes the operationalization of the variables, the sample of countries and the specification of the econometric regressions involved in the analysis. Chapter 4 contains the results of the analysis, including the statistical description of the data, the verification of the econometric assumptions, the interpretation of the regression results and the discussion of findings. Chapter 5 concludes and present some limitations and recommendations.

Chapter 2 Literature review

This chapter is divided into four sections. The first section presents a conceptual framework of the definition and causes of fungibility. The second section summarizes the results of the more relevant empirical literature on each type of aid fungibility, with emphasis on the different aid modalities. The third part describes the empirical evidence about the factors that can affect the degree of fungibility of aid, with a special focus on the role of institutional capacities. Last, the hypotheses of the research are presented.

2.1 Conceptualizing fungibility of aid and its causes

According to the World Bank, the first academic studies about the fungibility of aid appeared in the 60s[4]. Since then, the literature on the fungibility of aid has rapidly increased, especially during the 90s and the first decade of the new millennium. The definition of the concept of fungibility has changed over the time, which has allowed for identifying different types of fungibility of aid and to use different approaches to understand this phenomenon. Under these considerations, for the purpose of this thesis, aid is considered fungible when "the partner uses (or has the ability to use) aid for purposes other than those intended by the donors" (McGillivray & Morrissey, 2004, p. 75).

The most commonly used theoretical framework to explain how fungibility can arise is the application of the consumer choice theory to public finance decisions (Pack & Pack, 1993; Feyzioglu et al, 1998; World Bank, 1998; McGillivray & Morrissey, 2000; Jones, 2005). Under this economic framework, partner governments are rational agents who have to decide how to allocate limited resources between different public goods and services (e.g. education, defense, health, etc.). The criteria used in order to allocate these resources is based on achieving the maximum level of its hypothetical utility function,

[4] "Assessments of aid as early as the 1960s raised the issue of fungibility (Little and Clifford, 1965)" (World Bank, 1998, p.82).

which should represent the government's preferences and priorities for different social outcomes.

In the simple version of these models, partner governments consider earmarked aid as a supplement resource, which increases its possibility of consumption and allows them to obtain a higher utility level with (in principle) better outcomes for the society. However, the theory shows that if the total amount of aid is spent only in the targeted sector (non-fungibility), the new amounts of public goods and services that government can afford are suboptimal (McGillivray & Morrissey, 2000). Indeed, according to its preferences, this situation leads to a lower utility level than if government could use aid resources in other sectors as well, since foreign aid can increase the possibility of consumption for different public goods and services (not only the targeted sector). At the extreme, in a scenario with full fungibility, the partner government could achieve a higher utility, although the level of expenditure in the targeted sector by aid would be lower than the scenario without fungibility.

In extended versions of the models, the effects of fungibility on the new public consumption equilibrium could be modified by tax effort reduction (which reduces the budget constraint), income multiplier effects and the "aid illusion" effect (McGillivray & Morrissey, 2000; McGillivray & Morrissey, 2001). The last one is derived from a different interpretation about the expenditure plans, which includes aid resources, by the officials who have to implement them in the field. First, the planning officials set the budget for different implementing agencies, who do not necessarily know the source of the money, because they received it as a whole. Second, the implementing officials have autonomy to use their own resources in order to achieve the institutional goals of the agency. Because of the incomplete information about the different sources of their budget, the officials in the field could use their budget for different purposes, even when it comes from targeted aid.

Another study from the same authors exhibits that aid inflows can lead to greater increases in public expenditure (and thus, less aid fungibility) as an unintended consequence by failures of interpretation and communication between the planning and implementing officials (McGillivray & Morrissey, 2001). As it is argued by the authors, in context with

weak public expenditure management systems, the process of spending foreign aid is imperfect and can affect the way in which aid is used.

Regarding other causes, Nicolas Van de Sijpe argues that fungibility can be negatively affected by two mechanisms in addition to the "aid illusion effect" (Van de Sijpe, 2013). First, and most obvious, a higher degree of aid conditionalities' enforcement and close monitoring of aid resources by donors in partner countries. Second, the size of "off-budget aid", which is more difficult to divert to other sectors because those resources are usually used to finance specific sectorial technical assistance are spent in the donor country, and are not recorded as government spending by the partner country.

Other factors can affect fungibility such as the donors' monitoring costs and aid dependence. However, from a theoretical perspective, there are opposite arguments about the direction of these determinants on aid fungibility. On the one hand, if the number of aid sources in the partner country is high and donor coordination is weak, the monitoring costs are higher, so the efforts to oversee the use of aid resources decreases, and consequently becomes more likely that aid will be fungible (Devarajan et al, 1999). Conversely, the larger aid flows by donors may reflect stronger monitoring capabilities, hence it is expected that countries where aid represent a larger proportion of public expenditures, and exhibits a lower degree of fungibility (Pettersson, 2007). In this sense, the effect of this variable relies on empirical evidence.

Finally, other scholars found that aid fungibility has been signaled as one of the mechanisms attributed to the poor impact of aid on development outcomes in weak institutional environments (World Bank, 1998; Howes, 2014).

Institutional capacity refers to the "the degree to which rules and procedures enable actors to work together in order to solve collective problems" (Dang et al, 2017). In this sense, institutional capacity[5] represents the "enabling environment" in which individuals and organizations interact to achieve their own goals (Willems & Baumert, 2003; Wickham et al, 2009). Applying this concept to the public administration sphere, the concept of institutional capacity is highly related with the quality of governance and the institutional quality of the governments, because it refers to the ability of governments to fulfil their

[5] For the purpose of this research, the terms "institutional capacity" and "institutional quality" are used indistinguishable.

main functions, like keeping economic and political stability, promoting the participation of civil society in decision making processes, enhancing the quality of civil service, and strengthening the rule of law (Willems & Baumert, 2003; Dang et al, 2017).

Presumably, external non-tax revenue (such as foreign aid) is not tied to strong accountability mechanisms, and therefore it is more susceptible to be used for political clientelism purposes, especially in countries with weak budget systems and fiscal frameworks. Moreover, it is reasonable to expect that countries with low institutional capacity have a higher degree of aid fungibility.

In sum, from this theoretical framework, it is possible to conclude that fungibility depends on the preferences of political leaders regarding social outcomes, which are reflected in the allocation of public resources among different sectors (Ravallion, 2014). Additionally, the main factors of aid fungibility identified by the literature from a theoretical perspective are: the enforcement of aid conditionalities, aid modality, monitoring capabilities of aid resources by donors, size of aid, institutional quality and the "aid illusion effect".

2.2 Empirical evidence of aid fungibility

The literature on fungibility has focused on proving whether aid is fungible or not in specific contexts by using different approaches. In this section the more relevant studies are described according to the classification of the types of aid fungibility described in Chapter 1.

2.2.1 Macro fungibility

Macro fungibility is based on fiscal response models and looks at the impacts of foreign aid on fiscal aggregates of the partner country in areas such as public expenditures, tax revenues, and borrowing. Under this category, relevant studies are described as follows:

a) Country-specific studies

The case of Ghana shows that the increase in aid combined with increasing tax revenue allowed for an expansion of public expenditure with less borrowing, which

could result from aid conditionalities (Osei, Morrissey & Lloyd, 2003). The positive impact of aid on expenditures at the aggregate level represents a low degree of macro fungibility. However, the authors also found that this increase corresponds principally to current spending instead of investment, which demonstrates a high degree of general fungibility. Similar results are found in Costa Rica (Franco-Rodriguez, 2000 cited in McGillivray & Morrissey, 2004). In this sense, it would seem that aid facilitates improvements in fiscal management at the aggregate level, even if it seems to be fungible in specific types of expenditure (Morrissey, 2015, p. 101). However, the results in other contexts are totally different. For instance, in Pakistan aid causes a slight increase in investment but also reduces tax revenue, which in turn encourages borrowing (Franco-Rodriguez et al, 1998 cited in McGillivray & Morrissey, 2004). In Senegal, aid has no effect on total spending or on borrowing, but a negative impact on government revenues (Ouattara, 2006, cited in Morrissey, 2015). According to the author, aid flows are linked with policy reforms, like tariffs reduction due to trade liberalization, which may reduce tax revenues.

In North Cyprus, foreign aid flows do not have a long-run equilibrium relationship with tax revenues, nor total public spending (Feridun, 2014). However, the empirical results show that foreign aid has a strong positive effect on military expenditures. According to the author, this situation is due to the lax restriction by the main donor country (Turkey) and the large portion of the public budget allocated in defense and investment.

b) Cross-national studies

Among studies with larger samples, the research of Peter Heller is the first empirical study to use a fiscal response model. The author found that aid has a positive effect on investment but also a negative impact on the level of domestic taxes and borrowing in 11 African countries (Heller, 1975).

Similar results were found by Lloyd, McGillivray, Morrissey and Opoku-Afari (2009) applying a fiscal response model with annual data from the early 1970s to the early 2000s for 19 countries. According to the results, aid does not always hold a significant long-run relationship with tax effort and borrowing across the sample.

Only for some countries where aid has a significant effect on fiscal aggregates in the long run, the authors found that aid is positively associated with public spending and borrowing, but negatively associated with tax revenue (Lloyd et al, 2009).

In Cashel-Cordo and Craig (1990), the authors found different effects of aid modalities on total public expenditure. The study concludes that bilateral aid provided by DAC countries has little impact on expenditure, while multilateral loans have different effects. According to their results, IMF loans reduce total expenditures as a result of the larger effect of the reduction of public deficit which is part of IMF lending with high conditionalities. Moreover, loans from development banks increase public spending.

Finally, some literature found that the degree of macro fungibility does not vary over time (Devarajan et al, 1999). However, recent empirical findings show that aid inflows lead to an increase of around 40%-50% of government expenditure in the long run and between 80%-90% in the short run (Marc, 2017).

The studies of aid fungibility at the macro level allows for an understanding that aid is treated by partner governments as an additional resource, which can affect their decisions about fiscal behavior not only in spending but also on tax effort and borrowing. However, the mixed results show that there is no clear direction of the effects of aid on the aggregate fiscal variables and this could depend on country-specific characteristics. For those countries where aid is more important, the findings demonstrate that aid plays a key role in the budgetary process and can influence the long-run fiscal equilibrium of the partner country through influencing all other fiscal aggregates variables (Lloyd et al, 2009).

2.2.2 General fungibility

General fungibility occurs when aid intended for financing of public investment is used to finance government consumption at the aggregate level. Under this category, the literature also examines the effect of aid on development spending in a partner country, which is supposed to be allocated through public investment. Table 2.1 summarizes the methodology and main quantitative results of each selected research under this category.

Table 2.1 – Selected studies on macro and general fungibility of foreign aid

Author (year)	Country sample (years)	Methodology	Incremental impact of US$ 1 aid on public expenditure	Degree of fungibility (∝ represent the aid's effect on total expenditure)
Cashel-Cordo & Craig (1990)	46 least developed countries (1975-1980)	Pooled time-series cross-section analysis	In total expenditure: 0.00 (bilateral loans) -3.21 (IMF loans) 2.60 (development banks loans)	IMF loans: full fungibility (∝<0) Dev. banks loans: non fungibility (∝>1)
Pack & Pack (1990)	Indonesia (1966-1986)	Seemingly unrelated regressions (SUR)	1.58 (in total spending) 0.89 (in development expenditure)	Non fungibility (∝>=1)
Pack & Pack (1993)	Domincan Republic (1968-1986)	Seemingly unrelated regressions (SUR)	-0.27 (in total spending) -0.05 (in development expenditure)	Full fungibility (∝<0)
Feyzioglu, Swaroop & Zhu (1998)	38 developing countries (1971-1990)	Cross-sectional time-series analysis	In total expenditure: 0.63 (concessionary loans) 0.33 (total aid)	Partial fungibility (∝<1)
	14 developing countries (1971-1990)		In public investment: 0.32 (concessionary loans) 0.20 (total aid)	
Swaroop, Jha & Rakumar (2000)	India (1970-1995)	Ordinary least squares and Two stages least squares	0.00 (in development expenditure) 0.90 (in non-development expenditure)	Partial fungibility (∝<1)
Feridun (2014)	North Cyprus (1977 - 2007)	Cointegration analysis	0.00 (in current expenditures) 0.19 (in military expenditures)	Full fungibility (∝<0)
Marc (2017)	118 developing countries (1980-2012)	Cross-sectional time-series analysis	In total expenditure: 0.36 (on budget aid) 0.00 (off budget aid)	On budget aid: Partial fungibility (∝<1) Off budget aid: non fungibility (∝=0)

Source: Cited studies

a) Country-specific studies

The study of fungibility in Indonesia concludes that aid is not fungible (Pack & Pack 1990). Indeed, the authors found that most of the aid is allocated to development spending and there is no diversion of public resources from development purposes to current expenditures. In contrast, for the case of Dominican Republic, aid reduces investment for developmental purposes and increases current expenditures, which reflects full fungibility (Pack & Pack, 1993). According to the authors, the different results between both cases can be attributed to the relative importance of aid as a source of public revenue and the fiscal balance of the country. Other hypotheses are the ability of donors to track the aid through partner budget, and how likely it is that donor's intentions are reflected in the partner's expenditures (Pack & Pack, 1993).

In the case of India, Swaroop, Jha and Rakumar (2000) conclude that foreign aid does not have any effect on the development expenditure (including capital and recurrent components). Furthermore, the authors found that foreign aid substitutes spending that the government would execute anyway and the resources freed by aid are allocated on non-development purposes, such as general services and administration costs.

b) Cross-national studies

Among the studies with larger samples, Peter Heller found that the selection of aid modality can influence the effect of aid on public consumption and investment. On the one hand, "grants have a stronger pro-consumption bias, whereas loans are more pro-investment" (Heller, 1975, p. 430). On the other hand, bilateral and multilateral aid increases investment and reduces consumption in similar magnitudes, but only in the smaller sample of Anglophone countries. Similarly, Feyzioglu, Swaroop and Zhu (1998) found that foreign aid has lower impacts on public investment than public consumption. However, the authors pointed out that this situation may not be unintended, because investment is not the only way to promote development by ODA flows. In addition, the authors found that the degree of fungibility is lower through concessional loans than total ODA disbursements, which could be explained by the matching requirements.

A more recent study found that using ODA flows as a whole can bias the degree of fungibility, if the analysis considers the resources used by donors for the direct provision of goods and services (like technical cooperation) without using the partner's budget system ("off-budget aid") (Marc, 2017). The author found that this aid modality is not fungible because it does not reduce the partner's expenditure. Furthermore, aid resources channeled through partner's budget ("on budget aid") is partly fungible. (Marc, 2017). In addition, the study did not find any robust results about different degrees of fungibility between bilateral and multilateral aid.

In sum, the empirical studies on general fungibility show that aid is, at least, partly fungible. Only in specific countries, like in Indonesia, and aid modalities, like multilateral aid through development banks or "off-budget aid", the literature found no fungibility. Generally speaking, it seems that the degree of fungibility at the aggregate level varies according to specific fiscal context, the modality of aid, and the source of aid flows.

2.2.3 Categorical/sectorial fungibility

Categorical fungibility arises when the government allocates the aid resources to different sector than the donor's original intention; therefore, studies on sectorial fungibility examine whether aid that originally is intended to finance projects in specific sectors, like education or health, actually increases governmental expenditure in those areas. Table 2.2 summarizes the methodology and main results of selected studies.

a) Country-specific studies

In the case of Indonesia, the net effect of aid is to increase public spending in all sectors which demonstrate that sectorial aid is not fungible (Pack & Pack, 1990). Furthermore, the changes in public spending exceeds the increase of aid targeted to development expenditures. By contrast, the case of the Dominican Republic, which have a similar aid contribution to education and health sectors as Indonesia, exhibits opposite results. The net effect of categorical aid on public expenditure in social sectors is not statistically different from zero, which demonstrates full fungibility (Pack & Pack, 1993). In other sectors, the increments in public spending is very close to zero or even negative.

Table 2.2 – Selected studies on categorical fungibility of foreign aid

Author (year)	Country sample (years)	Methodology	Degree of fungibility (Ɛ represent the aid's effect on sectorial expenditure)				
			Transport and	Agriculture	Energy	Health	Education
Pack & Pack (1990)*	Indonesia (1966-1986)	Seemingly unrelated regressions (SUR)	Non-fungibility (Ɛ=1)	Non-fungibility (Ɛ= 1)	Non-fungibility (Ɛ= 1)	Non-fungibility (Ɛ>1)	
Pack & Pack (1993)**	Domincan Republic (1968-1986)	Seemingly unrelated regressions (SUR)	Full-fungibility (Ɛ=0)	Full-fungibility (Ɛ=0)	Full-fungibility (Ɛ<0)	Full fungibility (Ɛ=0)	
Feyzioglu, Swaroop & Zhu (1998)	14 developing countries (1971-1990)	Cross-sectional time-series analysis	Non-fungibility (Ɛ=1)	Partial fungibility in public investment (Ɛ<1)	Partial fungibility in total expenditure (Ɛ<1)	Not conclusive	Partial fungibility in public investment (Ɛ<1)
Devarajan, Rajkumar & Swaroop (1999)	18 Sub-Saharan countries (1971-1995)	Cross-sectional time-series analysis	Partial fungibility (Ɛ<1)	Full-fungibility (Ɛ=0)	Partial fungibility (Ɛ<1)	Full fungibility (Ɛ=0)	Non-fungibility (Ɛ=1)
Lu, Shneider, Gubbins, Leach-Kemon, Jamison & Murray (2010)	111 developing countries (1995-2006)	Cross-sectional time-series analysis	Not available	Not available	Not available	Aid goes to central government: Full-fungibility (Ɛ<0) Aid goes to NGOs: Non-fungibility (Ɛ>1)	Not available
Van de Sijpe (2013)	108 developing countries (1990-2003)	Cross-sectional time-series analysis	Not available	Not available	Not available	"On budget aid": non-fungibility (Ɛ=1) "Off-budget aid": non-fungibility (Ɛ=0)	"On budget aid": non-fungibility (Ɛ>1) "Off-budget aid: non-fungibility (Ɛ=0)
Berens (2016)	19 Latin American countries (1980-2008)	Cross-sectional time-series analysis	Not available	Not available	Not available	Full-fungibility (Ɛ<0)	Full-fungibility (=0)

* The authors groupped sectorial expenditures in 5 categories: i) Industry, mining and electric power; ii) Transportation and toursim; iii) Education, health, housing and water supply; iv) Other development expenditures; v) Agriculture and irrigation.

**The authors groupped sectorial expenditures in 5 categories: i) Agriculture; ii) Public works and communications; iii) President's office and Ministry of Finance; iv) Health, education, social services; v) All other real investment expenditures.

Source: Cited studies

b) Cross-national studies

In Feyzioglu, Swaroop and Zhu (1998), the authors found that the degree of fungibility varies among sectors and type of public spending. On the one hand, the concessionary loans to transport and communication sectors are fully reflected in the sectorial budget (both in total expenditure and public investment). On the other hand, public investment in agriculture, energy, and education increases less than concessional loans targeted to these sectors. However, the results for the health sector is much less clear.

In another study with a larger sample, the authors found that concessionary loans for education, energy, transport and communication lead to an increase in sectorial budgets, but only for education, the aid resources are spent fully in the same sector (Devarajan, Rajkumar & Swaroop, 1999). Additionally, the study found that only for the education sector, sectorial fungibility change over time. Moreover, in one study regarding fungibility in the health sector, the evidence shows that for each US$ 1 in aid, public health spending decreases by a range between US$ -1.14 to US$ -0.46 and the reduction is more severe among low-income countries rather than middle-income countries (Lu et al, 2010).

In Van de Sijpe (2013), the author found limited evidence of fungibility in education and health sectors using a static panel model. Health public spending increases almost in the same amount as "on budget health aid". Meanwhile, the expansion in education expenditure is larger than targeted "on-budget aid" to this sector. The study also found negligible effects of "off-budget aid" on displacement of partner's own public sectorial expenditure, which demonstrates non-fungibility. By contrast, a study of Latin American countries, shows that foreign aid does not affect social security and education expenditures, but it decreases spending on health (Berens, 2016). However, this negative impact of aid only holds among middle-income countries and becomes positive among low-income countries. The expenditures in education and social security remain unaffected for both groups of countries, which would demonstrate full fungibility as well[6].

[6] The author does not mention explicitly the results in terms of fungibility of aid, focusing the analysis of the existence of the substitution effect (if foreign aid reduces social expenditure by the government).

To sum up, the evidence of categorical fungibility shows that the degree of fungibility varies according to the specific contexts and sectors. Among the productive sectors, it seems that aid targeted to transport, and communication projects is less likely to be fungible, followed by aid oriented to finance projects in energy and agriculture sectors, respectively. In the social arena, foreign aid targeted at health projects is more fungible than in the education sector. In addition, "off-budget aid" and lower-income countries exhibit lower degree of fungibility. The former may be because partner countries spend very limited resources on similar goods and services provided by technical cooperation (Van de Sijpe, 2013). Furthermore, the weak institutional quality in low-income countries would encourage donors to monitor the aid resources in those countries more strictly (Berens, 2016). By analyzing these results, it seems that the impact of aid on specific public spending depends more on the government commitment to particular sectors than on aid targeting (World Bank, 1998, p. 69).

2.2.4 Micro fungibility

The studies on micro fungibility focus on how project funds financed by foreign aid can be reallocated to other projects within the same sector or to other target territories within the same project. The academic literature on fungibility in actual development projects is scarce, because they are implemented at the local level and the availability of administrative data is very limited. However, three studies stand out in this category.

On the one hand, two separate studies test the existence of fungibility in the first World Bank Rural Transport Project in Vietnam, launched in 1997 with the purpose to rehabilitate 5000 km of local roads (Van de Walle & Mu, 2007; Van de Walle & Cratty, 2007). Using independent administrative data and quasi-experimental methods with a control group of communes, the study found that, in comparison with non-participating communes, aid was used in the construction of new roads, but the number of kilometers of rehabilitated roads is lower than planned. Both studies conclude that these findings indicate partial fungibility, which represents about a half of the aid received for the project.

On the other hand, Wagstaff (2011) examines the degree of fungibility within the health sector across geographic areas, using data from two projects implemented in Vietnam: World Bank's Population and Family Health Project and the National Health Support Project. Both projects

were co-financed by the Vietnamese government and different international aid agencies (under the leadership of the World Bank) and started simultaneously in 1997. Although both programs had similar goals in order to improve primary health care facilities for maternal-child care, each of them has its own target areas according to specific geographical criteria. The authors found that the external and committed domestic resources for both projects were fungible, because they were used to improve health facilities in other non-targeted provinces.

2.3 Plausible causes of aid fungibility

The empirical evidence on the determinants of fungibility is scarce and is concentrated more on the analysis of the effect of aid on total expenditure, thus macro fungibility. Some scholars argue that high monitoring costs of aid resource allocation in partner countries discourage the supervision by donors of tracking them, and therefore, increase the degree of aid fungibility (Feyzioglu et al, 1998; Devarajan et al, 1999; Berens, 2016). This hypothesis was tested empirically with data from 18 Sub-Saharan African countries for the period 1971-1995 using categorical fungibility estimations for concessionary loans in agriculture, education, energy, health, industry, transport and communication sectors (Devarajan et al, 1999). According to the analysis, the results show that the number of donors increase the degree of fungibility, but only in education, transport, and communication sectors.

In addition, there is some evidence that fungibility may be a nonlinear function of aid. Some empirical evidence shows that fungibility is positively correlated with the size of aid relative to total expenditures (Pettersson, 2007). Among other possible theoretical explanations, the author argues that this situation can reflect the lack of donor coordination. An empirical study found “the more aid is given to a particular country, the lower is the impact of aid on the level of government expenditures” (Marc, 2017, p. 636-637), which demonstrate that fungibility at the aggregate level can be higher for high amounts of aid.

In the previous section the literature review has shown that aid fungibility has been signaled as one of the mechanisms of the poor impact of aid on development outcomes, and that aid is more effective in countries with “good governance” and strong institutions. Therefore, it is reasonable to expect that countries with low institutional capacity have higher degree of aid

fungibility. However, there is scarce empirical evidence of institutional capacity as a determinant of fungibility of foreign aid. There are only three recent studies on this topic with different methodological approaches (Berens, 2016; Marc, 2017; Pettersson, 2007).

In the study of fungibility in Latin American countries (Berens, 2016), the author examines the role of corruption on the effects of aid on sectorial expenditures and welfare indicators. Using data of corruption perception from the International Country Risk Guide, the results show that the coefficient of corruption variable is not significant and does not change the estimation results of aid fungibility in social sectors. In addition, the author also found that the degree of fungibility is lower in low-income countries than in middle-income countries. The study concludes that this difference can be attributed to the lower institutional quality in low-income countries, which encourages a stronger monitoring of aid resources by donor community in these countries and therefore, could lead a smaller degree of aid fungibility.

In the other study (Marc, 2017), the author mentions that the inclusion of variables about institutional quality as controls in the regression analysis did not alter the impact of aid on public expenditure at the aggregate level.

Finally, in Pettersson (2007) the author analyzes the correlation between the degree of macro fungibility (based on aid's effect on total expenditure) and three measures of institutional quality: a compound index from ICRG variables, a democracy index, and an index regarding the quality of the policy environment, constructed from prior research (Burnside & Dollar, 1997). Although the first two measures have no correlation with aid fungibility estimations, the third one has a higher correlation with aid fungibility, indicating that countries with sound economic policies have a higher degree of fungibility (Pettersson, 2007). According to the author, a plausible explanation is the donors' trust in partner countries that pursue good policies and have a strong policy environment. In such contexts, the donors are perhaps more tolerant and less worried about the deviation of aid resources.

2.4 Research hypotheses

H1: Low institutional capacity in developing countries increases the degree of fungibility of foreign aid targeted to the education sector.

Low institutional capacity means a weak ability of the State to perform its functions. The presumption is that in these contexts, the national systems, like civil service, public financial management, procurement, monitoring and evaluation systems may be less developed. A weak public financial management system implies a low performance of institutions in designing and implementing budget plans at different government levels, collecting taxes, setting fiscal frameworks, and in the application of good practices in accountability and transparency (UNDP, 2011). In such contexts, it is more difficult to track the use of public resources from different sources, including foreign aid. Furthermore, it is very hard for donors to monitor aid resources, and also for partner countries to know exactly how these resources are spent. Under these circumstances, without a strong budget system that allows a strong monitoring of aid resources, fungibility can easily rise.

In addition, a low institutional capacity reinforces the negative effect of foreign aid on growth through an increase in rent-seeking behavior and corruption by public officials. In such circumstances, aid resources are more likely to be appropriate by particular interests, which can differ from the donor's intentions, and therefore, the degree of fungibility can increase.

In addition, the "aid illusion effect" may be higher in countries with low institutional quality, which in turn can affect the use of aid resources. The "aid illusion effect" assumes that the officials who set the expenditures plan in the central government ("policy officials") are different from those who have to implement those plans in the field and execute the expenditures ("implementing officials") (McGillivray & Morrissey, 2001). The "policy officials" are in charge of allocating public resources, including actual or expected revenues and aid inflows, to different expenditure headings. However, the "implementing officials" receive their budget as a whole, and in the absence of any further information, they are subject to misperceptions about any restriction of the use of aid resources. In this scenario, the level of public spending in the target sector by "implementing officials" can be lower than expected by the policy officials and donors (McGillivray & Morrissey, 2001, p. 128).

H2: Multilateral aid is less fungible than bilateral aid in education sector.

Different degrees of fungibility between multilateral and bilateral aid can be explained by i) donor's motivation in allocating their aid resources, and ii) the use and compliance of aid conditionalities.

According to the literature, foreign aid through multilateral organizations is less politicized in comparison with bilateral aid (Gulrajani, 2016; Marc, 2017). Following this argument, bilateral aid is more vulnerable than multilateral aid to political capture, because under such modality aid allocation is shaped by donor's strategic and political considerations, and less development-oriented. Different factors could determine the allocation of bilateral aid, from historical ties (colonialism), and economic purposes (trade, investment flows) to security reasons; therefore, bilateral aid not necessarily is aligned with partner needs or preferences. This is more critical when the partner government pursues development goals, like reducing poverty, increasing health care and promoting education quality. Furthermore, some literature concludes that multilateral aid is better aligned with partner's needs than bilateral aid (Alesina & Dollar cited in Marc, 2017). This evidence is supported also by a higher preference from the partner countries to use multilateral channels than bilateral ones, because they are perceived more responsive, flexible, and more aligned with country systems and are therefore more quick to respond to requests (Gulrajani, 2016). In consequence, it is reasonable to expect that multilateral aid is more aligned with partner government preferences, and therefore, it would lead a lower degree of fungibility than bilateral aid.

Multilateral aid has been often tied to specific conditionalities about aid allocation and policy reforms, while bilateral aid usually requires partner countries to buy specific goods and services made in the donor country (Marc, 2017). However, in the case of bilateral aid, "at sectorial level, if products provided by the donor are not prioritized by the partner, a diversion of funds is very likely" (Marc, 2017, p. 642). In addition, multilateral agencies are more proficient in adding conditions to aid and implementing them, and may be more capable to extract information from partners about the use of aid resources (Rodrik, 1996 cited in Findley et al, 2017).

Chapter 3 Research design

In order to answer the research question, the thesis follows a non-experimental design with a large sample of developing countries, which involves a time-series cross-sectional analysis. The reasons are threefold. First, it is a non-experimental design, because it is impossible to do an experiment using developing countries as the unit of analysis and controlling the exposure to the treatment among them. By contrast, this research is based on observations from secondary data, which is not possible to manipulate. Second, for external validity purposes, the research design relies on a greater number of developing countries. This decision allows any cross-country generalization, which is more useful evidence for the donor community and partner countries as a whole, instead of evidence from a specific-country context. Third, the approach of the research design is quantitative, since it looks at the effect of specific causes of aid fungibility across the countries using measurable variables and regression analysis.

Regarding quantitative methods, this research uses a time-series cross-sectional analysis, with panel data from a sample of developing countries worldwide. The application of this method in sectorial fungibility studies starts with the research of Feyziouglu, Swaroop and Zhu (1998), and has been replicated several times since then (Devarajan et al, 1999; Lu et al, 2010; Van de Sijpe, 2013; Berens, 2016). For the purpose of the internal validity of this research, panel data analysis is selected because it allows to make some causal inferences of institutional quality variables on aid fungibility due to the variation of the variables across both the unit of analysis (developing countries) and also over time (years). In addition, it is especially useful when any time-constant unobservable variables can affect aid fungibility, like government preferences or priorities in the decision-making process about the use of aid resources in partner countries.

The rest of the chapter is divided in four sections. The first one describes the empirical strategy used for the time-series cross-sectional analysis. The second section discusses the relevant control variables to be considered. The third section describes the selection of the countries and the period of analysis. The fourth section presents the operationalization of the dependent, independent and control variables. The last section analyzes the reliability and validity.

3.1 Empirical strategy

In order to answer the research questions, the empirical strategy consists of three stages. The first step will address the second sub-question, about the extent of categorical fungibility and whether there is any difference between bilateral and multilateral aid. For this purpose, a panel data model with fixed effects is proposed. The aim of the second step is to calculate different estimates of aid fungibility among countries and years, which will be assessed by a panel varying coefficient model. The third stage uses the estimates of the second step as a dependent variable and identifies their causes and the impact for institutional capacity variables on aid fungibility, which is what the third sub-question postulates.

3.1.1 First stage: testing the existence of aid fungibility

At this stage, the objective is twofold. First, to analyze the effect of education aid on government expenditure on education; and second, to compare this effect among different aid modalities. For the first case, this research uses total aid flows for education as the main independent variable; while bilateral and multilateral aid flows targeted to education sector are used as the variables of interest for the second case.

For both purposes, the research design will follow the methodology used by most previous studies on categorical fungibility (Feyzioglu et al, 1998; Pettersson, 2007; Van de Sijpe, 2013, Berens, 2016). Therefore, the design consists of a time-series cross-sectional analysis, using the following general specification:

$$GovExp\_educ_{it} = \propto_i + \beta_1 TotalAid\_educ_{it} + \beta_2 X_{it} + \lambda_t + \varepsilon_{it}, \qquad (1)$$

In the equation (1), $GovExp\_educ_{it}$ represents the partner government expenditure in a specific sector (e.g. health or education) for every country (denoted with 'i' sub index) and for every year (denoted with 't' sub index) in the selected sample. The term $TotalAid\_educ_{it}$ represents the targeted aid on education received by each partner country for every year, X_{it} are a set of control variables, α_i are the country-specific parameters, λ_t are the time trend and ε_{it} is the error-term.

Using this simple model for the first objective, the parameter of interest is β_1, which represent the effect of targeted foreign aid on the sectorial expenditure in the partner country. If β_1 is negative and significant, then an increase in targeted aid to education leads to a reduction on government expenditure on education, which represent full fungibility. If β_1 is higher than 0 but less than 1, then government expenditure on education increases less than targeted aid to education, which implies partially fungibility. Finally, $\beta_1$higher or equal than 1 implies non-fungibility.

Additionally, it is necessary to adapt the simple model for the second objective, according to equation (2). Under this model specification, $BilatAid\_educ_{it}$ represent bilateral aid and $MultiAid\_educ_{it}$ is multilateral aid, both targeted to education sector for each country and year. In addition, X_{it} is a set of control variables similar than in equation (1).

$$GovExp\_educ_{it} = \alpha_i + \theta_1 BilatAid\_educ_{it} + \theta_2 MultiAid\_educ_{it} + \theta_3 X_{it} + \lambda_t + \varepsilon_{it}, \quad (2)$$

In this case, the parameters of interest are θ_1 and θ_2. Similarly the case of β_1, both estimators have to be less than 1 to prove partially fungibility or less than 0 to display full fungibility. Under either scenario, looking at the statistical significance regarding the difference of the coefficients allows one to respond the second part of sub-question 2. In case both coefficients are statistically different, and the estimate of the effect of bilateral aid on public spending (θ_1) is higher than the multilateral aid (θ_2), then it is possible to accept Hypothesis 1 and conclude that the multilateral aid is less fungible than the bilateral aid. Otherwise, the hypothesis is rejected at certain level of confidence.

The analysis will include different model specifications for equation (2) based on the number of regressors as a robustness-check procedure. If the coefficients do not change under several specifications, the estimations will be more robust and therefore increase the internal validity of this study.

The coefficients of equation (1) and (2) can be obtained by Ordinary Least Squares Regression Method (OLS) for fixed effect models or by Generalized Least Squares (GLS) for random effect models. The selection of fixed or random effects depends on the assumption that unobserved individual effects is correlated or not correlated with the regressors of the model (Hsiao, 2003). For the thesis' purpose, the empirical specification proposes a fixed-effect

model, because it is expected that unobserved individual effects, like government preferences and priorities, influence how the government allocates its budget and aid flows. Nevertheless, the selection of the model will be confirmed by testing the correlation between the country-specific terms and the errors through the Hausmann test.

Besides its advantages, the simple model is not appropriate to answer the third sub-question about the causes of aid fungibility, because the estimation of the parameter of interest (β_1) are the same for the entire sample. In order to look at the causes of the degree of fungibility, it is necessary to simulate the different size of fungible aid for the different countries and over time.

3.1.2 Second stage: simulating different degrees of aid fungibility

The aim of the second stage is to estimate different values of β_1 for equation (1) for each country and year. For that reason, a Panel Variable-Coefficient (PVC) model with fixed coefficients is applied. In its general form, the model specification is as follows (Hsiao, 2003, p. 151):

$$y_{it} = \sum_{k=1}^{K}(\bar{\beta}_k + \alpha_{ki} + \lambda_{kt})X_{kit} + u_{it} \qquad (3)$$

$$\text{where: } i = 1, \dots, N \; ; \; t = 1, \dots, T$$

The effect of each "*k*" independent variable (denoted by X_{kit}) on the dependent variable can be disaggregated in three components. The first one is the common-mean-coefficient ($\bar{\beta}_k$), the second component is an individual specific deviation from the common mean (α_{ki}) and the last one is a time-specific deviation (λ_{kt}).

Using the same explanatories variables of the best empirical specification for the equation (1), the PVC model with fixed coefficients is as follows:

$$GovExp\_educ_{it} = (\bar{\beta}_1 + \alpha_{1i} + \lambda_{1t})TotalAid\_educ_{it} + \sum_{k=2}^{K}(\bar{\beta}_k + \alpha_{ki} + \lambda_{kt})X_{kit} + u_{it} \quad (4)$$

$$\textit{where: } i = 1, \dots, N \; ; \; t = 1, \dots, T$$

Equation (4) will be calculated with government expenditure data and targeted aid for education. The aim is to estimate and predict the three components of the effect of aid on

education public expenditure. The model will be estimated by the Generalized Least Squares technique in order to get the best linear unbiased estimators (Hsiao, 2003, p.184)[7].

In order to estimate a PVC model, it is necessary to identify the source of the coefficients' variation. For instance, it can come from the heterogeneity of the observations across the units of analysis (fixed-coefficient model), or from random draws of a common population (random coefficient model) (Hsiao, 2003, p. 149). For the thesis' purpose, the empirical specification will use a fixed-coefficient model, because the sample consists of a large group of developing countries, which have different social, political and economic structures, and therefore have different degrees of sectorial fungibility as was demonstrated by the literature review in Chapter 2. In addition, the fixed-coefficient model is more appropriate in this case, because the interest is to predict each individual component of the aid's effect on government expenditure in order to make inferences conditional to country characteristics.

The PVC model specification will use the same regressors of the best fitted model selected in the first stage for equation (1). With the coefficients of the PVC model, it is possible to simulate the size of fungible aid for each country-year observation.

The simulation procedure is an adaptation from the methodology of Pettersson (2007) and is based on the idea that the extent of fungibility represents a change in public expenditure due to a change in aid flows. In equation (4), this effect is represented by the components of the coefficient of the aid variable.

First, let's specify δ_{1it} as the country-year specific effect of sectorial aid on public expenditure in the education sector, which can be calculated from the sum of the estimated coefficients:

$$\widehat{\delta_{1it}} = \widehat{\beta_1} + \widehat{\alpha_{1i}} + \widehat{\lambda_{1t}} \qquad (5)$$

If the variables of interest in equation (4) are expressed in logarithmic terms, $\widehat{\delta_{1it}}$ can be interpreted as the time-country-specific elasticity of public expenditure to the change of 1% of targeted aid going towards education. Therefore, the degree of aid fungibility can be expressed as the complement:

[7] According to Hsiao (2003, p. 183), is necessary to impose two restrictions on the model to get the GLS estimators: The first one is $\sum_{i=i}^{N} \alpha_{ik} = 0$ and the second is $\sum_{t=i}^{T} \lambda_{kt} = 0$, $k = 1, \dots, K$.

$$FungAid\_educ_{it} = 1 - \widehat{\delta_{1it}} \quad (6)$$

The variable $FungAid\_educ_{it}$ is continuous and represents the amount of targeted aid resources to education that are not spent through the public expenditure on education for each country-year observation.

3.1.3 Third stage: examining the causes of aid fungibility

The aim of this section is to identify the causes of aid fungibility in order to answer the third sub-question. For this purpose, $FungAid\_educ_{it}$ represents the new dependent variable, which represents the size of fungible aid for education sector and is different for each country and year. The empirical strategy consists to use a new panel data analysis in order to identify the factors that cause the variation of $FungAid\_educ_{it}$, where institutional capacity (IC_{it}) is the independent variable of interest. Using the estimate of (6), the model specification is as follows:

$$FungAid\_educ_{it} = \gamma_i + \lambda_1 IC_{it} + \sum_{j=2}^{J} \lambda_j W_{jit} + u_{it} \quad (7)$$

$$\text{where: } i = 1, \dots, N \; ; \; t = 1, \dots, T;$$

In equation (7), the parameter of interest is λ_1, which represent the impact of institutional capacity on the degree of aid fungibility. Other observable factors (W_{jit}) and country-specific unobservable effects (γ_i) as control variables are considered as well. If the estimate $\widehat{\lambda_1}$is not significant or if it is significant but with a positive sign in the model at a certain confidence level, then it is possible to reject the Hypothesis 1 about the negative relationship between institutional capacity and the degree of aid fungibility in education sector. If the estimate $\widehat{\lambda_1}$is significant and negative in the model at a certain confidence level, then it is not possible to reject the hypothesis. For this purpose, a panel data model with random-effects is applied using Generalized Least Squares (GLS) technique of estimation[8].

[8] According to Hausman specification test (see Chapter 4), random effects model is preferable over fixed effect model for the specification of equation (7).

3.2 Selection of the control variables

Because in the second stage the control variables are the same as those used for equation (1) in the first stage, this section describes the selection of control variables only for the first and third stages.

3.2.1 Control variables for the first stage

The sets of control variables for equations (1) and (2) are selected on the basis of the empirical strategy from the literature of categorical fungibility shown in the Table 2 in Chapter 2. The control variables used by each study are in Table 3. For the purpose of this thesis, only the most frequent control variables will be considered, which are: GDP per capita, total public expenditure, other sectorial aid and time variables. An exemption for this rule will be the inclusion of education outcomes, which will be explained later on.

Table 3.1 – Control variables in literature of categorical fungibility

Author (year)	GDP per capita	Total public expenditure	Other sectorial aid	Time dummies
Pack & Pack (1990)	x		x	x
Pack & Pack (1993)	x		x	x
Feyzioglu, Swaroop & Zhu (1998)	x	x (net of foreign aid)		
Devarajan, Rajkumar & Swaroop (1999)	x (one year lag)	x (net of foreign aid)		
Lu, Shneider, Gubbins, Leach-Kemon, Jamison & Murray (2010)	x	x		
Van de Sijpe (2013)	x		x	x
Berens (2016)	x (level and growth)	x (one year lag)		x
Pettersson (2007)	x		x	x

Author (year)	Urbanization	Trade	Infant mortality	Education outcomes	Others
Pack & Pack (1990)					
Pack & Pack (1993)					
Feyzioglu, Swaroop & Zhu (1998)			x (one year lag)	Average years of schooling (lag 1 year)	Military expenditures of neighboring countries, share of agriculture as % GDP
Devarajan, Rajkumar & Swaroop (1999)			x (one year lag, only health sector analysis)	School enrollment (lag 1 year, only education sector analysis)	
Lu, Shneider, Gubbins, Leach-Kemon, Jamison & Murray (2010)					Debt relief, HIV prevalence
Van de Sijpe (2013)	x	x			General aid, Present value of debt, public debt service
Berens (2016)	x	x			Inflation rate, Unemployment rate, Population under 14 and above 65, life expectancy, democracy index
Pettersson (2007)					

Source: Cited studies

The reasons for the selection of these control variables are as follows:

a) *GDP per capita:* it allows one to consider the potential effect of different levels of development on public expenditure among developing countries. It is expected that a higher GDP per capita leads to an increase in public revenues (through income taxes, for instance), which allows the government to expand sectorial budget.

b) *Total public expenditure:* this variable isolates the effect of the government's size. A larger general budget in the public sector facilitates a higher public expenditure on education.

c) *Other sectorial aid:* it accounts for the effect of the rest of aid (everything but education) on public expenditure for education. If the associated coefficient is positive, it means that there is a diversion of aid resources from other sectors to education, which increases the expenditures in those sectors of interest.

d) *Time trend:* it allows to capture the evolution of sectorial expenditure over the time, which is influenced by the cycle of the economy and other external shocks.

e) *School enrolment:* this variable is considered because "(…) this factor influence[s] education spending" (Feyzioglu, Swaroop & Zhu, 1998, p. 38). It is included with a one-year lag, assuming that the government define the current education budget in order to increase the previous level of school enrolment, because it is the last available information they have, and because it is part of their prioritized social goals.

3.2.2 Control variables for the third stage

The set of control variables (W_{jit}) was selected on the basis of the literature review described in the section 2.3 in Chapter 2, and can be synthetized as follows:

a) *Number of donors in partner country:* it represents a proxy for the monitoring costs of aid resources by donors in the partner country. When a partner country has a large number of donors, then the cost of coordination and reporting about the use of aid resources with each donor is more difficult. Therefore, the monitoring costs would be higher and in consequence, the degree of fungibility increases.

b) *Aid dependency:* when aid inflows represent a large proportion of the budget in a partner country, it can have two opposite effects on the degree of fungibility, according to the literature. First, the larger aid flows may reflect stronger monitoring capabilities from donors, and a lower degree of fungibility is expected (Pettersson, 2007). Second, a large aid inflow increases the size of available resources to be used by partner governments for different purposes, and also increases the cost of coordination with donors, therefore, the degree of fungibility would be higher.

In addition, the following variables will be included:

c) *Country development status:* the categorization used by the World Bank Atlas method based on the Gross National Income per capita allows to control for the different level of development of the economy, which affect the quality of public budgeting system. It is expected that a higher development status leads to a more reliable and transparent public budgeting system, which reduces the "aid illusion" effect and therefore, decrease the degree of aid fungibility.

d) *Share of wages in public expenditure:* if the total wages of civil servants in the education sector represent almost the total sectorial budget (net of foreign aid), then it is more difficult for the government to finance other needs in the form of current expenditures or capital goods (Devarajan, Rajkumar & Swaroop, 1999, p. 16). Under

this scenario, earmarked aid can be used to close these gaps and therefore, reduce the deviation of aid resources to other sectors.

3.3 Selection of countries and time horizon

The selection of the period of time is restricted by the data availability, especially for the dependent variable and the independent variables of interest. On the one hand, the data regarding government expenditure on education has a large number of missing values, specially before the year 2000 and after 2016. On the other hand, the sectorial ODA disbursements and commitments are readily accessible from 2002 and 1995, respectively. However, as it is argued later on, for the research it would be more important to operationalize the independent variable through ODA disbursements rather ODA commitments. Considering the overlapping years for both variables, the timeframe of the analysis includes the maximum number of years with available data, which needs less data imputation for both variables to achieve the required balanced panel by the PVC model. Using these criteria, the selected period for the analysis of aid fungibility will be from year 2000 to 2016, which only requires data imputation of two years for the independent variable of interest (2000 and 2001).

The choice of countries is based on those that receive aid flows to education from DAC members, which represent the population of the study. For instance, for the period 2002-2016, 157 countries receive at least one year of ODA disbursements to education sector. However, for this thesis' purpose, only countries that have received ODA disbursements for the most part of the period are considered. In addition, nine countries in the population were removed, because they were not included in the World Development Indicators dataset (WDI), which is the main source of the other variables. For these reasons, the potential sample consists of 142 countries that have ODA disbursements in education sector for at least nine years. However, as will be shown in next section, not all of them have complete information for the rest of variables during the whole period. Therefore, the final selection only considers those countries with available data for the dependent and control variables for at least 12 years, in order to minimize the data imputation of the variables in the first stage. Unfortunately, the countries of the potential sample that comply with this requirement is low, especially because of the lack

of data on government expenditure in education. The following section will discuss how many countries drop out because of data availability per each variable.

The final selection consists of 47 countries for 17 years (2000-2016), which represent 799 annual observations. The list of countries of the final selection is presented in Appendix A.1 by region and income classification.

3.4 Operationalization of variables

This section discusses the measurement of the dependent, independent and control variables that will be used in the econometric models of the empirical strategy explained in section 3.1.

3.4.1 Dependent variables

The empirical strategy considers two dependent variables: i) public expenditure on education for the first and second stages, and ii) the degree of fungibility for education aid for the third stage. As the latter is estimated from the analysis in the second stage and was explained in section 3.1, only the operationalization of the dependent variable in the first and second stages is explained here ($GovExp_{it}$).

The variable of public expenditure on education measures the amount of resources that the general government (including central, regional and local levels) of partner countries spends in the education sector. In order to get comparable and reliable data for different countries, this variable is operationalized through the indicator "Government expenditure on education per capita (in current US$)", which has been used by previous studies as well (Devarajan, Rajkumar & Swaroop, 1999; Pettersson, 2007)

This indicator was calculated for all the countries in the potential sample from 2000 to 2016 by the division of two variables: "Government Expenditure on education in current US$" from the UNESCO Institute of Statistics and "Population, total" from the World Development Indicators. However, two countries do not have any information on education expenditure, and for the rest of 141 countries, around 51% of the observations are missing. Therefore, it would be necessary to drop countries without enough information and apply a data imputation

technique with the rest. First, the potential sample was reduced to 56 in order to keep only countries with available data of the dependent variable for at least 12 years. Second, among this group, the missing data of the indicator in each country was replaced by its temporal mean calculated with the rest of observed data. At the end, almost 13% of the observations of this variable were imputed.

3.4.2 Independent variables

The independent variable of interest for the first and second stages is the total aid for education projects, which is replaced by bilateral and multilateral aid to estimate equation (2). In the third stage, the institutional capacity variables are the main independent variables of interest.

a) Targeted aid flows

Total aid inflows to partner countries are measured by the gross disbursements of Official Development Assistance flows on education in US$ current per capita ($TotalAid\_educ_{it}$). From this total, the resources transferred by DAC countries are considered bilateral aid ($BilatAid\_educ_{it}$), and those given by international organizations is considered multilateral aid ($MultiAid\_educ_{it}$). As was mentioned in previous studies (Feyzioglu, Swaroop & Zhu, 1998; Pettersson, 2007), it is preferable to use aid disbursements instead of commitments, because the former represent the actual amount of resources that partner countries use in a particular year. The indicator is calculated by dividing the variable of the ODA flows (in US$ current prices) from the Creditor Reporting System (CRS) of the OECD, with the variable of "Population, total" from the World Development Indicators for the World Bank.

The CRS database contains readily available data about the sources and destinations of aid, the type and modality of aid, and which purposes it serves on a comparable basis for all DAC members. In this database, the information about aid disbursement by sector is more restricted than the data of aid commitments. Indeed, the available data of the former starts from 2002, while for the latter starts from 1995. In order to complete data of aid disbursements for years 2000 and 2001, it is necessary to impute data for the missing values using the data from sectorial aid commitments. The technique consists of

calculating the proportion of sectorial aid commitments for each year and country and then applying this proportion to the amount of total disbursed aid for each country and year, which is available from 1995. This procedure was applied only for 2000 and 2001. Then, each value of ODA disbursement was divided by the population of each country in order to transform the variable in per capita terms. Overall, data imputation was used for 12% of the observations in the potential sample for targeted aid on education.

b) Institutional capacity variables

As was argued in Chapter 2, the concept of institutional capacity is highly related to the quality of governance in the countries, because it refers to the ability of governments to fulfil their main functions. Therefore, institutional capacity is measured through the Worldwide Governance Indicators (WGI) proposed by Kaufmann, Kraay & Mastruzzi (2011) and published by the World Bank. From the six available indicators of this dataset, this research proposes to use three of them, which are more related to the capability of the States to perform their functions and can influence the allocation of aid resources:

i) Index of government effectiveness ($IC1\_goveff_{it}$).

This measure "captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies" (Kaufmann, Kraay & Mastruzzi, 2011, p. 4). This indicator is an approximation to measure the problem of "aid illusion" between the planning officials and the implementing officials. In the situation of poor quality of civil service and low independence of technical decisions from political pressures, especially in the national budget system, diversion of foreign aid from its original purposes is likely. Therefore, a higher government effectiveness index would lead to lower aid fungibility.

ii) Index of Rule of law ($IC2\_rulelaw_{it}$).

This measure "captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement,

property rights, the police, and the courts, as well as the likelihood of crime and violence" (Kaufmann, Kraay & Mastruzzi, 2011, p. 4). In a society with a low level of rule of law, it is more probable that the formal agreements and contracts between the agents would be unfulfilled. When this situation becomes very common in the public sector, it is possible that the international commitments with donors about the use of foreign aid resources would have a higher level of non-compliance. Therefore, a higher rule of law index would lead to lower aid fungibility.

iii) Index of control of corruption ($IC3\_nocorr_{it}$).

This index "captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests" (Kaufmann, Kraay & Mastruzzi, 2011, p. 4). In highly corrupted governments, it is more probable that aid resources are spent in those purposes which return more political benefits for the government, or they spent in activities to obtain private gains promoted by rent-seeking behavior. Because of the methodology of calculation, lower values of the index express more corruption. Therefore, a higher control of corruption index would lead to lower aid fungibility.

All three indicators are available for the time horizon, with the exception of year 2001, which was imputed by the values of the previous year. The estimates give a continuous standardized score on each indicator for each country, ranging between -2.5 and 2.5.

In addition, an alternative variable called "Institutional capacity" (IC_PCA_{it}) is considered. This is a synthetized indicator of the above three, calculated by Principal Component Analysis technique. This variable will be useful in alternative specifications, in order to reduce the number of coefficients to be estimated and in consequence, increase the grades of freedom in the regression model.

3.4.3 Control variables

The description of the operationalization of the control variables for the first and second stage (X_{it} in equations 1, 2 and X_{kit} in equation 4) is as follows:

a) *Gross Domestic Product per capita (GDP_PC_{it}).* This indicator is released in US$ current from the WDI dataset. This indicator is missing for five countries for at least 5 years, which are removed from the potential sample. Because of missing values, less than 1% of the observations were replaced by the temporal mean of the corresponding countries.

b) *Total public expenditure ($GovExp\_Totlag_{it}$).* This variable is operationalized through the general government final consumption expenditure[9] of the previous year, measured in US$ current per capita. The use of the lag of one year is due to avoid a potential endogenous relationship with the dependent variable. Twenty-seven countries in the potential sample have missing values for at least 5 years, so they are removed. In addition, for the rest of countries, less than 3% of observations are missing, so they were replaced by the temporal mean of the corresponding countries. The source of information is the WDI dataset.

c) *Other sectorial aid ($TotalAid\_other_{it}$).* This indicator is calculated by the difference between total ODA disbursements and education aid disbursements for each country, both measured in US$ current per capita. Among the potential sample, 11 countries have at least one year without aid disbursements, which represent 47 observations with zero values (less than 2%). The source of information is the Creditor Reporting System by the OECD. In the case of equations (1) and (4), this variable is included as the sum of all non-education aid flows. In the case of equation (2), it is included for each aid modality: "other bilateral aid" *($BilatAid\_other_{it}$),* and "other multilateral aid" *($MultiAid\_other_{it}$).*

d) *Time variable ($YEAR_t$).* It consists of the inclusion of a time trend in the model along the time horizon.

e) *School enrolment ratios ($Enrol\_primlag_{it}, Enrol\_seclag_{it}$).* They are measured by gross enrolment ratio in primary and secondary, which represent the ratio of total

[9] A better option for this variable is to consider the total public expenditure, which includes public consumption and investment. However, this variable is available from IMF statistics for a smaller number of countries than using the variable of final government consumption.

enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education[10]. The use of the lag of one year is because its assumed that the education expenditure decisions are made on the basis of increasing the school enrolment of the previous year, as a proxy of the education sector outcome. The source of information is the World Development Indicators by the World Bank. The data of primary and secondary gross enrolment is not completely available for 30 and 53 countries, respectively, which have to be removed from the potential sample. For the rest, a total of 7% and 10% of observations in the ratio of gross enrolment in primary and secondary education, respectively, were imputed by the mean of each country.

Because of the lack of complete information for the dependent and control variables in the first stage, only 47 countries are considered for the analysis.

The control variables for the third stage are calculated only for the final selection of 47 countries. In contrast with PVC model, the third step of the empirical strategy does not require a balanced panel, therefore data imputation for missing values is not necessary. The operationalization of these variables is as follows:

a) *Number of donors in partner country* ($Numdonors\_educ_{it}$). This indicator is calculated for each year based on the ODA disbursements for education projects by each DAC country-donor and/or multilateral organization. The source of information is the Creditor Reporting System by the OECD. The data is complete for all the final selection, but the number of zero values represent 2% of the observations.

b) *Aid dependency* (Aid_depend_{it}). This is calculated in two forms based on the data from the Creditor Reporting System by the OECD and the World Development Indicators by the World Bank:

[10] It would be preferable to use the ratio of net enrolment for each education level, because it excludes overage students and captures more accurately the system's coverage and internal efficiency (World Bank, 2019). However, the data availability of this indicator is lower than the gross enrolment ratio. For instance, using the net enrolment ratio in primary, the number of removed countries from the potential sample would be increased by 70 countries.

- $Aid\_depend\_gfc_{it}$: Defined as the ratio of ODA disbursements flows divided by the general government final consumption in the partner country, both measured in current US$. The number of missing values is less than 1% of the observations.

- $Aid\_depend\_gdp_{it}$: Defined as the ratio of ODA disbursements flows divided by the gross domestic product of the partner country, both measured in current US$. The data is complete for all the countries and years.

c) *Country development status* ($LMdev\_status_{it}, UMHdev\_status_{it}$). The indicator classifies the country into four categories according their Gross National Income per capita. However, in order to include this indicator in the model specification, two binary variables are calculated: one that identifies "Lower and middle-low income" countries ($LMdev\_status_{it}$) and other for "High and upper-middle income" countries ($UMHdev\_status_{it}$). This variable is measured by each year by the World Bank.

d) Share of wage expenditure ($WageExp\_educ_{it}$)*:* this indicator represents all staff compensation expressed as a percentage of public expenditure on education. Staff compensation includes salaries, contributions by employers for staff retirement programs, and other allowances and benefits. The source for this information comes from the UNESCO Institute for Statistics. The number of missing values is around 57% of the observations for the final selection of countries. For this reason, a subsample of 29 countries[11] for the period 2007 and 2016 is defined, in order to have available data for at least 5 years by country. In this case, the number of missing values decreases to 22%.

The Appendix A.2 summarizes the operationalization of the variables and their sources.

[11] The excluded countries from the final selection are listed in the footnote of the Appendix A.1.

3.5 Validity and reliability

In this section, the internal and external validity of the research, as well as its reliability are assessed.

3.5.1 Validity

a) Internal validity

Internal validity refers to what extent the research design allows one to identify a causal relationship between the independent variables of interest and the dependent variable. For the purposes of this thesis, the internal validity is supported by three factors. First, the research design considers the use of econometric techniques that allows the inclusion of control variables that could affect the dependent variable. Therefore, the effect of the education aid flows on government expenditure is isolated from the potential impacts of other variables.

Second, the use of panel data models allows to have a "large number of data points, increasing the degree of freedom and improving the efficiency of econometric estimates" (Hsiao, 2003, p.3). Moreover, longitudinal data has a greater capacity for capturing more complex realities, like how governments allocate aid resources, in comparison with cross-sectional design. In this sense, panel data models "contain information on both the intertemporal dynamics and the individuality of these entities may allow one to control the effects of missing or unobserved variables" (Hsiao, 2007). Finally, the use of panel data models with fixed effects allow to control for unobserved country-specific variables that do not change over time and can be correlated with the covariates. This is particularly important for this thesis, because it is possible that colonial history, education system or demographic structure of partner governments can influence the priorities about allocation of aid resources of foreign aid targeted to education sector.

Third, the test for the assumptions about the estimation method for the panel data models contribute to increase internal validity. Because the empirical strategy is based on linear panel data models using Ordinary Least Squares, it is important to validate its assumptions with the data in order to reduce the bias in the estimation of coefficients. The most relevant suppositions are normal distribution of the variables, no perfect multicollinearity, error's homoscedasticity, exogeneity of the regressors, and for the panel data with fixed effects, the assumption of correlation of unobserved individual effects with the explanatory variables. The Appendix A.3 specifies the tests and techniques to validate them and how to overcome these assumptions in case they will be violated.

b) External validity

External validity is the extent to which the results of the study would be generalized for all the population. From the research design, the degree of external validity of the thesis relies on the representativeness of the final selection of countries.

The Appendix 3.4 presents the number of countries for each region and by income classification. There are no big differences among the potential sample and final selection. The main differences are that the final selection has a slightly higher proportion of countries with lower income, and also a smaller proportion of countries from the East Asia & Pacific region in comparison with the potential sample.

The final selection considers three countries classified as "High income" economies, which are Argentina, Chile and Barbados. The reasons are because the information in the tables about the selection of sample uses the income classification of 2017 by the World Bank, and the income classification of these countries has changed over time.

Overall, the number of countries in the final selection represents the 33% of the total economies in the potential sample, which implies 35% of targeted aid for the education sector worldwide. In addition, the distribution of the countries in the final selection by location and by income is similar to the potential sample, which supports the external validity of the research.

3.5.2 Reliability

The reliability of the research design is supported by two arguments. First, the sources of information come from official and recognized organizations, such as the World Bank, OECD, and UNESCO. Second, all the original data used in the study is available online for anyone who may want to replicate the analysis.

However, the study has some limitations on data availability and error measurements that have to be taken in account. First, the lack of a complete time-series for almost all the variables, especially those related with government expenditures. In order to overcome this issue, only countries with a minimum of information were included for the regression analysis. In addition, only for the first stage, a mean-imputation technique was applied for missing values in order to get a balanced panel dataset, which is a requirement for PVC modelling. In addition, for the third stage, a subsample with a lower number of countries and years with higher data availability was defined, in order to estimate alternative specifications using wage expenditure as an additional control variable.

Second, the errors of measurement in some variables can affect the estimation of the regression coefficients. For example, the data for variables on institutional capacity have measurement errors, because it comes from different sources based on perceptions of key stakeholders and do not cover all the components and definition of institutional capacity. In addition, other variables are selected as a proxy of others, because of data availability. For instance, gross enrolment ratios are proxies for educational outcome, which should be measured through net enrolment ratio or learning tests scores. However, these variables are not available for all the countries and period of the study.

In sum, the reliability of the study is strong, but it is constrained by the available information and error measurements of the variables.

Chapter 4 Results

This chapter contains the outcomes of the data analysis according to the research design and the discussion of the findings in order to respond the research questions and validate the hypotheses. Section 4.1 describes the statistical analysis of variables and econometric results for the equations (1) and (2) corresponding to the first stage of the empirical strategy. Section 4.2 contains the results for the simulation of the size of fungible aid, which vary among countries and years, according to the proposed methodology for the second stage. Section 4.3 presents the statistical analysis of variables and econometric results for the equation (7) of the third stage in order to identify the causes of aid fungibility. Section 4.4 discusses the findings.

4.1 First stage: testing the existence of aid fungibility

As was described in Chapter 3, the aim of the first step of the empirical strategy is twofold. On the one hand, it will test the existence of fungibility for foreign aid on education, which is related with the second sub-question. On the other hand, it provides evidence to validate (or dismiss) the hypothesis about whether or not multilateral aid is less fungible than bilateral aid in the education sector (H2) and is partially related with the second sub-question as well.

The outline to present the results is as follows. First, descriptive statistics and a matrix of correlations of all the variables used for equations (1) and (2) of the first stage are calculated. Second, both univariate and bivariate graphical analysis of variables are presented. Third, the econometric results for equation (1) and for equation (2) are described.

4.1.1 Descriptive statistics

The Table 4.1 shows some descriptive statistics of all the relevant variables for the first stage of the empirical strategy. Looking at the data, it is possible to summarize some attributes of the variables. First, it is possible to conclude that the dataset complies with the requirement of a balanced panel to use the PVC model. In addition, the final selection of countries not only

follows a similar distribution of the potential sample in terms of geographic location and income classification (as was shown in Chapter 3), but also allows one to have enough variation in the dependent and independent variables. The zero values represent only 7% of total observations, and it is explained by countries that did not receive multilateral aid in specific years, and the changes in the DAC list of ODA partners. For the last reason, Barbados, Belarus and Ukraine did not receive education aid during the whole time horizon. Insignificant negative values are present in the variable of multilateral aid on education, probably for the particular case of repayment of multilateral loans. The gross enrolment ratios present values above 100% because it does not consider if the ages of the students are according to the official age for each level of education.

Table 4.1 – Descriptive statistics of variables for first stage estimation

Variable	Unit of measurement	Obs.	Mean	Std. Dev.	Coef. Var.	Min	Max	Zero values
			Dependent variable					
GovExp_educ	US$ current per capita	799	157.82	189.38	120.0%	3.22	1,013.9	0
			Independent variables					
BilatAid_educ	US$ current per capita	799	3.32	4.33	130.2%	0.00	29.4	16
MultAid_educ	US$ current per capita	799	0.98	1.89	191.8%	-0.05	16.4	54
TotalAid_educ	US$ current per capita	799	4.31	5.48	127.1%	0.00	39.0	16
			Control variables					
GDP_PC(t)	US$ current per capita	799	3,782.62	3,664.86	96.9%	219.21	17,016.2	0
GovExp_totlag	US$ current per capita	799	483.74	563.92	116.6%	11.48	3,215.9	0
Enrol_primlag	Percentage	799	102.20	17.36	17.0%	30.72	165.6	0
Enrol_seclag	Percentage	799	68.49	27.89	40.7%	6.57	123.0	0
BilatAid_other	US$ current per capita	799	23.09	22.68	98.2%	0.00	198.1	16
MultiAid_other	US$ current per capita	799	19.47	25.66	131.8%	0.00	240.7	16
TotalAid_other	US$ current per capita	799	42.56	40.85	96.0%	0.00	281.2	16

Source: World Bank, OECD, UNESCO. (for a detailed description of the data sources, see Appendix A.2)

The Appendix B.1 shows the matrix of correlation among the variables considered in the first stage of the empirical strategy. According to the matrix of correlations, the association between the education aid variables and the public expenditure on education is negative but low, which could reflect full fungibility. The variables of GDP per capita and total public expenditure show

a positive and very high association, which display a problem of multicollinearity and therefore they cannot be included together in the same model specification. The same problem arises between total aid and its components of bilateral and multilateral aid, which is explained because the former is the sum of the latters. Therefore, these variables have to be included in separate model specification, as was shown in Chapter 3 through the equations (1) and (2)[12].

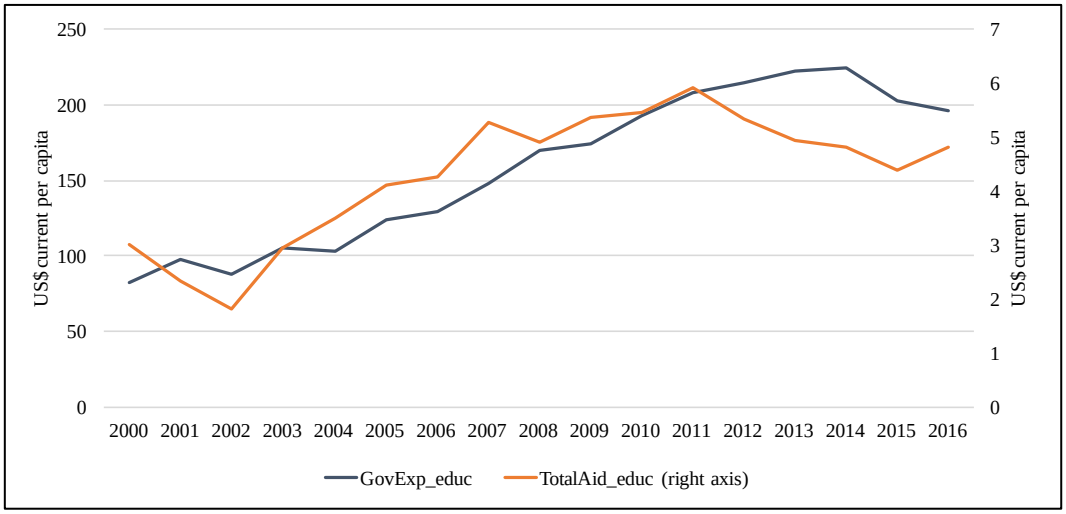
4.1.2 Descriptive graphic analysis

In order to validate the assumptions of the method of estimation, it is necessary to look at the distribution of each variable. Appendix B.2 contains the histograms of each variable in its original form and in log-transformed terms, with a normal density line as a reference. Generally speaking, all the variables measured in monetary terms (US$ current per capita) present a right skewed distribution, and therefore, all of them were transformed using natural logarithm. As a result, the shape of the density functions looks like normal distributions in all the cases. However, this transformation leads to a loss of information in the cases of the variables with zero values. As was shown in the previous subsection, this loss represents 7% of the observations, related with the variables of bilateral, multilateral and total aid for the cases of Belarus, Barbados and Ukraine. Therefore, these countries were removed for the econometric analysis, because a strong balanced panel is needed for the PVC model. Overall, for the econometric analysis, 44 countries are considered which represent 748 observations.

The Figure 4.1 shows the evolution of the sample-average of government expenditure on education (dependent variable) and total education aid (independent variable of interest) over time. Overall, both series have increase over time, but the ODA disbursements on education has fallen since 2011, and the public spending on education has decreased since 2014.

[12] The specification of the model for equation 1 uses total aid to education as independent variable, while equation (2) considers bilateral and multilateral aid to education as independent variables of interest.

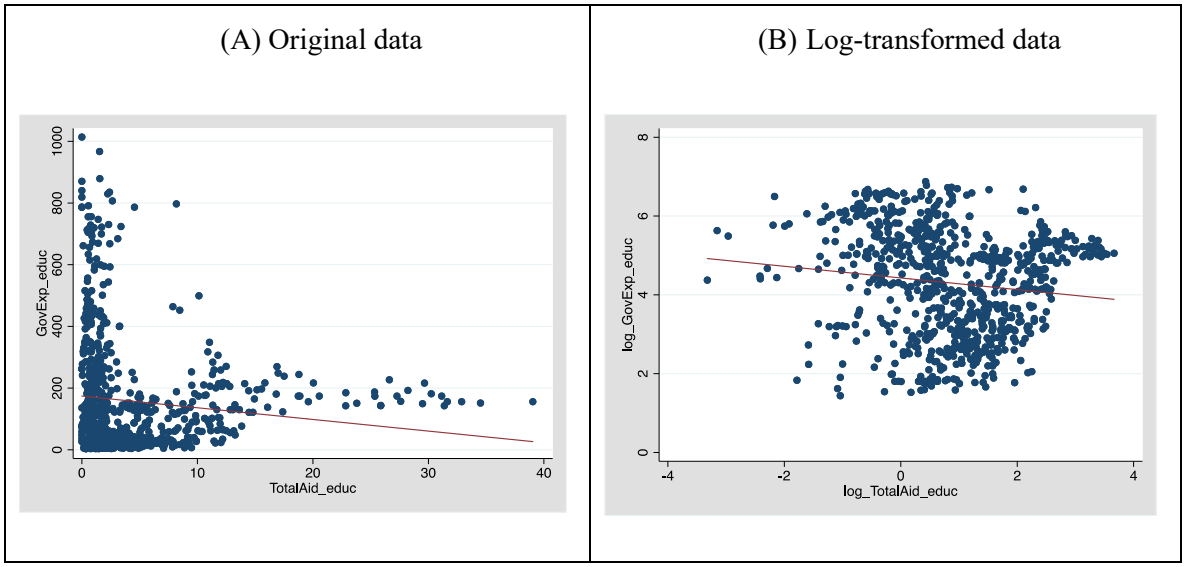
Figure 4.1 Evolution of dependent and independent variables over time



Source: OECD, World Bank.

Finally, Figure 4.2 shows the relationship between government expenditure on education and total aid targeted towards education using all the observations of the dataset (not only the average like Figure 4.1). From this bivariate analysis, both variables have a negative but weak relationship, especially when log-transformation is taken in account.

Figure 4.2 Graphical relation between dependent and independent variables



Source: OECD, World Bank.

4.1.3 Regression results

This section describes the regression results from the panel data model with fixed effects applied to equations (1) and (2). The procedure to select the specifications for both equations has two main features. First, for each model specification the explanatory variables are added sequentially, i.e. one by one, in order to analyze reliability of the coefficients' size and significance. Second, because the imperfect but strong relation between two control variables (GDP per capita and the lag of total government expenditure), they were included separately. Overall, a number of 10 specifications were used to estimate the coefficients for the equation (1) and the equation (2).

a) *Equation (1): basic model using total aid to education as independent variable*

The Table 4.2 present the results for models including GDP per capita as a control variable, while Table 4.3 presents the results for models considering total government expenditure as control variable instead.

Regarding the independent variable, in all the models the coefficient associated with total aid on education (β_1 in equation (1)) has a positive sign and it is statistically significant at 99% of confidence. The point estimation ranges between 0.094 and 0.118, depending on the model specification with control variables. However, the coefficients do not change significantly between the different specifications after controlling for other factors, which enhances the reliability of the estimation. This result shows that the effect of targeted aid in education sector is small on public expenditure on education even after controlling for other factors, which implies a very high degree of sectorial fungibility in the education sector.

Among the control variables, the coefficients of time trend, GDP per capita and total government expenditure are also positive and statistically significant in all the models where they were included. The positive sign of the time trend corresponds to the incremental shape of the dependent variable, as Figure 4.1 shows. The positive sign of GDP and government expenditure confirms the expectation that a higher development or a greater government size, the public spending on education is higher.

Table 4.2 Econometric results for equation (1) without total government expenditure as control variable[13]

Dependent variable: Government expenditure on education

Variables	(1)	(2)	(3)	(4)	(5)	(6)
TotalAid_educ	0.179**	0.118**	0.114**	0.110**	0.110**	0.094**
	(0.048)	(0.037)	(0.037)	(0.037)	(0.037)	(0.033)
YEAR	0.068**	0.042**	0.041**	0.037**	0.035**	0.020*
	(0.004)	(0.006)	(0.006)	(0.006)	(0.007)	(0.009)
GDP_PC		1.097**	1.112**	1.181**	1.173**	0.575**
		(0.146)	(0.147)	(0.148)	(0.146)	(0.189)
TotalAid_other			0.040	0.040	0.044	0.046
			(0.031)	(0.031)	(0.030)	(0.026)
Enrol_primlag				0.005	0.004	0.002
				(0.002)	(0.002)	(0.002)
Enrol_seclag					0.002	0.001
					(0.003)	(0.003)
GovExptotlag						0.377**
						(0.097)
Constant	-131.955**	-89.399**	-86.548**	-79.144**	-75.143**	-42.133*
	(8.284)	(11.540)	(11.341)	(11.612)	(13.783)	(18.265)
F-statistic	143.50	215.73	171.05	117.05	97.00	81.61
Adjusted R2	0.63	0.69	0.69	0.70	0.70	0.72
N	783	783	783	783	783	783

Notes: (i) All monetary variables are in logarithmic terms. (ii) Robust standard errors in parentheses. (iii) P-values: + $p<0.10$; * $p<0.05$; ** $p<0.01$

[13] All the regressions have 783 observations instead of 799, because 16 observations have missing values after the log-transformation of the data. In addition, robust standardized errors were specified in all the models to take in account potential heteroscedasticity.

Table 4.3 Econometric results for equation (1) without GDP per capita as control variable

Dependent variable: Government expenditure on education

Variables	**(1)**	**(7)**	**(8)**	**(9)**	**(10)**	**(6)**
TotalAid_educ	0.179**	0.112**	0.108**	0.108**	0.108**	0.094**
	(0.048)	(0.036)	(0.036)	(0.036)	(0.036)	(0.033)
YEAR	0.068**	0.025**	0.024*	0.024*	0.023*	0.020*
	(0.004)	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)
GovExptotlag		0.513**	0.517**	0.516**	0.514**	0.377**
		(0.087)	(0.089)	(0.089)	(0.088)	(0.097)
TotalAid_other			0.038	0.038	0.040	0.046
			(0.026)	(0.026)	(0.026)	(0.026)
Enrol_primlag				0.000	0.000	0.002
				(0.002)	(0.002)	(0.002)
Enrol_seclag					0.001	0.001
					(0.003)	(0.003)
GDP_PC						0.575**
						(0.189)
Constant	-131.955**	-49.243**	-46.345*	-46.196*	-44.601*	-42.133*
	(8.284)	(17.329)	(17.621)	(17.707)	(19.145)	(18.265)
F-statistic	143.50	157.63	118.20	94.05	79.62	81.61
Adjusted R2	0.63	0.71	0.71	0.71	0.71	0.72
N	783	783	783	783	783	783

Notes: (i) All monetary variables are in logarithmic terms. (ii) Robust standard errors in parentheses. (iii) P-values: + $p<0.10$; * $p<0.05$; ** $p<0.01$

The other control variables, total aid for other sectors, gross enrolment ratio in the previous year in primary and in secondary, are also positive but not significant in any model specification, so it is reasonable to conclude that they have no impact on public expenditure on education. The lack of significance of other aid implies that no deviation from aid resources targeted to other sectors are spent in education sector. However, it does not necessarily indicate no fungibility of those resources, because it can be spent for other non-education purposes. The enrolment ratios do not seem to have any influence on the budget allocation in the education sector.

In order to select the model specification for the second stage of the empirical strategy, the traditional indicators for the "good fit performance" of the econometric models are reported (F-statistic and adjusted R^2). Even though, these values indicate that the variables explain the variance of the dependent variable in all models including the control variables[14], the specification of model 6 is chosen, because it has the highest adjusted R^2 and includes all relevant control variables from the theoretical framework.

Finally, in order to validate the econometric assumptions of the model, Appendix B.4 exhibits the results for different statistical tests applied on model 6. According to the results, the model presents systematic differences across units (therefore, a panel is preferable over a pool) and fixed effects are preferable over random effects. The errors do not have constant variance (heteroscedasticity), therefore robust standard errors are included in the specification. The errors of the model do not exhibit autocorrelation of first order, so no correction for serial correlation is needed. Last, but not least, according to the endogeneity tests, neither GDP per capita, nor enrolment ratios are endogenous in the model.

[14] The null hypothesis of F-statistic is that all coefficients of the model are zero, which implies that the model does not have predictive capability. For all the models, the null hypothesis is rejected at least at 99% of confidence. The R^2 is above 0.60 for almost all the models, which implies that at least the 60% of the variance of the dependent variable is explained by the variance of all the variables included in each model specification.

b) *Equation (2): basic model using bilateral and multilateral aid to education as independent variables*

The Table 4.4 presents the results including GDP per capita as control variable, while Table 4.5 presents the results for models considering total government expenditure as control variable. In contrast with the models for equation (1), the variables of total aid are replaced by bilateral and multilateral aid.

Regarding to the independent variables, in all models the coefficient associated with bilateral aid on education ($\theta_1$in equation (2)) has a positive sign and it is statistically significant at 99% of confidence. The point estimation ranges between 0.114 and 0.153, depending on the model specification with control. Correspondingly, the coefficient associated with multilateral aid on education (θ_2 in equation (2)) also have a positive sign but it is not statistically significant in all model specifications. Among the models with control variables without GDP per capita, the coefficient is around 0.02 and significant at 95% of confidence. For other specifications with control variables, this coefficient is statistically zero. Additionally, the estimated values of the coefficients do not change significantly between the different specifications including the control variables, which enhances the reliability of the estimation. This result shows that the effect of bilateral aid on public expenditure in the education sector is greater than multilateral aid, which implies that multilateral aid to education exhibits more fungibility than bilateral aid, contrary to what was expected from hypothesis 2.

Among the control variables, the coefficients of time trend, GDP per capita and total government expenditure are also positive and statistically significant in almost all the models where they were included. The other control variables, likewise, the results for equation (1), are also positive but not significant in any model specification, which suggest they have not impact on public expenditure on education.

Finally, in order to validate the econometric assumptions of the model, the Appendix B.4 exhibits the results for different statistical tests applied on the model 7, which includes all the control variables. The implications of the results are the same of the model 6 for equation (1).

Table 4.4 Econometric results for equation (2) without total government expenditure as control variable

Dependent variable: Government expenditure on education

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
BilatAid_educ	0.439**	0.203**	0.153**	0.148**	0.135**	0.140**	0.114**
	(0.059)	(0.051)	(0.044)	(0.044)	(0.043)	(0.043)	(0.041)
MultiAid_educ	0.082**	0.030**	0.013	0.012	0.014	0.013	0.014
	(0.019)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.010)
YEAR		0.064**	0.041**	0.039**	0.036**	0.033**	0.019+
		(0.004)	(0.006)	(0.006)	(0.007)	(0.008)	(0.010)
GDP_PC			1.047**	1.059**	1.121**	1.110**	0.553**
			(0.149)	(0.149)	(0.157)	(0.155)	(0.196)
BilatAid_other				0.009	0.009	0.011	0.024
				(0.034)	(0.033)	(0.032)	(0.027)
MultiAid_other				0.030	0.033	0.037	0.031
				(0.028)	(0.029)	(0.030)	(0.027)
Enrol_primlag					0.004	0.003	0.001
					(0.002)	(0.002)	(0.002)
Enrol_seclag						0.003	0.001
						(0.003)	(0.003)
GovExptotlag							0.358**
							(0.098)
Constant	4.065**	-125.305**	-86.820**	-83.077**	-76.641**	-71.517**	-41.063*
	(0.048)	(8.109)	(10.867)	(11.577)	(12.470)	(14.973)	(19.288)
F-statistic	39.09	101.13	165.68	109.76	83.20	71.70	61.95
Adjusted R2	0.36	0.65	0.70	0.70	0.71	0.71	0.73
N	743	743	743	743	743	743	743

Notes: (i) All monetary variables are in logarithmic terms. (ii) Robust standard errors in parentheses. (iii) P-values: + $p<0.10$; * $p<0.05$; ** $p<0.01$

Table 4.5 Econometric results for equation (2) without GDP per capita as control variable

Dependent variable: Government expenditure on education

Variables	(1)	(2)	(8)	(9)	(10)	(11)	(7)
BilatAid_educ	0.439**	0.203**	0.129**	0.123**	0.124**	0.126**	0.114**
	(0.059)	(0.051)	(0.042)	(0.042)	(0.042)	(0.042)	(0.041)
MultiAid_educ	0.082**	0.030**	0.021*	0.020*	0.019*	0.019*	0.014
	(0.019)	(0.011)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)
YEAR		0.064**	0.025**	0.023*	0.023*	0.022*	0.019
		(0.004)	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)
GovExptotlag			0.486**	0.492**	0.492**	0.489**	0.358**
			(0.091)	(0.093)	(0.092)	(0.092)	(0.098)
BilatAid_other				0.019	0.019	0.020	0.024
				(0.027)	(0.027)	(0.027)	(0.027)
MultiAid_other				0.026	0.026	0.027	0.031
				(0.026)	(0.026)	(0.027)	(0.027)
Enrol_primlag					-0.000	-0.000	0.001
					(0.002)	(0.002)	(0.002)
Enrol_seclag						0.001	0.001
						(0.003)	(0.003)
GDP_PC							0.553**
							(0.196)
Constant	4.065**	-125.305**	-48.685**	-44.594*	-44.741*	-43.122*	-41.063*
	(0.048)	(8.109)	(17.483)	(18.385)	(18.627)	(20.135)	(19.288)
F-statistic	39.09	101.13	114.52	82.11	70.81	61.89	61.95
Adjusted R2	0.36	0.65	0.72	0.72	0.72	0.72	0.73
N	743	743	743	743	743	743	743

Notes: (i) All monetary variables are in logarithmic terms. (ii) Robust standard errors in parentheses. (iii) P-values: + $p<0.10$; * $p<0.05$; ** $p<0.01$

4.2 Second stage: simulating different degrees of aid fungibility

This section contains two parts. The first presents some basic statistics of the data used for the PVC model. The second part describe the results for the model estimation and the simulation of the degree of fungibility for each country-year observation.

4.2.1 Descriptive statistics

From the Table 4.2, it is obvious that the dataset for the second stage has less observations than the first stage, because all the information of Belarus, Barbados and Ukraine was removed from the sample after the log-transformation[15].

Overall, the data for the second stage comes from 44 countries for 17 years, hence the balanced panel is ensured and the distribution of the countries by region and income classification has not changed dramatically. Generally speaking, the descriptive statistics for this sample is very similar to final selection discussed in subsection 4.1.1. The main differences with the first stage are: a lower GDP per capita and lower government expenditure, and a higher amount of foreign aid to education. In addition, the variability of the variables is slightly lower, but it is enough for the purposes of the estimation.

[15] In total, 51 observations were deleted: 3 countries multiplied by 17 years. So, the new data set was reduced from 799 to 748 observations.

Table 4.6 – Descriptive statistics of variables for second stage estimation

Variable	Unit of measurement	Obs.	Mean	Std. Dev.	Coef. Var.	Min	Max	Zero values
Dependent variable								
GovExp_educ	US$ current per capita	748	141.49	167.99	118.7%	3.22	835.22	0
Independent variables								
BilatAid_educ	US$ current per capita	748	3.48	4.42	127.0%	0.03	29.44	0
MultAid_educ	US$ current per capita	748	1.02	1.92	188.1%	-0.05	16.44	36
TotalAid_educ	US$ current per capita	748	4.50	5.60	124.3%	0.04	39.04	0
Control variables								
GDP_PC(t)	US$ current per capita	748	3,495.59	3,275.76	93.7%	219.21	14,958.56	0
GovExp_totlag	US$ current per capita	748	438.54	499.32	113.9%	11.48	2,479.17	0
Enrol_primlag	Percentage	748	102.22	17.86	17.5%	30.72	165.65	0
Enrol_seclag	Percentage	748	66.10	27.19	41.1%	6.57	123.09	0
BilatAid_other	US$ current per capita	748	24.26	22.92	94.4%	0.34	198.15	0
MultiAid_other	US$ current per capita	748	20.09	25.79	128.4%	0.15	240.72	0
TotalAid_other	US$ current per capita	748	44.35	41.13	92.7%	0.53	281.29	0

Source: World Bank, OECD, UNESCO. (for a detailed description of the data sources, see Appendix A.2)

The Appendix C.1 shows the matrix of correlation among the variables considered in the second stage of the empirical strategy. The signs of the correlation coefficients are the same as those of the first stage. However, the size of some of them have changed. For instance, the correlation coefficients between the dependent variable and total aid to education and gross enrolment ratios have increased in comparison with the first stage. In contrast, the correlations of government expenditure on education with GDP per capita and total government expenditure are lower.

4.2.2 Regression results

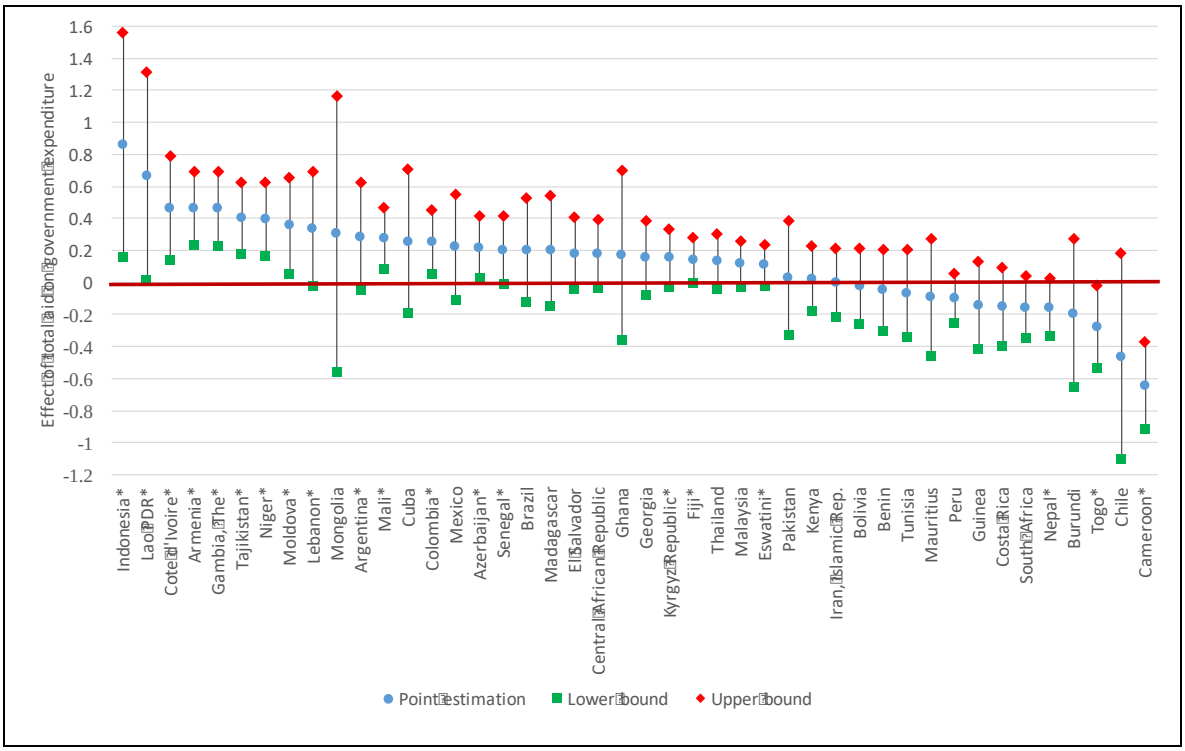
The specification of the PVC model with fixed coefficients follows the model 7 from the first stage, which contains all the control variables. The regression technique corresponds to a Generalized Least Squares, and the estimation results are in Appendix C.2[16].

Looking at the first panel of Appendix C.2, the constant coefficients show some similarities and differences from those estimated in equation (1). First, the coefficients of GDP per capita and total government expenditure are statistically significant and have similar sign and size as those estimated in model 7 for equation (1). Second, the coefficients' size for the other control variables are also similar and are not statistically significant (similar to model 7), although they have now the opposite sign. Finally, the most important difference is the coefficient of the targeted aid to education, which is negative, statistically significant and higher in absolute terms than the estimation in model 7 (-0.214 vs. 0.094). Thus, after controlling for specific country-specific and year-specific effects, an increase in targeted aid to education leads to a reduction in government expenditure, which reflects full fungibility.

The second panel of Appendix C.2 shows the different country-specific effects of total aid to education on government expenditure in education sector. For instance, from the 44 countries of the final sample, in 24 countries the coefficient of education aid was not significant at 90% confidence, which means that there is no effect on public expenditure, and therefore aid targeted to education sector is fully fungible. From the rest of countries, 17 have a coefficient statistically significant with positive sign, but with different sizes: five countries have a magnitude above 0.4, nine between 0.2 and 0.4 and three less than 0.2. Indonesia has the highest degree of aid fungibility (around 0.86), followed by Lao PDR (0.66) and Cote d'Ivore (0.46). Therefore, in all 17 economies the targeted aid to education is partially fungible, with the exception of Indonesia, which can be considered non-fungible, based on the point estimation. Correspondingly, Cameroon (-0.64), Togo (-0.27) and Nepal (-0.15) are the only countries where an increase of aid leads to a reduction of public expenditure on education, and therefore aid targeted to education is fully fungible.

[16] For presentation purposes and because of their relevance to calculate the degree of aid fungibility, only country-specific and time-specific coefficients of the targeted aid on education are shown.

Figure 4.3 Country-specific estimations of the effect of aid on government expenditure in education sector



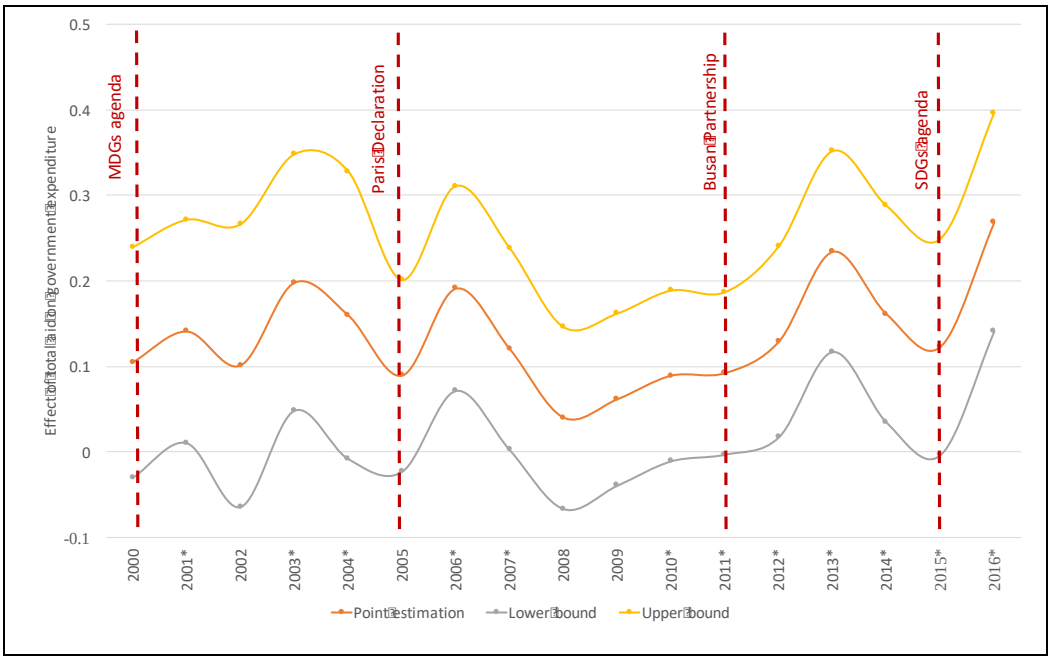
Note: Country-specific coefficients are statistically significant with at least 90% of confidence for the years with asterisk. Source: Point estimations and confidence intervals at 95% for year-specific coefficients of equation (4) reported in Appendix C.2.

The output of the model also brings year-specific coefficients about the effect of total aid to education on government expenditure in the education sector. Overall, they all are positive but small (between 0.1 and 0.2 for almost of the time horizon) and 12 out of 17 year-specific coefficients are statistically different from zero with at least 90% of confidence[17]. In addition, they have less variability than country-specific coefficients. The maximum value is 0.269 and the minimum 0.040, with a standard deviation of 0.060. Figure 4.4 shows the point estimation and its confidence interval of the year-specific coefficients and how it has changed over time, indicating the year of signature of the main international agreements on development aid since 2000. The years 2013 and 2016 exhibit the highest point estimation of the effect of aid on public spending in education sector, while the years 2008 and 2009, are the smallest. No specific pattern or trend was found related to the international commitments. However, it seems

[17] The coefficients correspond to the years 2013 and 2016.

that the coefficients were lower after the signature of Paris Declaration of Aid Effectiveness and just increased after the Busan Partnership of Aid Effectiveness and the SDG agenda.

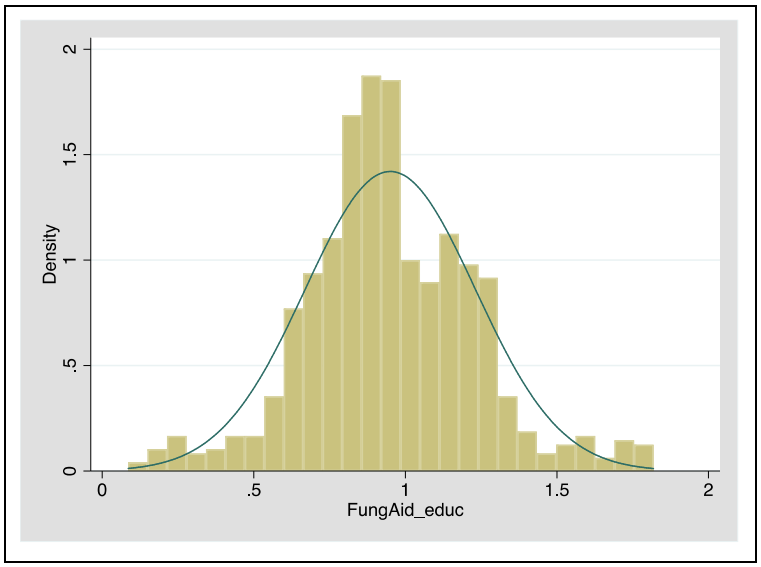
Figure 4.4 Year-specific estimations of the effect of aid on government expenditure in education sector



Note: Year-specific coefficients are statistically significant with at least 90% of confidence for the years with asterisk. Source: Point estimations and confidence intervals at 95% for year-specific coefficients of equation (4) reported in Appendix C.2.

Although not all country-specific or year-specific coefficients are statistically significant, the overall model explains pretty much the variance of the dependent variable (R^2 above 0.90), which enhances its predictive power. Therefore, using the point estimation of the variable coefficients of education aid, the degree of fungibility for each country-year observation is calculated. As was described in equation (5), the procedure consists of adding the three components of coefficients to calculate the degree of aid fungibility according to equation (6). As a result, 748 country-years degrees of aid fungibility are simulated. Figure 4.5 shows the density function of this new continuous variable ($FungAid\_educ_{it}$), which follows the shape of a normal distribution.

Figure 4.5 Graphical relation between dependent and independent variables



Source: Own calculations based on point estimations for coefficients of equation (4) reported in Appendix C.2.

Higher values for $FungAid\_educ_{it}$ mean a higher degree of aid fungibility. This variable is complete for all country-years observations and it will be used as dependent variable in the third stage to assess the causes of aid fungibility in education sector.

4.3 Third stage: examining the causes of aid fungibility

This section will provide evidence to validate the first research's hypothesis about the role of institutional capacity in developing countries on the degree of aid fungibility, which is related to the third sub-question as well. The outline is similar to section 4.1, starting with the descriptive statistics, then the graphical analysis, and finally, the econometric results for equation (7).

4.3.1 Descriptive statistics

From the Table 4.3, it is possible to summarize some attributes of the dataset. First, it is possible to conclude that the panel dataset is unbalanced. Second, almost all the explanatory variables exhibit higher variability than the dependent variable. Third, the sample consists of 44 countries

with estimation of aid fungibility from the second stage[18], and a time horizon from 2000 to 2016, which implies a total of 748 observations. From this total, 72% come from low and lower-middle income countries and the rest from upper-middle and high income countries. Fourth, the variable *IC4_PCA* has a mean of zero because it was calculated by principal component analysis using the other three institutional capacity variables (see Appendix D.1).

Table 4.7 – Descriptive statistics of variables for third stage estimation

Variable	Unit of measurement	Obs.	Mean	Std. Dev.	Coef. Var.	Min	Max
Dependent variable							
FungAid_educ	US$ current per capita	748	0.950	0.281	29.6%	0.085	1.819
Independent variables							
IC1_goveff	Standarized index	748	-0.377	0.604	160.1%	-1.848	1.275
IC2_rulaw	Standarized index	748	-0.499	0.589	118.0%	-1.817	1.433
IC3_nocorr	Standarized index	748	-0.478	0.569	119.0%	-1.410	1.592
IC4_PCA	Standarized index	748	0.000	1.6365	-	-3.447	5.471
Control variables							
Numdonors_educ	Absolute number	748	16.215	5.637	34.8%	4	30
Aid_depend_gfc	Percentage	741	0.439	0.662	150.7%	0.001	6.730
Aid_depend_gdp	Percentage	731	0.052	0.071	135.8%	0.000	0.603
LM_dev_status	Binary variable	748	0.717	0.451	62.9%	0	1
UMH_dev_status	Binary variable	748	0.283	0.451	159.1%	0	1
WageExp_educ	Percentage	317	0.685	0.132	19.2%	0.017	0.987

Source: World Bank, OECD, UNESCO. (for a detailed description of the data sources, see Appendix A.2)

The Appendix D.2 shows the matrix of correlations among the variables considered in the third stage of the empirical strategy. The association between aid fungibility variables and institutional capacity variables are positive but low, which could reflect that a stronger institutional capacity leads to a higher degree of aid fungibility in the education sector. Regarding the association of the dependent variable with the control variables, the number of donors and the indicator of development status shows a negative and low correlation, whilst the aid dependency variables (aid/gdp and aid/exp) exhibit positive and low correlation. In addition, among the highest correlation coefficients between explanatory variables comes from

[18] Barbados, Belarus and Ukraine are not included because they have not estimates for aid fungibility.

the institutional capacity variables (between 0.81 and 0.95), aid/gdp and aid/exp ratios. Therefore, these variables are included in different model specifications.

4.3.2 Descriptive graphic analysis

From the histograms of each variable, only the aid dependency variables present a right skewed distribution, and therefore, they were transformed using natural logarithm (see Appendix D.3). This transformation leads to a loss of information in the cases of zero values. However, this loss represents 3% of all the observations. The rest of the variables exhibit a Normal-like distribution.

The Appendix D.4 shows the bivariate relationship between the degree of aid fungibility and each of the variables of institutional capacity. Apparently, both variables have a positive relationship, but is weak. However, they only express a bivariate relationship without controlling for other control variables, which is the central part of the econometric regressions.

4.3.3 Regression results

This part describes the estimation of equation (7) using a panel data model with random effects. Overall, 16 specifications were used to estimate the coefficients, and the results are presented in Table 4.8, Table 4.9, and in the Appendix D.5. Each specification includes one independent variable at a time, because they are highly correlated. Finally, the specifications with the variable *WageExp_educ* are applied only for the subsample of 32 countries and for years 2007-2016. The coefficients are estimated with Generalized Least Squares and robust standardized errors were specified in all the models to overcome potential heteroscedasticity.

a) *Equation 7: results for the complete sample without wage expenditure as control variable (models 1 to 8)*

   The Table 4.8 contains the results for models 1 to 4 (with aid/gfc as control variable) and the Table 4.9 for models 5 to 8 (with aid/gdp instead). All regressions have 741 observations from 44 countries for the period 2000-2016, because some observations of aid/gdp and aid/fgc ratios have missing values.

Table 4.8 Econometric results for equation (7) using aid dependency as share of government expenditure

Dependent variable: Estimated degree of aid fungibility in education

	(1)	(2)	(3)	(4)
Numdonors_educ	0.004)***	0.004***	0.004***	0.004***
	(0.001	(0.001)	(0.001)	(0.001)
Aid_depend_gfc	-0.010**	-0.010**	-0.010**	-0.010**
	(0.005)	(0.005)	(0.005)	(0.005)
LM_dev_status	-0.024***	-0.026***	-0.024***	-0.024***
	(0.006)	(0.007)	(0.005)	(0.006)
YEAR	-0.007***	-0.007***	-0.007***	-0.007***
	(0.001)	(0.001)	(0.001)	(0.001)
IC1_goveff	-0.026**			
	(0.013)			
IC2_rulaw		-0.036***		
		(0.011)		
IC3_nocorr			-0.004	
			(0.013)	
IC4_PCA				-0.011**
				(0.005)
_cons	14.279***	14.314***	14.133***	14.337***
	(1.765)	(1.617)	(1.706)	(1.702)
Chi2-statistic	226.11	212.30	269.39	221.14
Prob>Chi2	0.00	0.00	0.00	0.00
N	741	741	741	741

Notes: (i) Robust standard errors in parentheses. (ii) P-values: * $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table 4.9 Econometric results for equation (7) using aid dependency as share of GDP

Dependent variable: Estimated degree of aid fungibility in education

	(5)	(6)	(7)	(8)
Numdonors_educ	0.004***	0.004***	0.004***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Aid_depend_gdp	-0.097*	-0.094*	-0.098*	-0.095*
	(0.059)	(0.057)	(0.059)	(0.058)
LM_dev_status	-0.021***	-0.022***	-0.021***	-0.021***
	(0.005)	(0.006)	(0.005)	(0.005)
YEAR	-0.007***	-0.007***	-0.006***	-0.007***
	(0.001)	(0.001)	(0.001)	(0.001)
IC1_goveff	-0.026*			
	(0.013)			
IC2_rulaw		-0.034***		
		(0.011)		
IC3_nocorr			-0.007	
			(0.013)	
IC4_PCA				-0.011*
				(0.006)
_cons	14.099***	14.206***	13.957***	14.174***
	(1.760)	(1.661)	(1.689)	(1.709)
Chi2-statistic	315.76	255.16	380.38	291.39
Prob>Chi2	0.00	0.00	0.00	0.00
N	731	731	731	731

Notes: (i) Robust standard errors in parentheses. (ii) P-values: * $p<0.1$; ** $p<0.05$; *** $p<0.01$

Regarding to each independent variable, almost all the coefficients associated with the institutional capacity variables have a negative sign and are statistically significant, at least, at 90% of confidence in the models where they were included. Although the coefficient of the index of control of corruption is negative, it is not statistically significant, and therefore, the effect on aid fungibility can be considered statistically equal to zero. However, the overall index calculated by principal component analysis is negative and significant, like the government effectiveness index and rule of law index. In addition, the coefficients' sizes do not change among specifications. For instance, they do not change if the aid dependency variable is expressed as a share of final government expenditure or as a share of GDP, which enhances the reliability of the estimation. These results would confirm the hypothesis that weaker institutional quality in the partner country leads to a higher degree of aid fungibility.

Among the control variables, the coefficients of the number of donors are positive and statistically significant, which implies that with more donors in the country, the higher the aid fungibility is expected. The other control variables have a are negative and are statistically significant with at least 90% confidence. For instance, an increase in aid dependency (whether measured as a percentage of GDP or public expenditure) leads to a reduction of the degree of aid fungibility. The sign of the development status' variable reflects that lower and middle-low income countries have a lower aid fungibility than upper-middle and high-income countries. Finally, the time trend indicates that the degree of aid fungibility has been decrease over time. Overall, the size of the coefficients of the control variables among all specifications are very similar, which reflects strong reliability.

Finally, the Appendix D.5.5 contains the results for different statistical tests to validate the econometric assumptions of model 4, which includes the overall index of institutional capacity and the aid dependency as a share of government expenditure. According to the results, a panel is preferable over a pool, and random effects are preferable over fixed effects. The errors of the model do not exhibit autocorrelation of first order, so no correction for serial correlation is needed. Finally, the overall index of institutional capacity was tested as a potential endogenous variable, using GDP per capita as the

instrument. However, according to the results, the index can be considered exogenous, and therefore no correction for endogeneity is needed.

b) *Equation 7: results for the subsample using wage expenditure as control variable (models 9 to 16)*

The Appendix D.5.1 contains the results for models 9 to 12 (with aid/gfc as control variable) and the Appendix D.5.2 for models 13 to 16 (with aid/gdp instead). For these models, the regressions have 263 observations from 29 countries for the period 2007-2016, due to limited data availability of variable *WageExp_educ*.

Regarding each independent variable, all the coefficients associated with the institutional capacity variables have a negative sign and are statistically significant with at least 95% confidence in the models where they were included. Moreover, the coefficient's sizes of the independent variables do not change among specifications. These results would confirm the results using the total sample and validate the hypothesis that a weaker institutional quality in the partner country leads to a higher degree of aid fungibility.

However, the results for the control variables are quite different from the regressions using the total sample. For example, the coefficients associated with the variables number of donors are positive (same as the total sample) but not statistically significant. The coefficients for aid dependency are negative and statistically insignificant when measured as a share of public expenditure, but positive and statistically insignificant when measured as percentage of GDP.

The effect of development status and the time trend are very similar as in the models with the total sample. The dummy of development status reflects that low- and middle-low income countries have a lower aid fungibility than upper-middle and high-income countries. Finally, the time trend indicates that the degree of aid fungibility has decreased over time. The size of these coefficients among all specifications are very similar within the models with the subsample, which reflects that they are reliable.

Finally, the coefficients of wage expenditure on the education sector have positive sign in almost all the models but are not significant.

4.4 Discussion of findings

This section presents and explains the answers to the research question and to the research hypotheses, from the results described in the previous sections and compare them with previous studies. The structure of the section follows the three stages of the empirical strategy, highlighting the findings within them related with the research question and hypotheses.

4.4.1 First stage: testing the existence of aid fungibility

From the results of the first stage, the estimations show that the effect of education aid disbursements on government expenditure in terms of education is positive and statistically significant. The associated coefficient in all the models is less than unity, which implies partial fungibility. Indeed, an increase of 1% of aid to education leads to an increase between 0.09% and 0.11% on public spending for education. Although the size of the coefficients from the first stage are significantly different from zero, they are very small and close to zero. Therefore, these estimates are aligned with other cross-sectional time-series studies, which found that the effect is statistically equal to zero (Feyzioglu et al, 1998; Van de Sijpe, 2013; Berens, 2016). Only in one model specification using public investment and concessional loans as aid variable, one study found a partial aid fungibility in education sector (Feyzioglu et al, 1998).

Moreover, from the results from first stage it is possible to conclude that bilateral and multilateral aid have a positive and significant effect on government expenditure in the education sector. However, both effects differ in their magnitudes, which implies a different degree of aid fungibility among aid modalities. One the one hand, the estimations of the coefficients associated with bilateral aid show that an increase of 1% of bilateral aid leads to an increment between 0.11% and 0.15% on public expenditure on education. On the other hand, the effect of multilateral aid is between 0.01% and 0.02%. As the difference between both coefficients are statistically significant, it is possible to reject the second hypothesis of this research and argue that multilateral aid is more fungible than bilateral aid in education sector.

None of the studies of categorical fungibility in the literature review had assessed the effect of bilateral and multilateral aid on government expenditure in the education sector. Nonetheless, this issue was analyzed in studies of macro fungibility with different results. For instance, Marc

(2017) found that bilateral aid has no effect on government expenditure, while multilateral aid has a positive impact on public spending, but the coefficients range between 0.32 to 0.64, higher than my estimates for education sector. In the same way, Cashel-Cordo and Craig (1990) found that bilateral aid provided by DAC countries had no effect on public expenditure. But, multilateral loans from IMF reduced total expenditures, while loans from development banks increased public spending. The magnitudes of the effects are similar to the study of Marc (2017).

The results from previous studies imply that bilateral aid leads to a higher degree of aid fungibility than multilateral aid, in contrast with own estimations for education sector. Two reasons can be drawn to explain these differences.

First, the previous studies focus on the effect on total government expenditure, while this research focuses on a particular sector (education). This indicates that the same aid modality can have a different degree of fungibility among sectors, which compensate each other at the aggregate level.

From the literature on macro fungibility, Marc (2017) argues that multilateral aid is usually tied to specific conditionalities even more than bilateral aid, while bilateral aid requires partner countries to buy specific goods and services from the donor country. From the literature of categorical fungibility, Feyzioglu et al (1998) mention two possibilities. First, for specific sectors, like transport and communications, partner countries are required to finance using their own resources a portion of specific projects, co-financed with foreign aid. Second, the irregular nature of investments for specific sectors can also provide less margin to reduce public spending. Combining these arguments together, it seems that multilateral aid targeted to education sector applies less conditionalities or co-financing mechanisms aid for other sectors, and therefore, aid fungibility arises.

Second, the composition of "on-budget" and "off-budget" aid could lead to disparities among the effects of aid modalities on fungibility. Since the own estimations did not make those distinctions on aid variables, it is expected that they were biased downwards, and hence the degree of fungibility would be overestimated, because "off-budget" aid does not increase public spending directly (Marc, 2017, p. 638).

At the aggregate level, there is evidence that overall bilateral aid to developing countries has a greater proportion of "off-budget" aid than multilateral aid, and hence it is more probable that the former would have a higher degree of fungibility than multilateral aid (Marc, 2017). The same logic can be applied in case multilateral aid to education has a larger proportion of "off-budget" aid than bilateral ODA disbursements. However, according to the Creditor Report System of of the OECD, for the period 2010-2016, the "off-budget" aid was 14% of the bilateral aid to education; while among the multilateral aid flows, it represents less than 1%[19].

An alternative explanation for the higher effect of bilateral aid to education expenditure is that it suggests a better alignment of preferences between individual donor countries and partner government, at least in regard to education projects. Historic colonial ties, economic dependency and political interests between donor and partner countries are some factors that contribute to this common understanding of setting priorities of aid resources in the education sector. Indeed, Klingebiel (2013) argues that bilateral donors have greater direct influence over the decisions of aid allocation among sectors, which enhance their reputation and visibility in their own territory and in partner countries.

The lower degree of fungibility for bilateral aid increases the chances of improving educational outcomes than multilateral aid does. This result is consistent with evidence showing that "bilateral aid to primary education appears to be more significantly related to education outcomes than is comparable multilateral aid (…) [because] (…) bilateral donors may condition their primary-education aid on partners' quality of governance" (Christensen, Homer & Nielson, 2011, p.24-25).

4.4.2 Second stage: simulating different degrees of aid fungibility

The results of the Panel Variable Coefficient model in the second stage give important insights about the attributes of aid fungibility. First, they confirm the signs of the coefficients from the first stage, except for the aid variable. Indeed, under the PVC model, the estimation results indicate that a 1% increase in sectorial aid leads to the reduction of public expenditure on

[19] The calculation of "Off-budget" aid considers only the category "Experts and other technical assistance" under the "Type of Aid" attribute according to the CRS definition. This category involves the costs of hiring donor personnel (experts, consultants, researchers, etc) and expenses regarding to research projects, south-south studies, workshops, publishments, etc.

education by -0.21%, which implies full fungibility. A possible explanation relies on the statistical differences between the PVC model and the basic form of a panel model. In the basic panel model, the coefficient represents the "average" effect of the sectorial aid on public expenditure, but in the PVC model, this effect is adjusted by controlling for all the possible country-specific and year-specific effects of sectorial aid on public expenditure for education. Therefore, the constant coefficient in the PVC model can be interpreted as the "underlying" effect of sectorial aid on public expenditure in the education sector. Overall, considering both results from the first and second stage, it is reasonable to conclude that the degree of aid fungibility in education is very high, because for this sector the elasticity of aid on public expenditure can range from -0.2 to 0.11. As was pointed out, this result is aligned with previous studies, meaning high aid fungibility.

The results from the PVC model confirm that the degree of sectorial aid fungibility varies across countries, which was found by previous studies as well (Pack & Pack 1990; Pack & Pack, 1993). Moreover, the own estimations of the aid's effect on public expenditure similar to those found in Pettersson (2007), despite some methodological differences. From comparing these estimates for 12 countries included in both studies, the effect of aid on public expenditure has the same sign in seven countries, and two of them have a similar magnitude[20]. Furthermore, the estimations for the Indonesian case were similar to previous research, which found that aid earmarked to education is not fungible (Pack & Pack, 1990).

In addition, the degree of aid fungibility varies over time. This result confirms the findings by a previous study, which found evidence that aid fungibility changes over time only for the education sector (Devarajan, Rajkumar and Swaroop, 1999, p. 19). Among the 17 years considered in the analysis, the degree of aid fungibility is statistically significant in 12 years and is always positive, which implies partial fungibility. Replacing with zero the point estimation of the degree of fungibility for those years when the effect of aid is not statistically significant, an important finding stands out; the average of the year-specific coefficients of aid on public expenditure during the period 2000-2005 is almost the same for the period 2005-

[20] The comparison is based on the estimates of the effect of aid targeted to pro-poor sectors on pro-poor expenditure, which includes education, health, and expenditures on housing and amenities (Pettersson, 2007).

2011: 0.083 and 0.082, respectively. However, for the period 2012-2016, the same indicator was more than doubled, however, still low.

Overall, the variation of the year-specific coefficients among years are lower than the country-specific coefficients. This result reveals that the variation of the degree of aid fungibility comes more from country specific factors, instead of common temporal factors, like the signature of international agreements of aid effectiveness. More recently, however, after the signature of the Busan Partnership Agreement, the degree of fungibility seems to be lower than in the past.

4.4.3 Third stage: examining the causes of aid fungibility

From all the three dimensions for institutional capacity included in the models, the coefficients associated with institutional capacity are negative, however only government effectiveness and rule of law are statistically significant. Moreover, the overall index of institutional capacity is also negative and statistically significant at least with 90% confidence in all model specifications. **Therefore, it is possible to confirm the first hypothesis of this research and answer the research question as such: the effect of institutional capacity on categorical fungibility of foreign aid in developing countries is negative. In other words, a weak institutional capacity in partner countries leads to an increase in the degree of fungibility of foreign aid targeted to the education sector.** However, as it will be explained shortly, this not necessarily means that a "bad policy environment" increases aid fungibility.

This general finding contrasts with results from previous empirical evidence (Berens, 2016; Marc, 2017). Nonetheless, most of these studies only use corruption indexes as a proxy indicator of institutional capacity, and only one includes broader indicators about quality of institutions and democracy (Pettersson, 2007). Contrary to the results of this thesis, the latter found a positive correlation with a proxy of the quality of the policy environment, indicating that countries with a stronger institutional quality have a higher degree of fungibility. However, the cited study not only focuses on fungibility in the education sector, rather an aggregation of pro-poor sectors. Moreover, it does not propose any model specification for the causes of aid fungibility.

The negative impact of government effectiveness on aid fungibility provides evidence about a specific case of the "aid illusion" effect. Indeed, a country with less government effectiveness has a poor quality of the civil service, weaker planning and budgeting systems and more dependence of the technical decisions on political pressures. Under such circumstances, the diversion of foreign aid from its original purposes is more likely, because the budget system is not able to match the origin of the public resources with specific expenditure purposes. Besides, the monitoring mechanisms to track and enforce the use of aid resources to specific projects are more limited. Finally, stronger political pressures on the national budgeting and planning systems lead to allocation decisions of aid resources according to political priorities of the partner government.

Regarding the effect of rule of law on aid fungibility, it is important first to remember the definition and its main functions. Using the definition for the rule of law from formal theories (Erbeznik, 2011), governments with weak rule of law have limited capacity to enforce rules regularly, predictably and equally against all persons, both citizens and political elites. In such environments, the legal constraints on government officials to comply with the existing law and the legal limits on law-making power are weak (Tamanaha, 2007). Because the evidence shows that the lack of the rule of law has negative impacts on growth and development, countries with a low degree of the rule of law are those who have a "bad policy environment." However, for the purposes of this research, it is more relevant to analyze one of the core functions of the rule of law, which looks at constraining decisions on government officials according to existing law.

The literature points out some problems with these types of restrictions, like enforcement mechanisms for the government itself, different interpretations of the law, lack of clarity on legal limits, and so on. Under this framework, government officials do not comply with the law, or legal agreements, like international agreements on use of aid resources, if the benefits they receive from cooperating with such rules are lower than defecting them. In this sense, the alignment of the interests and preferences between donors and partner countries is crucial in order to increase the expected benefits of mutual cooperation. When the benefits about specific projects financed by foreign aid are not appropriated by partner countries (low degree of ownership) and are not aligned with their priorities and preferences, is likely a higher degree

of fungibility. Indeed, under this scenario, partner government would use targeted aid for those purposes which are more aligned with their own preferences instead of the donor intentions. This conclusion is consistent with previous studies that argue that "[there] is nothing inherently wrong or inappropriate about fungibility; all it indicates is that donors and partners have different views about how expenditures should be allocated" (McGillivray & Morrissey, 2000, p. 419, Cashel-Cordo & Craig, 1997). Furthermore, other scholars claim that social preferences of political leaders in partner countries crucial to understand aid allocation, and moreover, a perfect alignment between the donors and partner countries is not necessary to increase aid effectiveness (Ravallion, 2014).

The null effect of control of corruption on aid fungibility is more aligned with the results from the literature. Indeed, one previous study did not find any relationship of corruption on the effect of aid on sectorial expenditure (Berens, 2016; Pettersson, 2007) using data obtained from the corruption perception index of the International Country Risk Guide. The main implication of these findings is meaningful in order to refuse the stigmatization of aid fungibility in the sense that it is not related with corruption and rent-seeking practices, which are the signals of "bad policy environment". Instead, aid fungibility is more related with weak planning and budgeting systems in partner countries, and lack of preferences' convergence between donors and partner governments about the purposes of aid flows.

Among the effects of control variables, most of them have the expected direction found in previous studies. Below, a brief discussion of each of them:

a) *A larger number of donors increases the degree of aid fungibility.* This finding confirms the hypothesis that a higher number of donors implies higher transaction costs for overseeing the use of aid resources (Devarajan et al, 1999). Furthermore, the adverse effects of coordinating with a larger number of donors leads to a fragmented development policy, which deteriorates the quality of governance (Dijkstra, 2018).

b) *Less developed countries have a lower degree of aid fungibility than more developed economies.* Although a previous study attributes a similar effect to a stronger monitoring of aid resources in low-income countries with fragile institutional infrastructure (Berens, 2016), their own estimations show that this effect remains even

after controlling for institutional quality variables. Two alternative explanations can be drawn from this finding. On the one hand, following Pettersson (2007), it is possible that the donor community has a higher level of trust in partner governments of upper-middle income countries about the allocation of aid resources in comparison with low- and lower-middle income countries. Therefore, donors are more tolerant and less strict when the partner country treats sectorial aid as fungible, because they expect that their money will be used anyway in other productive purposes. On the other hand, following Marc (2017), another explanation could be related with the fact that tied aid is a high fraction for aid to least developed countries, who must to buy specific goods and services from the donor country (Marc, 2017).

c) *Higher aid dependency of the economy leads to a lower degree of aid fungibility.* In contrast with previous empirical evidence (Pettersson, 2007), when the public budget or the economy as a whole is more dependent on foreign aid, the government's capacity to use targeted sectorial aid for other purposes is more limited. For instance, the partner governments are less willing to treat education aid as fungible because its own resources are insufficient to afford the provision of public education. Therefore, economies with higher budget constraints have a lower degree of categorical fungibility and in doing so, they avoid that budget when specific sectors shrink.

d) Size of wage in sectorial expenditure has no effect on aid fungibility in the education sector. Contrary to what was expected, deviation of aid resources from education sectors is not related with the structure of the education budget. This result also controverts the explanation from a previous study, which argues that sectorial fungibility is higher when the aid is used to finance almost everything at the margin, because a large proportion of the sectorial budget is spent in wage expenditures (Devarajan et al, 1999).

Chapter 5 Conclusions

This chapter starts addressing the three research sub-questions from the summary of the main findings. Section 5.2 describes the limitations of the thesis, and section 5.3 contains some insights for future research and recommendations.

5.1 Answers to the research sub-questions

5.1.1 SQ1: According to the literature, which are the causes of aid fungibility?

The literature on aid fungibility has focused on testing to what extent foreign aid is fungible at different levels. As a result, the evidence from cross-national and country-specific studies have demonstrated that aid is at least partly fungible, but the degree of fungibility is very different between and within countries and sectors. However, the assessment of the causes of aid fungibility have received less attention from academia.

On the one hand, from the theoretical studies, fungibility depends on the preferences of political leaders about social outcomes. Furthermore, specific characteristics from the donors and partner countries can influence the degree of aid fungibility, such as the enforcement of aid conditionalities in partner countries, like the implementation of policy reforms, requirements of co-finance payments, and an obligation to purchase goods and services from donor countries. On the other hand, from an economic perspective, the fiscal balance of the country, the composition of the sectorial budget and the nature of the investment in each sector are factors that can affect aid fungibility. In addition, the modality through aid is channeled, monitoring capabilities by donors, size of aid, institutional quality and the "aid illusion effect" among public officials can influence the use of aid resources for other purposes.

The empirical evidence on the determinants of fungibility is scarce, and it has focused more on explaining the differentiated effect of aid on total expenditure, while the empirical evidence of

the causes of categorical fungibility is even more limited. However, considering all the relevant studies, the main findings are summarized as follows:

i) Aid through multilateral and "off-budget" modalities is less fungible than bilateral and "on-budget" mechanisms, respectively (Marc, 2017).

ii) A higher number of donors increases the degree of fungibility, but only in some sectors (Devarajan et al 1999).

iii) Fungibility is positively correlated with the size of aid relative to total expenditures (Pettersson, 2007).

iv) The degree of fungibility is lower in low-income countries than in middle-income countries (Berens, 2016).

v) Corruption and democratic index variables have no correlation with aid fungibility. However, a more comprehensive measure of policy environment is positively correlated with aid fungibility, which implies that countries with sound economic policies have a higher degree of fungibility (Pettersson, 2007).

Overall, most of the results of these empirical studies rely on the analysis of differentiated effects of aid on public expenditure at the aggregate level but not for a specific sector. Moreover, they analyze the causes of categorical fungibility using different estimates for the degree of fungibility by country or by year. Finally, the results for the effect of institutional quality over aid fungibility are based on correlation analysis and do not address a causal relationship. These are the main gaps that this research contributes to close.

5.1.2 SQ2: What is the extent of categorical fungibility aid in developing countries? Is there any difference among aid modalities?

For the case of total aid targeted to education sector, an increase of 1% of ODA disbursements leads to an increase between 0.09% and 0.11% on the sectorial expenditure, which implies that education aid is almost fully fungible. Moreover, after controlling for country-specific and

year-specific effects, the underlying impact of education aid reduces public spending by -0.21%, which confirms full fungibility in the education sector.

Furthermore, the degree of sectorial fungibility is not homogeneous across countries and years. For almost half of the sample, the aid's effect on sectorial expenditure ranges above 0% but less than 0.86%, while the year-specific effects are almost always positive, but with lower variability than across countries. This result reveals that the variation of the degree of aid fungibility comes more from country-specific factors, instead of common temporal factors, like the signature of international agreements of aid effectiveness. More recently, however, after the signature of the Busan Partnership Agreement, the degree of fungibility seems to be lower than in the past.

Regarding the differences among aid modalities, the findings suggest that multilateral aid is more fungible than bilateral aid in education. Although previous studies of macro and general fungibility found opposite results, two reasons can explain the differences. First, the same aid modality can have a different degree of fungibility among sectors, which compensate each other at the aggregate level. Second, bilateral donors have greater direct influence over the decisions of aid allocation among sectors due to colonial history ties, economic dependency and political interests.

5.1.3 SQ3: What is the empirical impact of institutional capacity on aid fungibility?

According to the empirical results, the effect of institutional capacity on aid fungibility is negative, which implies that lower institutional capacity increases the degree of fungibility of foreign aid targeted to education. However, when individual effects of the components of the overall index of institutional capacity are disaggregated, it is possible to argue that aid fungibility is not necessarily a consequence of a "bad policy environment".

The negative impact of government effectiveness on aid fungibility provides evidence about a specific case of the "aid illusion" effect. Following this argument, the diversion of foreign aid from its original purposes is more likely in countries with poor quality of the civil service, weaker planning and budgeting systems and more dependence of the technical decisions on

political pressures. Under such circumstances, a budget system is not able to match the origin of the public resources with specific expenditure purposes, monitoring mechanisms to track and enforce the use of aid are more limited, and social preferences of political leaders have more influence on the planning and budgeting decisions. All these factors affect the allocation of aid resources, and therefore the donors have to be aware of such conditions if they want earmarked aid is spent according to their interests.

The negative effect of rule of law on aid fungibility suggests that when government officials are not strongly constrained or enforced to comply with the existing law, the degree of aid fungibility increases. Under such circumstances, it is easier for partner governments to defect international agreements about allocation of aid resources for specific purposes when it perceives that benefits from defection are higher than cooperation. In cases where those commitments about aid resources are based on a misalignment of preferences between donors and partner countries or are based on a lower degree of ownership by developing countries, the benefits of defecting increases, and it is more probable that aid becomes fungible.

The null effect of control corruption index on aid fungibility, in conjunction with the negative effects of the other dimensions of institutional capacity reflect that aid fungibility does not necessarily represent a consequence of "bad policy environment". Indeed, these variables represent weak planning and budgeting systems in partner countries that have to be improved, and lack of preferences' convergence between donors and partner governments about the purposes of aid flows, which have to be aligned in order to decrease aid fungibility.

5.2 Limitations

The research's findings are based only on the analysis of the aid fungibility in education, and it is possible that they do not hold for other sectors. More research on the causes of fungibility using data from other sectors would bring more evidence in order to confirm if the results of this thesis are particular to education or can be generalized to other areas targeted by foreign aid.

The incompleteness of data for all countries and years represents the main challenge for this thesis, especially of the fiscal variables, like government expenditure on education, wage

expenditure in education, but also for ODA disbursements by sector before the year 2002. In order to overcome this problem, imputation techniques were applied to maximize the number of countries and periods in the sample. However, at the same time, the sample and time horizon have to be restricted in order to keep those countries and periods with enough information in order to preserve most of the original data for the analysis. In addition, due to lack of reliable time series and data across countries, some potential causes identified by the theoretical studies were not possible to include in the analysis, like degree of aid conditionalities' enforcement, the composition of the sectorial budget and the nature of the investment in the education sector. Overall, it is critical that international organizations who compile and publish data from countries, can close this gap of information through more complete and more disaggregated data availability about aid flows and public expenditures in order to get reliable estimates of aid fungibility and its causes.

The estimations of aid fungibility relies on the effect of total ODA gross disbursements to the education sector from DAC donors, and only through two modalities. More research on the causes of aid fungibility using disaggregated aid data by other modalities, like "on-budget" and "off-budget" channels; by instrument, like concessional loans and grants; or by different sources, like Non-DAC donors or private foundations. These studies would be useful to identify if they are associated with different degrees of aid fungibility, and to understand the underlying causes behind these differences.

In addition, the measurement errors of the variables could affect the results. This is of particular importance for institutional capacity variables, which are based on aggregate indexes based on perceptions, and they come from only one source without being contrasted with others. Measurement errors can also arise from the operationalization of monitoring capabilities of donors to track the use of aid resources through the variable "number of donors". Furthermore, due to data unavailability, the operationalization of "total government expenditure", used itself as a control variable and as a denominator for the "aid dependency" control variable, is based on final government consumption as a proxy, which excludes public investment. It is possible that the inclusion of public investment in the first stage would reduce the aid's effect on public expenditure even more, and therefore increase the degree of aid fungibility. Again, more efforts from international organizations are necessary in order to close these gaps of information with

more reliable and comparable historical data across countries in order to analyze the causes of aid fungibility.

Finally, the instruments to test the exogeneity assumption of the econometric models were selected according to available data, and not necessarily comply with the characteristics of a strong instrument. This problem can undermine the internal validity of the results.

5.3 Recommendations

The main empirical finding of this research confirms that aid fungibility is not necessary a symptom of "bad policy environment", rather a misalignment of donors and partner countries about their social preferences and development priorities. Therefore, and in line with the Busan Partnership for Effective Development Cooperation (OECD, 2011), it is very important for donors to understand the social preferences of partner countries and implement approaches and development projects that are tailored to country-specific situations and needs, in order to ensure the ownership of development priorities by developing countries, especially those with low institutional quality. With a strong ownership, it is more likely that the benefits of defecting aid commitments decrease, and aid resources achieve an optimal allocation in terms of donors and partner countries' preferences.

Moreover, if donors wanted their contribution for development to be used according to their preferences, they should be aware of specific conditions on the public management systems in the partner country. For instance, the effectiveness of policy formulation and implementation, the quality of the civil service, the strength of planning and budgeting systems, and the influence of political pressures on technical decisions. This research provides empirical evidence that if these conditions are weak in the partner country, then it is expected that aid would be spent for other purposes. Furthermore, aid could be targeted to contributing to achieving some of these conditions, like planning and budgeting systems, if it fits the preferences of the partner country.

In addition, this research has demonstrated that a large number of donors in one country, which is a close proxy of aid fragmentation, increases aid fungibility. Although this finding is based on the analysis for one specific sector, it is expected that fragmentation of aid becomes larger

when all sectorial aid flows are considered. Therefore, efforts to reduce fragmentation of aid is crucial to decrease transaction costs not only for the donor, for monitoring aid resources but also for the partner country for coordinating and managing the administrative procedures with each donor. In order to do so, it is necessary to accelerate the implementation of more programme-based approaches and mechanisms like joint-programming and delegated cooperation.

Last, but not least, more empirical research about the causes of aid fungibility is needed. For instance, analyzing causes of fungibility for aid targeted in other sectors, and for other modalities, instruments, and different types of donors. In parallel, more reliable, complete, disaggregated and comparable historical data across countries on aid disbursements and public expenditures, especially for education sector, is also needed. For this purpose, initiatives like the Global Health Expenditure Database by the World Health Organization are good examples to be replicated in education and other sectors.

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APPENDIX A: Complementary information of the research design

Appendix A.1: List of countries in the final selection by income and region[21]

Region	Low income	Lower middle income	Upper middle income	High income
East Asia & Pacific		Indonesia Lao PDR Mongolia	Fiji Malaysia Thailand	
Europe & Central Asia	Tajikistan	Georgia Kyrgyz Republic Moldova Ukraine	Armenia Azerbaijan Belarus	
Latin America & Caribbean		Bolivia El Salvador	Brazil Colombia Costa Rica Cuba Mexico Peru	Argentina Barbados Chile
Middle East & North Africa		Tunisia	Iran, Islamic Rep. Lebanon	
South Asia	Nepal	Pakistan		
Sub-Saharan Africa	Benin Burundi Central African Rep. Gambia Guinea Madagascar Mali Niger Senegal Togo	Cameroon Cote d'Ivoire Eswatini Ghana Kenya	Mauritius South Africa	

Source: World Bank list of countries (June 2018).

[21] For the subsample used in the third stage, the following countries are removed from the final selection: Cameroon, Central African Republic, Costa Rica, Cuba, Eswatini, Fiji, Georgia, Guinea, Iran, Madagascar, Mauritius, Mongolia, Pakistan, South Africa, Tajikistan, Tunisia and Ukraine. Nonetheless, the countries of the subsample have a similar distribution by region and income classification than the final selection.

Appendix A.2: Description of data sources

Type	Indicator	Unit of measurement	Name of variable	Source dataset	Source organization
			Variables for models in first and second stages		
Dependent	Government expenditure on education	US$ current per capita	GovExp_educ	Education dataset of UIS.Stat	UNESCO Institute for Statistics
Independent	Total ODA disbursements in education sector	US$ current per capita	TotalAid_educ	Creditor Reporting System	OECD
	Bilateral ODA disbursements in education sector	US$ current per capita	BilatAid_educ	Creditor Reporting System	OECD
	Multilateral ODA disbursements in education sector	US$ current per capita	MultiAid_educ	Creditor Reporting System	OECD
Control	Gross Domestic Product	US$ current per capita	GDP_PC(t)	World Development Indicators	World Bank
	General government final consumption (one-year lag)	US$ current per capita	GovExp_totlag	World Development Indicators	World Bank
	Gross enrolment ratio in primary (one-year lag)	Percentage	Enrol_primlag	World Development Indicators	World Bank
	Gross enrolment ratio in secondary (one-year lag)	Percentage	Enrol_primlag	World Development Indicators	World Bank
	Total ODA disbursements in other sectors (no education)	US$ current per capita	TotalAid_other	Creditor Reporting System	OECD
	Bilateral ODA disbursements in other sectors (no education)	US$ current per capita	BilatAid_other	Creditor Reporting System	OECD
	Multilateral ODA disbursements in other sectors (no education)	US$ current per capita	MultiAid_other	Creditor Reporting System	OECD

Type	Indicator	Unit of measurement	Name of variable	Source dataset	Source organization
			Variables for models in third stage		
Independent	Perception on government effectiveness	Standarized index	IC1_goveff	World Governance Indicators	World Bank
	Perception on rule of law	Standarized index	IC2_rulaw	World Governance Indicators	World Bank
	Perception on control of corruption	Standarized index	IC3_nocorr	World Governance Indicators	World Bank
Control	Number of donors	Absolute number	Numdonors_educ	Creditor Reporting System	OECD
	Total ODA disbursements as share of government final consumption or GDP (aid dependency)	Percentage	Aid_depend_gfc	Creditor Reporting System	OECD
			Aid_depend_gdp	World Development Indicators	World Bank
	Country development status (2 dummies variables: Low income is base category)	Categorical	LM_dev_status	World Bank classification by income	World Bank
			UMH_dev_status_		
	All compensation staff expenditure as share of total public spending on education	Percentage	WageExp_educ	Education dataset of UIS.Stat	UNESCO Institute for Statistics

Source: cited datasets and organizations sources.

Appendix A.3: Check of econometric assumptions

i) Normal distribution

Two main assumptions for linear models used in the empirical strategy are that the dependent variable may be continuous, and it comes from a normal distribution, with a constant variance and centered in its mean value. As was shown in the previous section, the dependent variables for all stages are continuous. However, it is necessary to analyze if they have the shape of a normal distribution. For this purpose, a graphical analysis of all the variables using histograms will be placed. In case there is no evidence about normality distribution in some variable, a log-transformation will be applied.

ii) No multicollinearity

It implies that no independent or control variable is a almost perfect linear function of any other explanatory variable. Otherwise, the OLS coefficients cannot be estimated. A correlation matrix of the variables is calculated in order to calculate correlation coefficients among the variables. In case the correlation coefficient between two or more variables would be above 0.8, they will be included in separate model specifications to analyze the change of the significance of the regression coefficients.

iii)Homoscedasticity

This assumption implies that the modelling errors are uniform and uncorrelated, which implies that they have a constant variance. In case they are correlated, the coefficients are unbiased estimates, but they would be inefficient, because the true variance and covariance of the errors are underestimated. In order to validate this assumption, the Cook-Weisberg test for heteroscedasticity will be applied. In case of presence of a non-constant variance of the errors, robust standard errors are applied. In addition, robust t-statistics are calculated in order to test the statistical significance of the regression coefficients.

iv) Exogeneity

For any model specification (not only linear), the explanatory variables are assumed to be exogenous. When any of the independent or control variables are correlated with the error term, then the model has a endogeneity problem. This issue can arise from omitted variables in the model, from measurement errors in the covariates or from simultaneity (reverse causality) or from selection bias.

In the first stage of the empirical strategy, it is possible that endogeneity problem comes from a reverse causality between GDP per capita and public expenditure on education, because a higher government expenditure on education leads to a higher level of income and development of the country. In this case, one-year-lag GDP per capita is proposed as an instrument, because it is highly related with the original control variable. In addition, it is unlikely that public expenditure in a given year will affect GDP per capita in a previous year.

Other potential source of endogeneity comes from a reverse causality between the government expenditure on education and the enrolment ratios in primary and in secondary, because a higher spending on education can increase the enrolment ratio through the construction of new educational infrastructure, for example. For this reason, the percentage of population living in rural areas is proposed as an instrument. In a country with larger rural population, the enrollment and attendance may be lower due to the larger distances to school in comparison with urban areas. In addition, this variable does not necessarily affects directly the government expenditure on education.

After running the instrumental regression panel model, the Durbin and Wu-Hausman test for endogeneity will be applied in order to determine whether endogenous covariates in the model are in fact exogenous. In case endogeneity would be confirmed, the estimates using instrumental variables method will be preferable than those calculated by Ordinary Least Squares.

v) Individual specific effects are fixed

In panel modelling, it is important to determine the nature of the individual specific effect, because it can affect the efficiency of the coefficients' estimation. In fixed effect models, the individual component is correlated with the covariates. In random effect models, the individual-specific effects are uncorrelated with them. In order to validate which option fits better with the data, a Durbin-Wu-Hausmann test will be applied.

Appendix A.4: Selected countries for the analysis

Number of selected countries by income[22] and region

(A) Potential sample

Region	Low income	Lower middle income	Upper middle income	High income	Total	Regional distribution (%)
East Asia & Pacific	1	12	9	1	**23**	**16.2%**
Europe & Central Asia	1	5	11	1	**18**	**12.7%**
Latin America & Caribbean	1	4	19	8	**32**	**22.5%**
Middle East & North Africa	2	5	6	1	**14**	**9.9%**
South Asia	2	5	1		**8**	**5.6%**
Sub-Saharan Africa	26	14	6	1	**47**	**33.1%**
Total	**33**	**45**	**52**	**12**	**142**	**100.0%**
Income distribution (%)	**23.2%**	**31.7%**	**36.6%**	**8.5%**	**100.0%**	

(B) Final selection

Region	Low income	Lower middle income	Upper middle income	High income	Total	Regional distribution (%)
East Asia & Pacific		3	3		**6**	**12.8%**
Europe & Central Asia	1	4	3		**8**	**17.0%**
Latin America & Caribbean		2	6	3	**11**	**23.4%**
Middle East & North Africa		1	2		**3**	**6.4%**
South Asia	1	1			**2**	**4.3%**
Sub-Saharan Africa	10	5	2		**17**	**36.2%**
Total	**12**	**16**	**16**	**3**	**47**	**100.0%**
Income distribution (%)	**25.5%**	**34.0%**	**34.0%**	**6.4%**	**100.0%**	

Source: World Bank list of economies (June 2018)

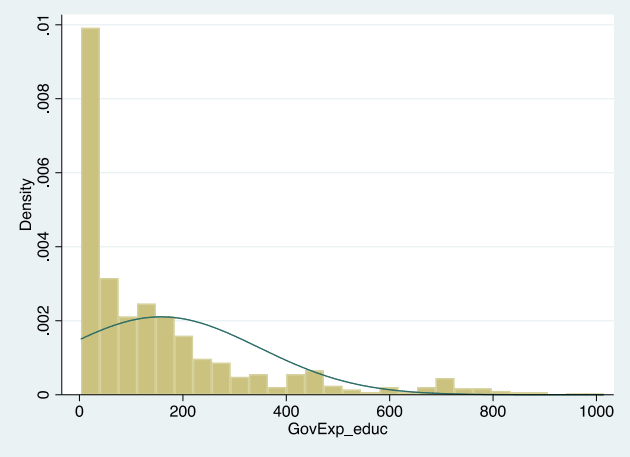
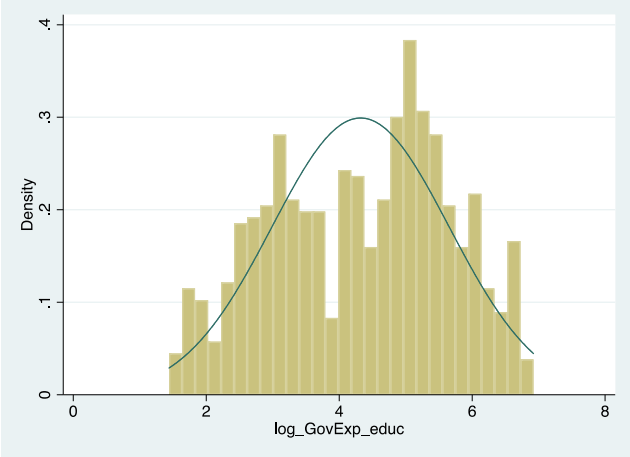
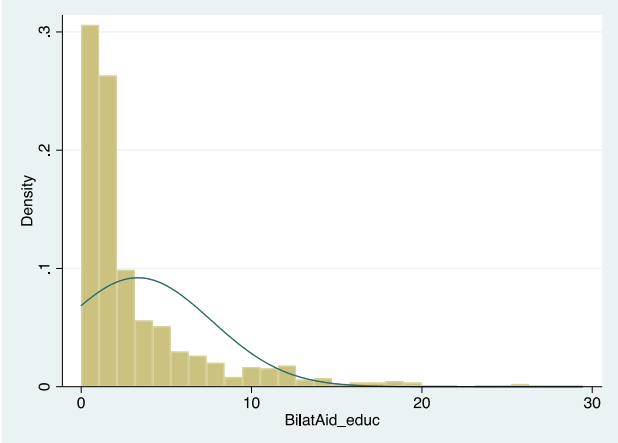
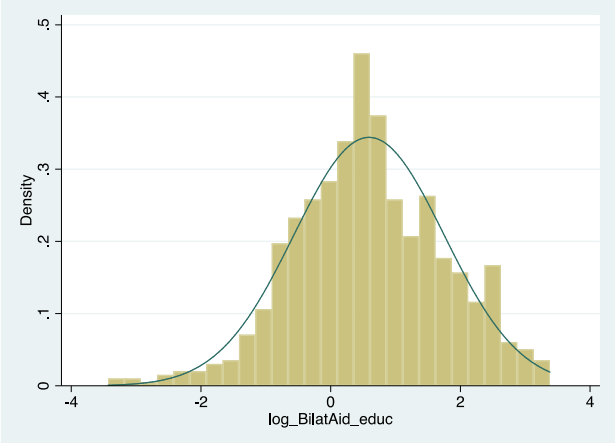
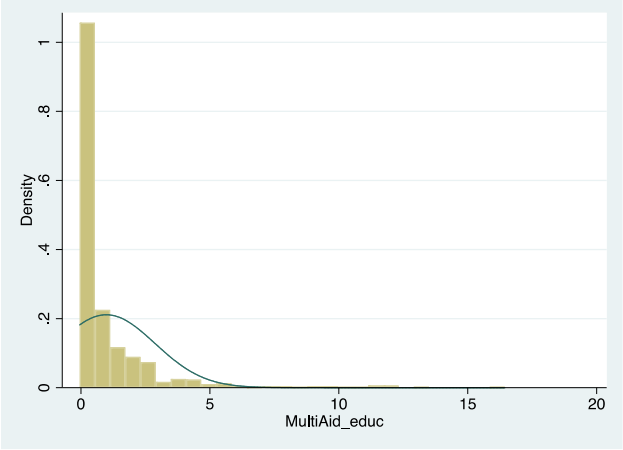
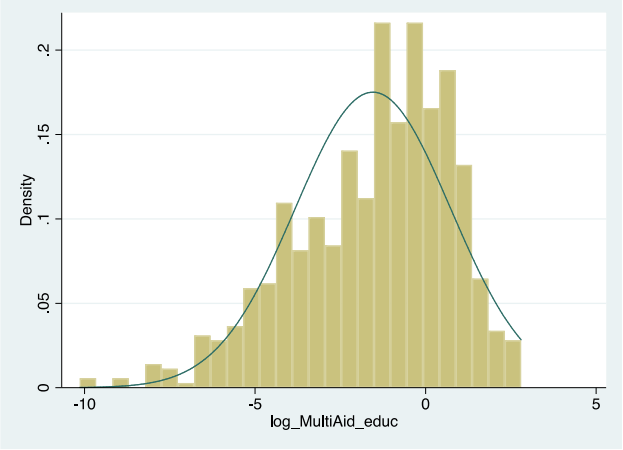
[22] The income classification corresponds to 2017 and comes from the World Bank categorization based on Gross National Income per capita.

APPENDIX B: First stage estimations

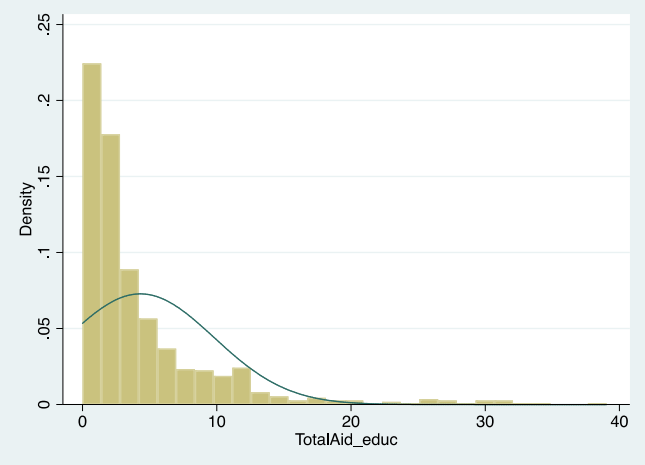
Appendix B.1: Correlation matrix

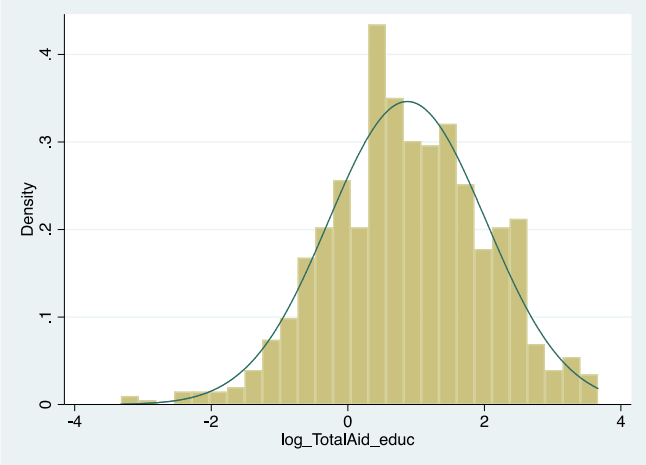
	Dependent variable	Independent variables of interest			Control variables						
	GovExp_ educ	**BilatAid_ educ**	**MultAid_ educ**	**TotalAid_ educ**	**GDP_PC**	**GovExp_ totlag**	**Enrol_ primlag**	**Enrol_ seclag**	**BilatAid_ other**	**MultiAid_ other**	**TotalAid _other**
GovExp_educ	1										
BilatAid_educ	-0.0932	1									
MultAid_educ	-0.1035	0.4709	1								
TotalAid_educ	-0.1094	**0.9526**	0.7169	1							
GDP_PC	**0.8863**	-0.0566	-0.0415	-0.059	1						
GovExp_totlag	**0.9382**	-0.0039	-0.0067	-0.0054	**0.8768**	1					
Enrol_primlag	0.1776	0.031	-0.0415	0.0102	0.2293	0.1795	1				
Enrol_seclag	0.6103	0.0275	-0.031	0.0111	0.663	0.6199	0.4057	1			
BilatAid_other	-0.2039	0.6174	0.4349	0.6379	-0.2013	-0.1075	-0.0254	-0.0577	1		
MultiAid_other	-0.2135	0.3057	0.2784	0.3376	-0.2344	-0.1563	-0.1555	-0.1765	0.4265	1	
TotalAid_other	-0.2473	0.5347	0.4163	0.5661	-0.2589	-0.1578	-0.1118	-0.1429	**0.823**	**0.8648**	1

Appendix B.2: Distributional graphics

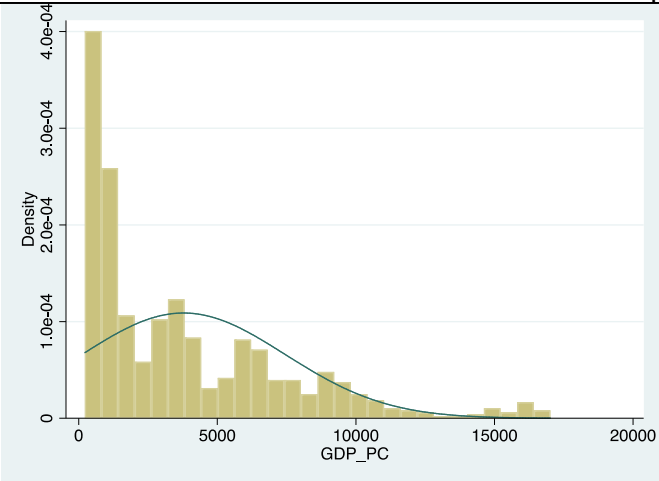
Original form	Log-transformed form
Government Expenditure on education	
	
Bilateral aid on education	
	
Multilateral aid on education	
	

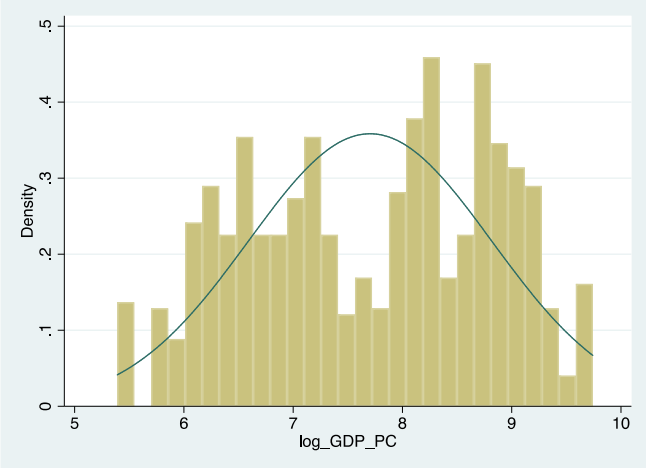
Total aid on education



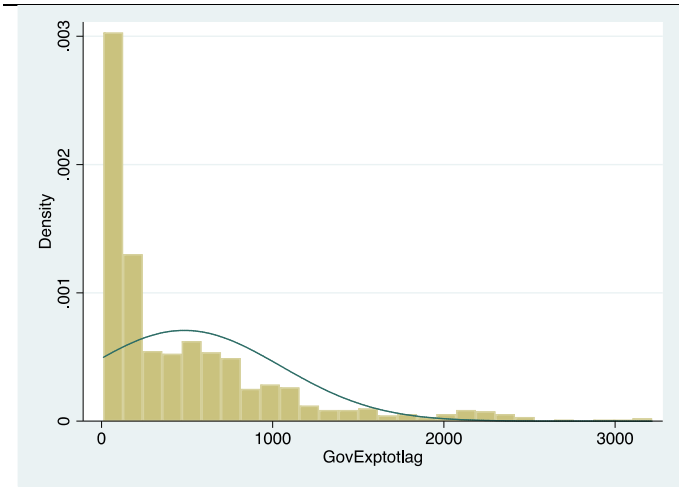


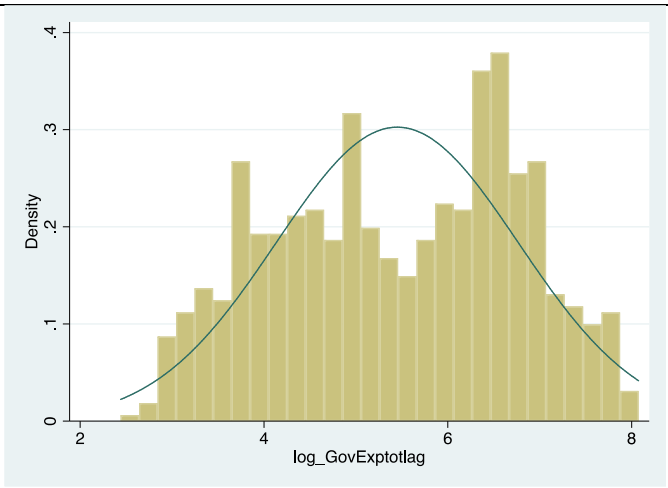
GDP per capita



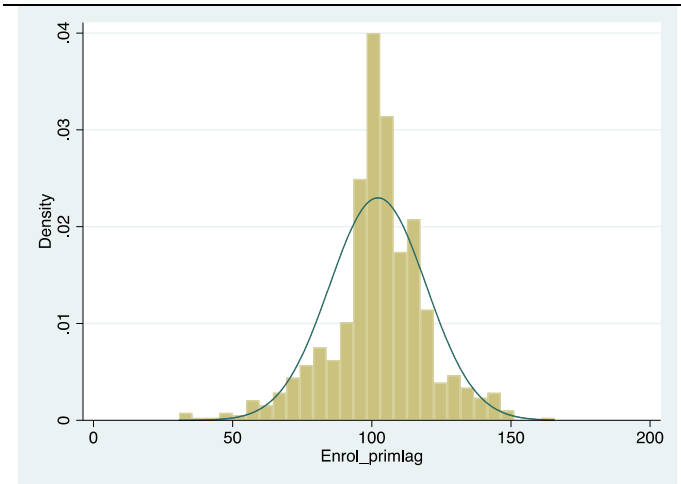


Total government expenditure (t-1)



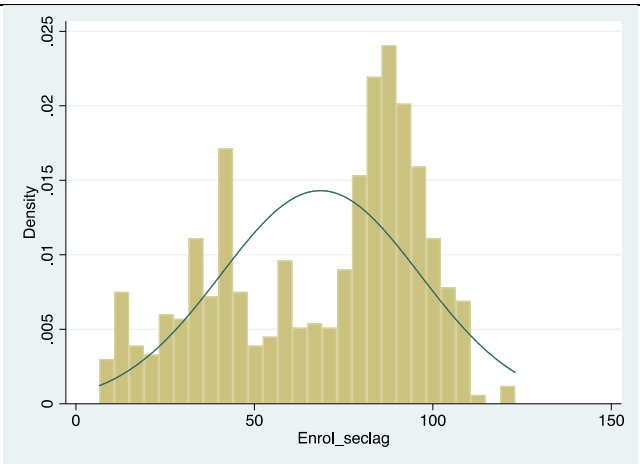


Enrolment ratio primary



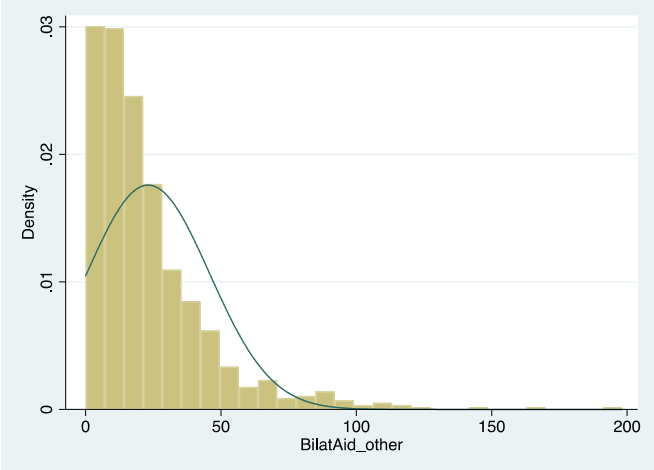
No transformation is needed.

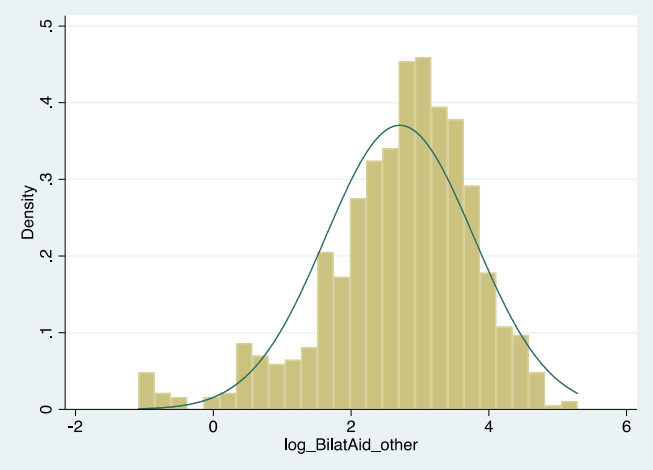
Enrolment ratio secondary



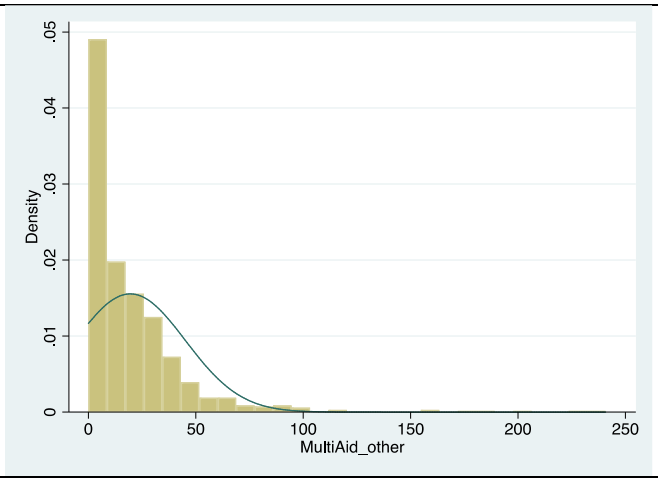
No transformation is needed.

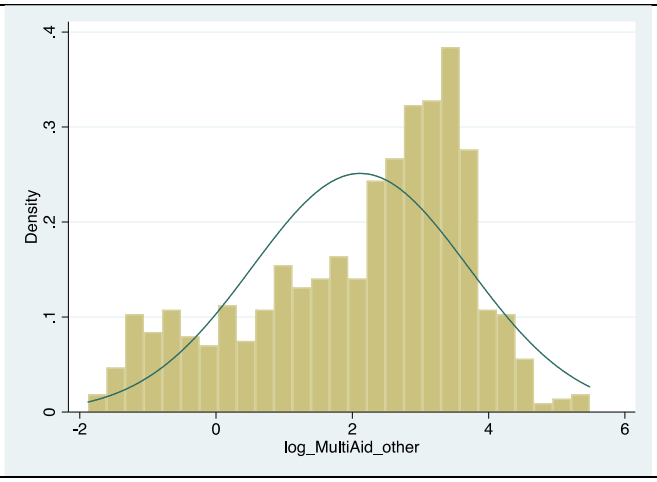
Other bilateral aid (no education)



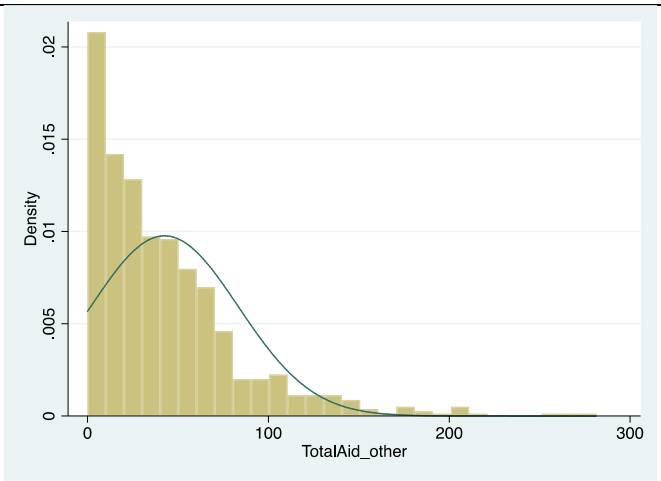


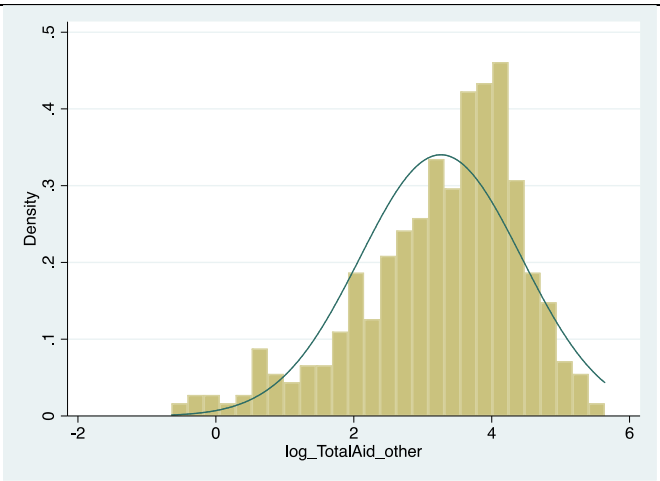
Other multilateral aid (no education)





Other Total aid (no education)





Appendix B.3: Test results for econometric assumptions for equation (1) – *Model 6*

Econometric assumption	Null Hypothesis (Ho)	Test name	Associated statistic	Prob>associated statistic	Ho rejected at 95% confidence?	Consequence
Significant differences across units	Variances across units is zero.	Breusch and Pagan Lagrangian multiplier test	Chi-sq(01)=1531.23	P-value=0.0000	Rejected	Panel model is selected
Country-specific unobservable effects are correlated with explanatory variables	No correlation between errors and explanatory variables	Hausman test	Chi-sq(7)=21.20	P-value=0.0035	Rejected	Panel model with fixed effects is chosen
Homoscedasticity	Variance of the regression errors are constant	Modified Wald test	Chi-sq(47)=4335.86	P-value=0.0000	Rejected	Robust standard errors have to be included to the model
Serial correlation	No first order autocorrelation among the regression errors	Wooldridge test for autocorrelation in panel data	F(1,46)=3.977	P-value=0.0521	Not rejected	No correction for autocorrelation is needed
Endogeneity	GDP_pc is exogenous	Difference of two Sargan-Hansen statistics (like C statistic)	Chi-sq(1)=1.574	P-value=0.2097	Not rejected	No correction for endogeneity is needed
	Enrol_primlag is exogenous		Chi-sq(1)=2.512	P-value=0.113	Not rejected	
	Enrol_seclag is exogenous		Chi-sq(1)=0.925	P-value=0.336	Not rejected	

Appendix B.4: Test results for econometric assumptions for equation (2) – *Model 7*

Econometric assumption	Null Hypothesis (Ho)	Test name	Associated statistic	Prob>associated statistic	Ho at 95% confidence?	Consequence
Significant differences across units	Variances across units is zero.	Breusch and Pagan Lagrangian multiplier test	Chi-sq(01)=1450.83	P-value=0.0000	Rejected	Panel model is selected
Country-specific unobservable effects are correlated with explanatory variables	No correlation between errors and explanatory variables	Hausman test	Chi-sq(9)=28.57	P-value=0.0008	Rejected	Panel model with fixed effects is chosen
Homoscedasticity	Variance of the regression errors are constant	Modified Wald test	Chi-sq(47)=3802.49	P-value=0.0000	Rejected	Robust standard errors have to be included to the model
Serial correlation	No first order autocorrelation among the regression errors	Wooldridge test for autocorrelation in panel data	F(1,46)=3.590	P-value=0.0644	Not rejected	No correction for autocorrelation is needed
Endogeneity	GDP_pc is exogenous	Difference of two Sargan-Hansen statistics (like C statistic)	Chi-sq(1)=1.213	P-value=0.2707	Not rejected	No correction for endogeneity is needed
	Enrol_primlag is exogenous		Chi-sq(1)=1.133	P-value=0.2872	Not rejected	
	Enrol_seclag is exogenous		Chi-sq(1)=0.275	P-value=0.5998	Not rejected	

APPENDIX C: Second stage estimations

Appendix C.1: Correlation matrix

	Dependent variable	Independent variables of interest			Control variables						
	GovExp_ educ	**BilatAid_ educ**	**MultAid_ educ**	**TotalAid_ educ**	**GDP_PC**	**GovExp_ totlag**	**Enrol_ primlag**	**Enrol_ seclag**	**BilatAid_ other**	**MultiAid_ other**	**TotalAid _other**
GovExp_educ	1										
BilatAid_educ	-0.0456	1									
MultAid_educ	-0.1241	0.4758	1								
TotalAid_educ	-0.0786	**0.9535**	0.7188	1							
GDP_PC	**0.8544**	-0.0061	-0.0566	-0.0242	1						
GovExp_totlag	**0.926**	0.0544	-0.0105	0.0394	**0.8468**	1					
Enrol_primlag	0.2315	0.0321	-0.0399	0.0117	0.2898	0.2355	1				
Enrol_seclag	0.6127	0.0797	-0.0095	0.0597	0.6832	0.6356	0.4339	1			
BilatAid_other	-0.1688	0.6087	0.4319	0.6292	-0.1728	-0.0608	-0.0252	0.0086	1		
MultiAid_other	-0.2585	0.306	0.2772	0.3368	-0.2888	-0.1946	-0.1565	-0.1592	0.4244	1	
TotalAid_other	-0.2561	0.531	0.4144	0.5617	-0.2773	-0.1559	-0.1121	-0.095	**0.8232**	**0.8634**	1

Appendix C.2: Econometric results for equation 4 – *Dependent variable: FungAid_educ*

Variables	Constant coefficients ($\bar{\beta}_1$)	Robust Std. Errors.
TotalAid_educ	-0.214***	0.053
GDP_PClag	0.503**	0.205
GovExptotlag	0.391***	0.083
TotalAid_other	-0.025	0.037
Enrol_primlag	-0.006	0.015
Enrol_seclag	-0.003	0.017
N	748	
R^2	0.988	

Notes: (i) All monetary variables are in logarithmic terms.
(iii) P-values: * p<0.10; ** p<0.05; *** p<0.01

Countries	Country-specific coefficients of TotalAid_educ (α_{1i})	Robust Std. Errors.
Argentina	0.285*	0.173
Armenia	0.462***	0.117
Azerbaijan	0.219**	0.099
Benin	-0.050	0.131
Bolivia	-0.026	0.12
Brazil	0.199	0.166
Burundi	-0.195	0.238
Cameroon	-0.644***	0.139
Central African Republic	0.177	0.108
Chile	-0.463	0.329
Colombia	0.254**	0.101
Costa Rica	-0.153	0.125
Cote d'Ivoire	0.464***	0.165
Cuba	0.256	0.23
El Salvador	0.179	0.114
Eswatini	0.107*	0.064
Fiji	0.138*	0.073

Countries	Country-specific coefficients of TotalAid_educ (α_{1i})	Robust Std. Errors.
Gambia, The	0.461***	0.118
Georgia	0.153	0.117
Ghana	0.169	0.269
Guinea	-0.144	0.138
Indonesia	0.860**	0.359
Iran, Islamic Rep.	-0.004	0.109
Kenya	0.023	0.103
Kyrgyz Republic	0.152*	0.092
Lao PDR	0.667**	0.330
Lebanon	0.333*	0.181
Madagascar	0.197	0.174
Malaysia	0.115	0.074
Mali	0.275***	0.098
Mauritius	-0.094	0.188
Mexico	0.220	0.169
Moldova	0.355**	0.153
Mongolia	0.302	0.439
Nepal	-0.157*	0.093
Niger	0.394***	0.115
Pakistan	0.031	0.181
Peru	-0.101	0.078
Senegal	0.201*	0.109
South Africa	-0.157	0.099
Tajikistan	0.399***	0.114
Thailand	0.129	0.086
Togo	-0.279**	0.130
Tunisia	-0.067	0.14

Note: P-values: * $p<0.10$; ** $p<0.05$; *** $p<0.01$

Year	Year-specific coefficients of TotalAid_educ (λ_{1t})	Robust Std. Errors.
2000	0.105	0.069
2001	0.141**	0.067
2002	0.101	0.084
2003	0.198***	0.076

Year	Year-specific coefficients of TotalAid_educ (λ_{1t})	Robust Std. Errors.
2004	0.160*	0.086
2005	0.089	0.057
2006	0.191***	0.061
2007	0.121**	0.060
2008	0.040	0.054
2009	0.062	0.051
2010	0.089*	0.051
2011	0.092*	0.048
2012	0.129**	0.057
2013	0.235***	0.060
2014	0.161**	0.065
2015	0.123*	0.065
2016	0.269***	0.065

Note: P-values: * $p<0.10$; ** $p<0.05$; *** $p<0.01$

APPENDIX D: Third stage estimations

Appendix D.1: Principal component analysis for institutional capacity index

a) Principal components/correlation

Rotation: (unrotated = principal)

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.67813	2.48981	0.8927	0.8927
Comp2	0.188328	0.0547894	0.0628	0.9555
Comp3	0.133538	.	0.0445	1

From above, it is possible to conclude that the first component explains almost 90% of the data of three variables.

b) Principal components (eigenvectors)

Variable	Comp1	Unexplained
IC1_goveff	0.5767	0.1093
IC2_rulaw	0.583	0.08961
IC3_nocorr	0.5723	0.123

Fort he first component, the table above shows the eigenvectors for each original variable. The new variable contains a great proportion of variance of each original variable.

c) Kaiser-Meyer-Olkin measure of sampling adequacy

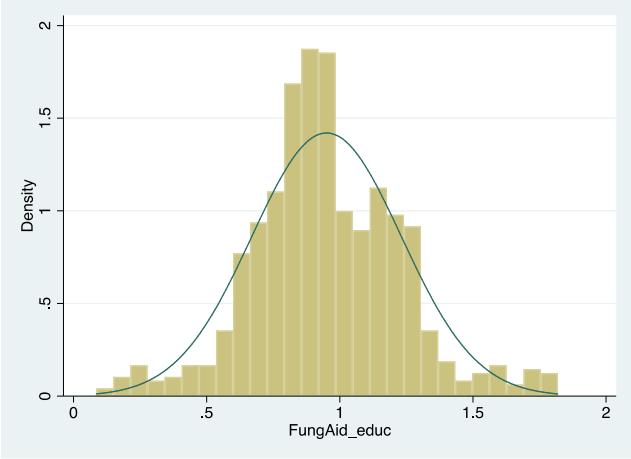
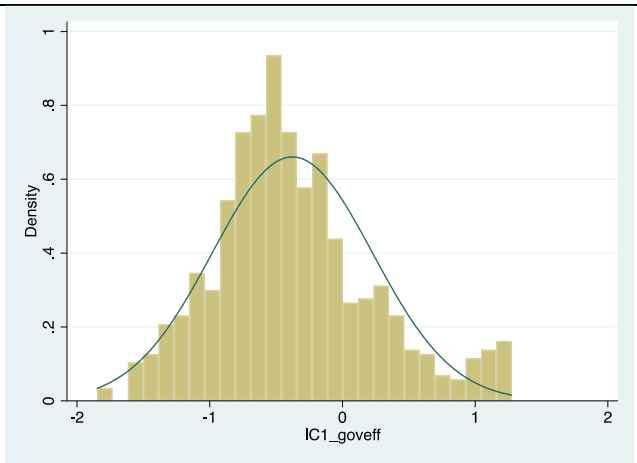
Variable	kmo
IC1_goveff	0.7700
IC2_rulaw	0.7277
IC3_nocorr	0.8044
Overall	0.7654

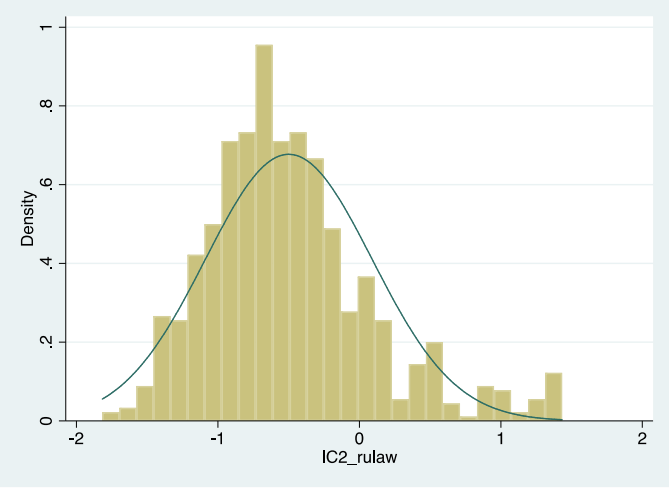
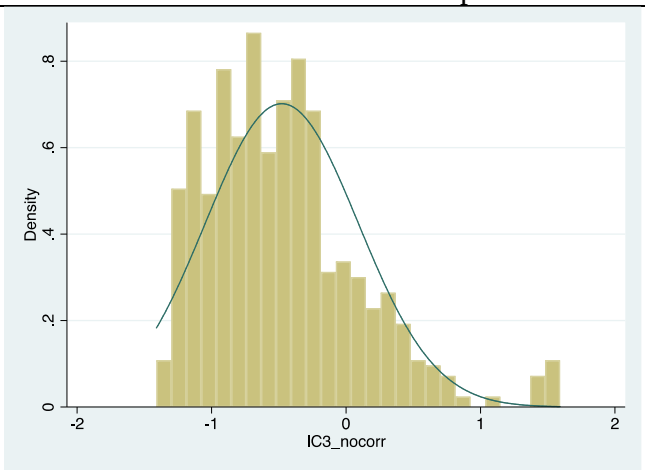
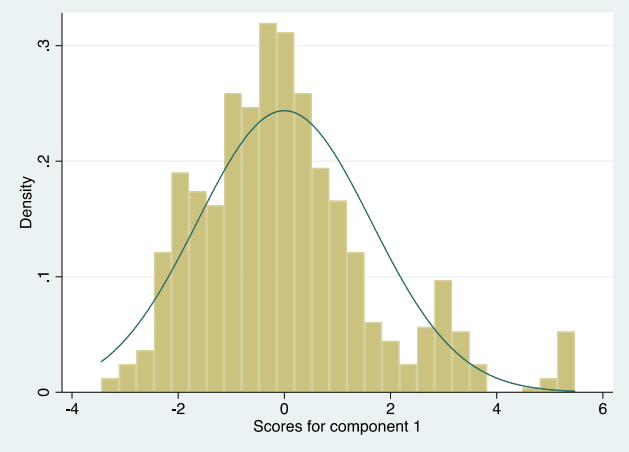
The KMO statistic is above 0.5, which reflects that PCA has a good performance to summarize the data.

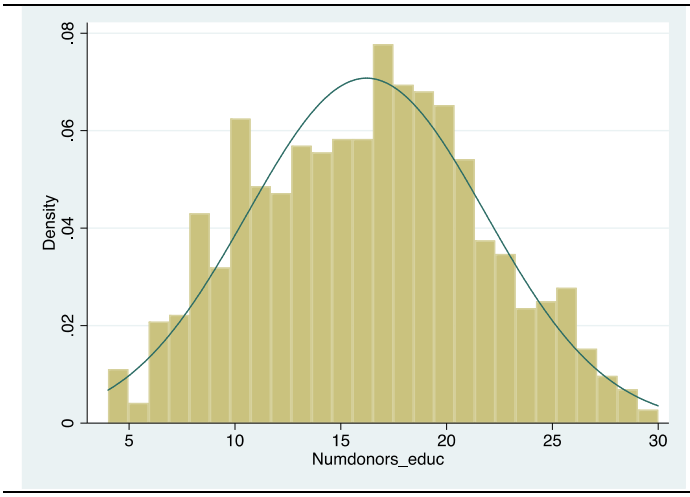
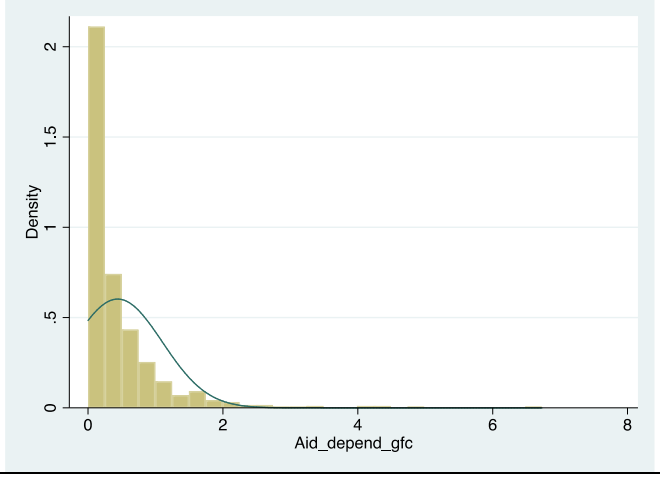
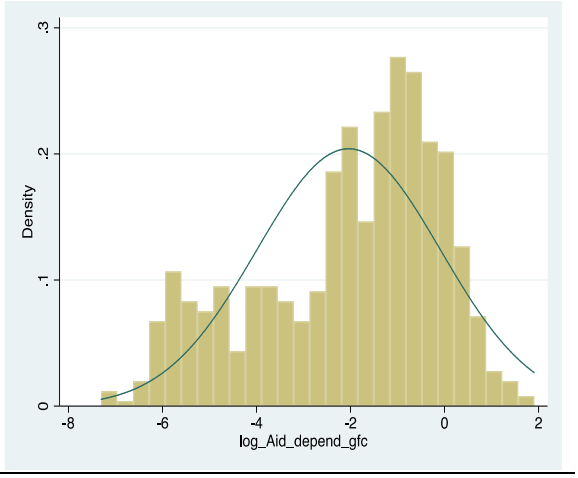
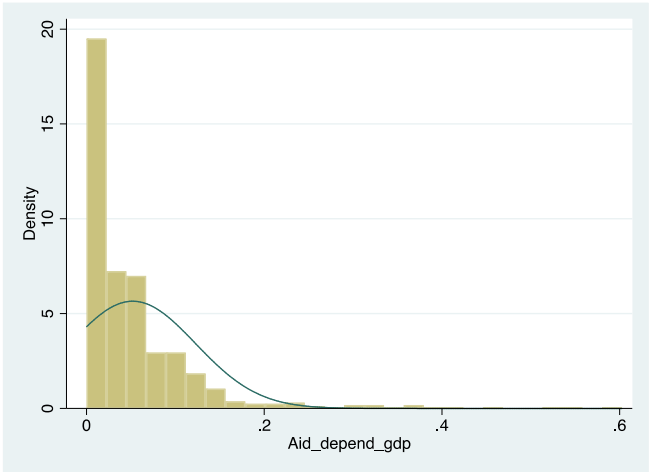
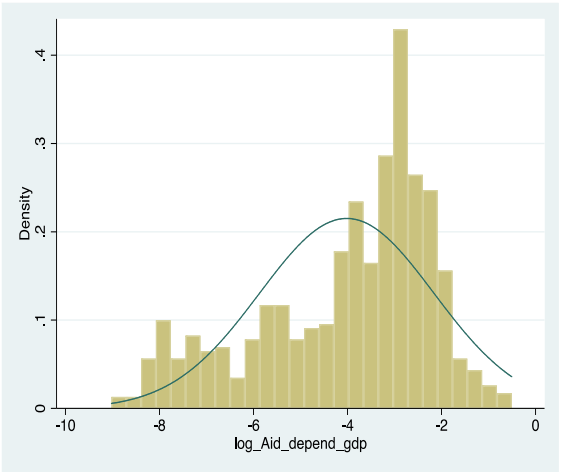
Appendix D.2: Correlation matrix

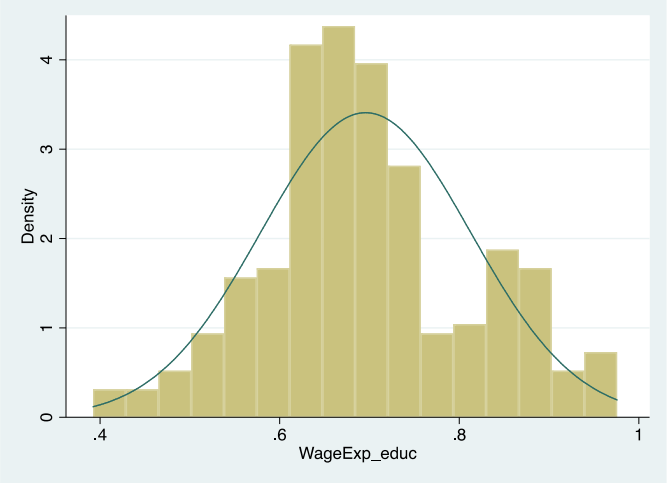
	Dependent variable	Independent variables of interest				Control variables					
	FungAid_ educ	**IC1_ goveff**	**IC2_ rulaw**	**IC3_ nocorr**	**IC4_ PCA**	**Numdonors_ educ**	**Aid_depend_ gfc**	**Aid_depend_ gdp**	**WageExp _educ**	**LM_dev_s tatus**	**UMH_dev _status**
FungAid_educ	1										
IC1_goveff	0.0648	1									
IC2_rulaw	0.1387	**0.849**	1								
IC3_nocorr	0.2479	**0.8154**	**0.8888**	1							
IC4_PCA	0.1568	**0.9389**	**0.9598**	**0.9483**	1						
Numdonors_educ	-0.1353	-0.0306	0.0016	-0.0301	-0.0212	1					
Aid_depend_gfc	0.0836	-0.3745	-0.1954	-0.1838	-0.268	-0.1266	1				
Aid_depend_gdp	0.1539	-0.4537	-0.2898	-0.2779	-0.3618	-0.0997	**0.884**	1			
WageExp_educ	0.1214	0.0035	-0.0839	0.0176	-0.021	-0.1106	-0.144	-0.1368	1		
LM_dev_status	-0.0685	-0.6303	-0.4393	-0.4569	-0.5396	0.0267	0.4113	0.4366	-0.2359	1	
UMH_dev_status	0.0685	0.6303	0.4393	0.4569	0.5396	-0.0267	-0.4113	-0.4366	0.2359	-1	1

Appendix D.3: Distributional graphics

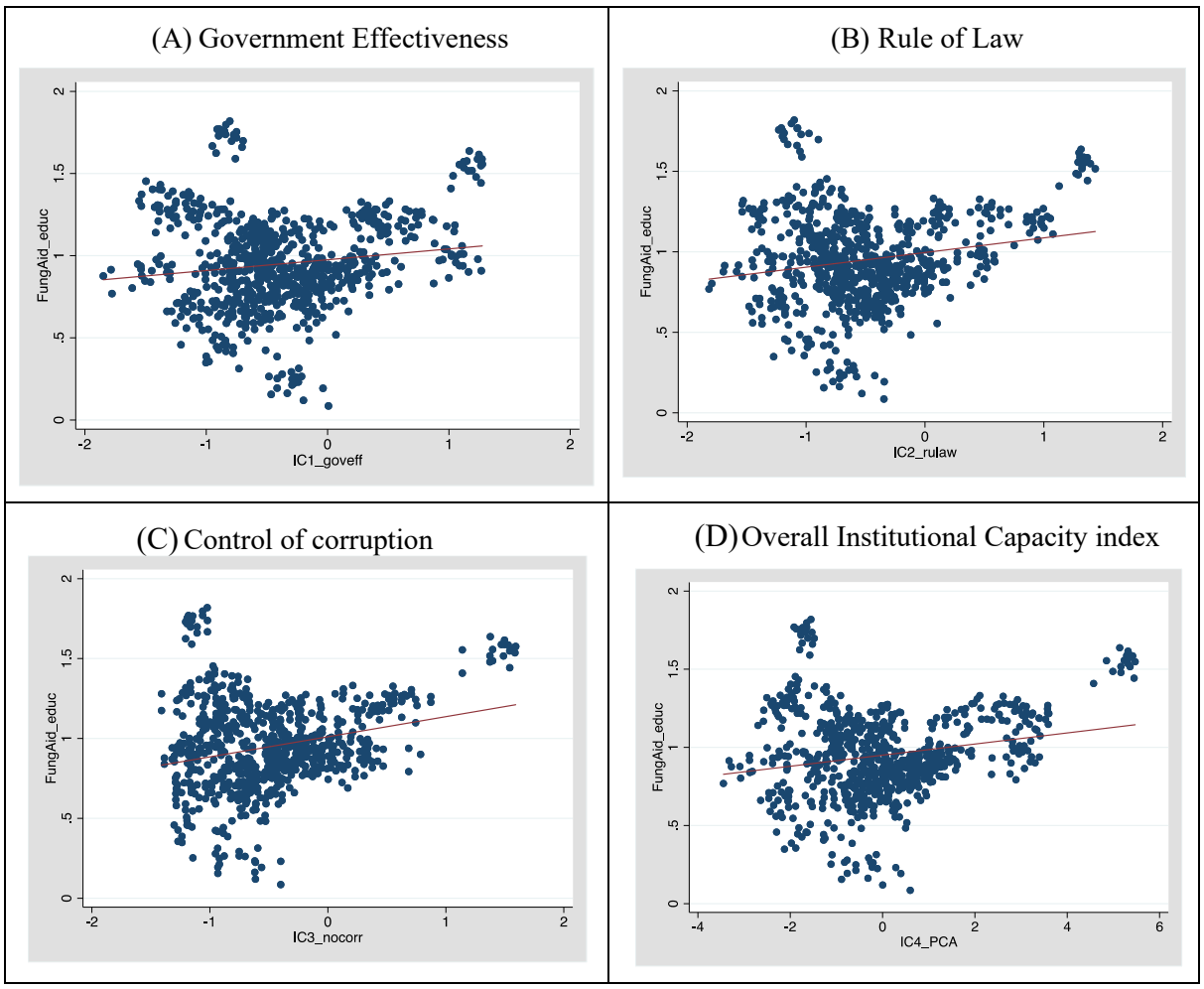
Original form (w)	**Log-transformed form** $\ln(w)$
Degree of aid fungibility on education	
	No transformation is needed.
Perception on government effectiveness	
	No transformation is needed.

Perception on rule of law	
	No transformation is needed.
Perception on control of corruption	
	No transformation is needed.
Institutional Capacity (Total-PCA)	
	No transformation is needed.

Number of donors	
	No transformation is needed.
Aid dependency (percentage of final government consumption)	
	
Aid dependency (percentage of GDP)	
	

Wage expenditure in education sector (only for the subsample)	
	No transformation is needed.

Appendix D.4: Graphical relation between dependent and independent variables



Source: Own calculations of aid fungibility and World Governance Indicators.

Appendix D.5: Econometric results for equation (7) with wage expenditure as control variable (subsample)

D.5.1 Using aid dependency as share of government expenditure

Dependent variable: Estimated degree of aid fungibility in education

	(9)	(10)	(11)	(12)
Numdonors_educ	0.002	0.002	0.002	0.001
	(0.003)	(0.003)	(0.003)	(0.003)
Aid_depend_gfc	-0.009	-0.010	-0.010	-0.011
	(0.015)	(0.017)	(0.016)	(0.015)
LM_dev_status	-0.042**	-0.042***	-0.035**	-0.043***
	(0.018)	(0.015)	(0.015)	(0.016)
YEAR	-0.006***	-0.006***	-0.007***	-0.006***
	(0.002)	(0.002)	(0.002)	(0.002)
WageExp_educ	-0.015	0.020	0.003	0.001
	(0.057)	(0.059)	(0.061)	(0.057)
IC1_goveff	-0.080***			
	(0.026)			
IC2_rulaw		-0.068**		
		(0.029)		
IC3_nocorr			-0.055**	
			(0.024)	
IC4_PCA				-0.036***
				(0.011)
_cons	13.776***	13.802***	14.588***	13.711***
	(4.298)	(4.563)	(4.495)	(4.370)
Chi2-statistic	45.43	54.20	56.28	58.33
Prob>Chi2	0.00	0.00	0.00	0.00
N	263	263	263	263

Notes: (i) Robust standard errors in parentheses. (ii) P-values: * $p<0.1$; ** $p<0.05$; *** $p<0.01$

D.5.2 Using aid dependency as share of GDP

Dependent variable: Estimated degree of aid fungibility in education

	(13)	(14)	(15)	(16)
Numdonors_educ	0.002	0.002	0.002	0.001
	(0.003)	(0.003)	(0.003)	(0.003)
Aid_depend_gdp	0.031	0.026	0.024	0.017
	(0.145)	(0.142)	(0.133)	(0.137)
LM_dev_status	-0.042**	-0.043***	-0.036**	-0.044***
	(0.017)	(0.015)	(0.015)	(0.016)
YEAR	-0.006***	-0.006***	-0.007***	-0.006***
	(0.002)	(0.002)	(0.002)	(0.002)
WageExp_educ	-0.007	0.027	0.010	0.008
	(0.055)	(0.056)	(0.057)	(0.054)
IC1_goveff	-0.079***			
	(0.025)			
IC2_rulaw		-0.067**		
		(0.029)		
IC3_nocorr			-0.054**	
			(0.024)	
IC4_PCA				-0.036***
				(0.011)
_cons	13.268***	13.293***	14.079***	13.207***
	(4.338)	(4.587)	(4.535)	(4.399)
Chi2-statistic	45.44	58.08	53.32	58.74
Prob>Chi2	0.00	0.00	0.00	0.00
N	263	263	263	263

Notes: (i) Robust standard errors in parentheses. (ii) P-values: * $p<0.1$; ** $p<0.05$; *** $p<0.01$

D.5.3 Test results for econometric assumptions (model 4)

Econometric assumption	Null Hypothesis (Ho)	Test name	Associated statistic	Prob>associated statistic	Ho rejected at 95% confidence?	Consequence
Significant differences across units	Variances across units is zero.	Breusch and Pagan Lagrangian multiplier test	Chi-sq(01)=5,290.82	P-value=0.0000	Rejected	Panel model is selected
Country-specific unobservable effects are correlated with explanatory variables	No correlation between errors and explanatory variables	Hausman test	Chi-sq(5)=3.01	P-value=0.6990	Not rejected	Panel model with random effects is chosen
Serial correlation	No first order autocorrelation among the regression errors	Wooldridge test for autocorrelation in panel data	F(1,43)=576.59	P-value=0.0000	Not rejected	No correction for autocorrelation is needed
Endogeneity	IC4_TOT is exogenous	Difference of two Sargan-Hansen statistics (like C statistic)	Chi-sq(1)=2.502	P-value=0.1137	Not rejected	No correction for endogeneity is needed