

## OFFICIAL DEVELOPMENT ASSISTANCE, PUBLIC INVESTMENT AND ECONOMIC GROWTH IN ASIA AND THE PACIFIC

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Official development assistance contributes directly and indirectly through public investment to economic growth in least developed and developing countries. This study investigates the impacts of official development assistance and public investment on economic growth in 24 Asian and Pacific Island countries over the period from 1996 to 2012. Aid volatility, public investment volatility, and government revenue volatility are also considered in the aid-growth model to test for the respective effectiveness of aid and public investment. The system generalized method of moments estimator is employed to correct for potential endogeneity bias, as well as potential bias arising from country specific fixed effects. While variation in aid proves a favorable contributor to economic growth, aid's impact is mitigated by public investment volatility.

*Key Words:* Aid volatility, public investment, economic growth

### 1. Introduction

Official development assistance (ODA) is also referred to as foreign aid or aid. Aid plays an important role in least developed and developing countries by providing budgetary support and sponsoring infrastructure construction. Foreign aid's such contribution to recipient countries' public investment in turn drives economic growth. Foreign aid flow is volatile, partly attributed to changing situations in recipient countries. Aid volatility leads to volatility in public investment in small economies and hence affects economic growth.

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This concern has been echoed by “The Paris declaration on aid effectiveness<sup>1</sup>, 2005” and “Accra Agenda for action on aid effectiveness<sup>2</sup>, 2008”. It may be particularly relevant for Pacific Island countries and under-achieving Asian countries which rely on aid for trade and development. This article aims to examine the potential impacts of aid and aid volatility on economic growth in the Asia-Pacific region.

Generally there are two lines of thoughts on impacts of aid volatility on economic growth. First line of thoughts argues that aid volatility is harmful for economic growth. For instance, Lensink and Morrissey (2000) argue that aid is productive when it is anticipated. Unanticipated changes in aid flow however make aid less productive as recipient governments may decide to discontinue, postpone or not to implement new projects that are funded by donors’ fund; moreover, sudden fluctuations in aid flow depict shocks to the economy, and it is hence taken as an indicator of instability by private investors who are accordingly disincentive in sight of aid volatility. Similar sentiments are also shared by Arellano et al. (2009) who argue that unexpected fluctuation in foreign aid diminishes a countries ability to use aid effectively as it affects volatility of domestic investment and consumption. Bulir and Hamann (2003) argue that aid volatility can indirectly offset some of direct positive effects of aid as it complicates the conduct of fiscal and monetary policies.

The second stream of thoughts argue that if aid volatility is counter cyclical, it may not impose any harmful effect on an economy as it provides stabilizing effects and thus promotes economic growth. For instance, Chauvet (2001), Chauvet & Guillaumont (2004, 2009) and Collier and Goderis (2008) argue that aid is likely to mitigate adverse effect of external shocks on economic growth. Aid might cushion negative impacts of shocks by providing insurance or it might finance precautionary expenditures which make the recipient country more resilient to shocks. Hence unanticipated rise in aid to finance such external shocks will not harm the economy.

This paper adds to the literature on aid volatility in two ways. First the paper analyses the impact of aid volatility in more homogenous group of countries in the Asia-Pacific region. These countries are vulnerable to external shocks, face unfavorable terms of trade, subject to adverse weather condition, and faced with unfavorable terms of trade; while they are generally financially constraint to effectively address these issues. Second, it tests the aid volatility-growth relationship proposed by examining the aid volatility-growth nexus by including public investment volatility and revenue volatility into the aid-growth framework. We further differentiate aid volatility’s growth impacts among the concerned countries by interacting aid volatility with country heterogeneity.

The rest of the paper is organized as follows. Section 2 provides a brief overview of the aid-growth literature. Section 3 discusses the model and methodology employed in this study. Section 4 examines the data and provides descriptive statistics. Section 5 presents and discusses the empirical findings. And Section 6 concludes.

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<sup>1</sup> Available at <http://www.oecd.org/dac/effectiveness/34428351.pdf>

<sup>2</sup> Available at <http://www.ppdafrika.org/docs/accra.pdf>

## **2. Literature Review**

The impact of aid on economic growth has received much attention since 1940's. The early studies focused on the role of aid in alleviating growth constraints (e.g., Domar, 1947; Chenery and Strout, 1966; Bacha, 1990).

Recently there has been huge literature directly examining the impact of aid on economic growth. Three streams of arguments have emerged on aid effectiveness. The first stream of theoretical and empirical literature argues that aid supports economic growth through provision of financial assistance for public investment plan (e.g., Mekasha and Tarp, 2013). The second line of literature argued that aid has a negative impact on economic growth (e.g., Economides and Kalyvitis, 2008; Papanek, 1973; Alvi and Senbeta, 2012; Drazen, 2000; Economides, Kalyvitis & Philippopoulos, 2008). The third line of literature argues that aid has positive impact in presence of good economic policies in the recipient countries (e.g., Burnside and Dollar, 2000; Hansen and Tarp, 2001; Easterly et. al, 2004; Roodman, 2007; Rajan and Subramanian, 2008; Kimura, Mori and Sawada, 2012; Angeles and Neanidis, 2009).

Over the last decade the concern over aid effectiveness has shifted to aid volatility. These concerns over aid volatility have been reflected in rather considerable literature examining the impact of aid volatility on economic growth. Essentially two line of theory have emerged. The first maintains that not only aid volatility depresses growth through investment but also through public investment volatility (Museru, Toerein and Gossel, 2014 & Kodama, 2012). Some of the channels through which aid volatility depresses growth include; aid shortfall creates difference in expenditure allocation and thus consequently leads to halt, termination or suspension of certain projects if alternative funding are not available (Bulir and Hamann, 2008). Incomplete projects significantly reduce the return on investment (Hudson and Mosley, 2008). Concurrently, unstable aid can incite governments to scale down investment, which mean lower funding requirement. This can be wrongly interpreted by donor countries that countries have absorption problem and hence trigger them to reduce aid allocation which can further depress the economy and create poverty trap (Agenor and Aizenman, 2010). In addition, unstable aid induces unstable government expenditure allocation resulting in unpredictable policy environment and hence it provides disincentive to private and foreign investors (Hudson and Mosley, 2008).

Similarly, many aid recipient countries lack capacity to raise domestic revenue through taxes, therefore foreign provides an essential source of government finance for long term public development projects such as infrastructure development, health and education. For this reason, a frequent disturbance in aid flow provides major challenge to authorities in formulating medium to long term development plan (Agenor and Aizenman, 2010). Likewise, instability of certain types of aid such technical assistance and consultancy can prompt high staff movement, terminate relationship within aid donor-recipient community and consequently limit social capital and opportunities for learning for both parties.

A number of empirical studies found support for negative impact of aid volatility on economic growth. For instance, Lensink and Morrissey (2000) examined the influence of aid instability on aids impact on growth. They find that the effect of aid on growth

is insignificant unless some measure of aid uncertainty is included in cross-country regressions and that uncertainty about aid is detrimental to growth. Arellano et al (2009) using sample of 73 countries from 1981-200 and two sector equilibrium model examined the implication of foreign aid and its variability on consumption, investment, and structure of production. They find that aid had a significant negative impact on consumption. Hudson and Mosley (2008a) using sample of 131 countries from 1977-2001 examined the macroeconomic impact of aid volatility. They find that both positive and negative volatility significantly reduces government consumption and investment. Gemmell and McGillivray (1998), using a sample of 48 developing countries, find that shortfalls in aid are followed most frequently by reductions in government spending, sometimes by increase in taxes, and sometimes by both. In other words, the typical aid-receiving country is unable to offset an unexpected windfall of aid by borrowing and has resort to costly, swift, and possibly inefficient fiscal adjustments. Hudson and Mosley (2008b) analyzed the impact of positive/upside and negative/downside volatility separately. They noted that while both reduce the impact of aid on growth, but subsequently some of this adverse impact is reversed in case of positive volatility only. They argued that positive volatility could have result from donor response to address shocks in aid recipient countries. Even unanticipated aid reduction might feasibly have longer-term beneficial impacts, in influencing policy reform in aid recipient countries. Contrarily, Bulir and Hamann (2008) using sample of 76 countries from 1975–2003 found that aid has failed to act either as a stabilizing force or as an insurance mechanism. They argue that while a stable and predictable aid is important for achieving macroeconomic stability; other mechanism such as IMF support programme should be formulated to address various sources of external volatility.

Kodama (2012) using calibration examined aid unpredictability effect on recipient countries economic growth. They find that effect of the unstable aid is lower than growth effect of stable aid in the long run. They concluded that unstable aid depresses production facilities and consequently depresses economic performance as well. They further show that negative impact of aid is more in countries with poorly developed bond market compared to countries with access to bond market. A well-established bond market would mean that in period of aid windfall remaining spending target can be used to purchase investment bonds; while it might be used for consumption in absence of bond market.

Museru, Toerien and Gossel (2014) examined the impact of aid and public investment volatility on economic growth in Sub-Saharan countries over the period 1992-2011. The study found that aid has a positive impact on growth in Sub-Saharan countries. The study further finds that positive impacts of aid have been eroded by volatility of the public investment. They also find negative impact of aid volatility on economic growth.

On the other hand, the second stream of studies argues that the effectiveness of volatile aid may depend on factors such as external shocks and quality of institution of aid recipient countries. For instance, Guillaumont and Chauvet (2001) and Chauvet and Guillaumont (2004, 2009) argued that aid performs better in countries more vulnerable to external shocks. Unexpected rise in aid in response to external shocks can provide important source of finance for stabilization. This view was further echoed by Bulir and Hamann (2008)

who argued that procyclicality of aid are not a much concern if aid is provided when it is needed most; that is, during periods of large negative shocks. Most of the aid recipient countries are vulnerable to external and internal shocks due lack of diversified economy and liquidity constraints. These constraints their quick recovery from crisis and hence they are likely to benefit from prompt income-stabilising mechanism such as aid bonanza. More recently, Kathavate and Mallik (2012) argued that quality of the institution can influence the impact of aid volatility. They hypothesized that most of the aid is received through state government and states facing strong institutions are less likely to inappropriate fund. Such a government would attempt to cushion foreign aid fluctuation through saving, investment and other means. In absence of such institutions, government is likely to inappropriate fund and uses it for corrupt practices instead of addressing the needs of its citizens. Therefore, institution plays a significant role in determining impact of aid volatility on growth. Strong institutions will force governments to moderates its infrastructure investment in response to volatile aid environment. For these reasons government will chooses small scale projects over large scale project so that project are completed in a given (high aid) period, or if aid in the subsequent period is low, small scale projects will continue to be completed. Kathavate and Mallik (2012) using data of 78 aid recipient countries from 1984-2204 examined the relationship between aid volatility, institution and growth by constructing interactive term between institution and aid volatility. They find that aid volatility has a negative impact on growth; however its impact is mitigated by stronger institutional quality.

All in all, studies examining consequence of aid volatility on growth do not offer an irrefutable conclusion. Although only few studies categorically claim that aid volatility in certain aid recipient countries or under certain conditions should not be a matter of concern, the majority of the studies reveal a depressing impact of aid volatility. However, because aid flow mainly finances specific shocks facing aid recipient countries, nature of its impact may very across countries. Moreover, as aid hugely support public investment, its volatility can influence public investment volatility and consequently influence net effect of public investment on growth.

### **3. Model and Methodology**

The empirical model used in this study is based on the aid-growth literature including Boon (1996), Burnside and Dollar (1997, 2000), Tarp (2006), Roodman (2007), Goucouliagos and Paldam (2009), Hauk and Wacziarg (2009), Rajan and Subramanian (2011), Kathavate and Mallik (2012) and Malimu et al. (2014). The model considers economic as well as institutional factors that can possibly explain the growth performance of poor countries, while ensuring that any inferences between the variables are countered. The empirical volatility-growth model is also consistent with the conditional convergence model derived from the Solow (1956) model, which is widely used in the growth literature. The empirical model takes a panel data structure as follows:

$$gy_{it} = \alpha_0 + \sum_{j=1}^p \beta_j X_{j,it} + \sum_{k=1}^q \gamma_k W_{k,it} + \pi_i + \sigma_t + \varepsilon_{it} \quad (1)$$

Where  $gy_{it}$  is the average growth rate of GDP per capita at constant 2005 prices (%),  $X_{it}$  is a matrix of control variables,  $W_{it}$  is a matrix of variables of interest,  $\pi_i$  denotes time-invariant country-specific effects,  $\sigma_t$  denotes country-invariant time-specific effects, and  $\varepsilon_{it}$  is an i.i.d. error term.

Variables of interest include:

- Net official development assistance received (% of GDP, denoted by  $aid_{it}$ ), and its quadratic ( $aidsq_{it}$ ) and cubic forms ( $aidcub_{it}$ )

ODA promotes education, health and infrastructure of an economy and thus it is expected to have a positive impact on the long-run economic growth. However, ODA's effects may be complicated due to its various types and scales, and recipient countries' absorption capacity. While we focus on ODA as a whole, it is reasonable to hypothesize that a small amount of ODA is inefficient for a country to effectively implement long-term development schemes; while excessively large amounts of ODA might increase recipient countries' dependency on aid, and thus reduce their incentives to implement long-term development schemes.

- Public investment (measured by government's capital expenditure, % of GDP, denoted by  $pinv_{it}$ ), and its quadratic form ( $pinvsq_{it}$ ).

Public investment is composed of government revenue, aid, grants and other sources. It invests on a nation's long-run social and economic development, and hence should be an important contributor to a country's long-term economic growth.

- Volatility of aid (denoted by  $aidvol_{it}$ ; measure of volatility is explained in below):

Most sample countries have limited export diversification which limits their ability to participate better in global trades, exposing them to unfavorable terms of trade and external shocks such as changes in commodity prices. Aid for trade soothes the harmful effects of such shocks. Moreover, most of these countries are vulnerable to natural disasters, and scale-ups or draw downs in ODA are generally in response to these shocks. For instance, the ODA/GDP ratio increased from 2.6% in 2004 to 7.6% in 2005 in Maldives, from 2.5% in 2004 to 4.8% in 2005 in Sri Lanka, following a major tsunami in December 2004. Samoa and Tonga had record highs of ODA/GDP ratios over the sampled period 1996–2012, respectively ranging from 15.4% to 25.7% and 12.3% to 22.2% over 2009–2012 after they were affected by a major tsunami in 2009. Humanitarian aid to Pakistan increases significantly in years of massive floods such as 2003, 2007, 2010 and 2011.

In addition, changes in aid in some events are due to changes in political environments of recipient countries. For instance, Pakistan had record highs of ODA/GDP ratios 2.7% and 2.9% in 2001 and 2002 respectively, following the active and long-lasting conflicts since 2001. Solomon Islands is a countries with significant riots; the Regional Assistance Mission to Solomon Islands (RAMSI) was created in 2003 in response to the country's a request for international aid. The ODA/GDP ratio in Solomon Islands



increased dramatically from 7.7% in 2002 to more than 30% since 2004, as a result of combined events of natural disasters and riots. The 2008 Georgian presidential election increased Georgia's ODA/GDP ratio from 3.7% in 2007 to 6.9% and 8.4% in 2008 and 2009 respectively.

In some events aid is used to finance recipient countries' budgetary shortfalls. For instance, the ODA/GDP ratio reached historic highs (37%) in Kiribati in 2011 and 2012 after its Revenue Equalization Reserve Fund assets was affected by the global financial crisis and declined hugely in 2009.

Given the above analyses, aid volatility may not be harmful because of its countercyclical effects, that is, extra ODA eliminates the adverse effect of a shock; it may instead be beneficial to an economy if the economy has a strong absorption capacity to utilize scaled-up ODA to strengthen its shock resilience capacity. The correlation coefficient between aid volatility and GDP per capita growth uncertainty (measured by estimated residuals from the second order of autoregressive model of GDP per capita growth) is further found out as 0.32; this provides some preliminary evidence that aid volatility may not be necessarily harmful to economic growth in some cases.

However, aid volatility may not be beneficial if (1) the scaled-up amount of ODA is insufficient to restore an economy to the pre-shock level, such as the cases of Samoa in the 2009 tsunami and Maldives in the 2004 tsunami; (2) an economy does not have a system to effectively use the scaled-up ODA to build or strengthen its resilience capacity, making the additional amount of ODA received lose its cushion effects, such as the case of Tonga; (3) the recipient countries' long-term development plans are interrupted by scale-up and sudden windfall in ODA, such as the case of Bhutan and Nepal; (4) the recipient government loses incentives to implement prevention strategies if they receive considerably large amounts of ODA, such as the case of Marshall Islands and Federated States of Micronesia; and (5) countries, such as Pakistan, Papua New Guinea and Solomon Islands, are featured with riots.

- Volatility of public investment (denoted by  $pinvvol_{it}$ )

Public investment volatility on the other hand may be harmful to an economy since public investment is the fund source to plan and implement long-term development schemes while volatility directly leads to inconsistency in conducting such schemes. Public investment volatility is weakly correlated with aid volatility (correlation coefficient = 0.1242), suggesting that there is no significant overlapping between the types of shocks captured by aid volatility and those captured by public investment, and hence allowing the two types of volatility to enter a regression simultaneously.

- Volatility of government revenue (denoted by  $revvol_{it}$ )

As another major source of public investment, government revenue volatility would contribute to a large portion of public investment volatility. The correlation coefficient between public investment volatility and government revenue volatility is as high as 0.738. So the two types of volatility can only be used alternatively in regressions.

Government revenue volatility is weakly correlated with aid volatility (correlation coefficient = 0.1470), allowing the two types of volatility to enter a regression simultaneous.

Growth impact of government revenue differs from that of ODA, because government revenue mainly comes from taxes which result from domestic economic activities and hence lacks a cushion effect. And government revenue volatility results from policy changes, internal shocks such as political riots and natural disasters which affect economic output, as well as external shocks such as changes in commodity prices and financial crises which affect trade activities. However, it is worth noting that governments may initiatively adjust fiscal policies to mitigate adverse effects brought by various types of shocks. In such case, government revenue volatility may not be harmful.

The control variables considered in this study include:

- Real per capita GDP in initial years of corresponding sub-periods (in natural logarithm, constant 2005 prices, denoted by  $ly0_{,it}$ )

This variable changes with time and country. It is used to capture convergence effect. Conditional convergence is evidenced by a negative and significant coefficient on this variable.

- Financial depth measured by domestic credit to private sector (% of GDP, denoted by  $credit_{it}$ )

Financial development should have a positive impact on promoting economic growth. However, its growth impact may be affected by governments' regulations. Excessive regulations would either lead to a tight lending market or affect the financial market's efficiency, and thus hinder economic growth; meanwhile less regulated and monitored financial sector may have the asymmetric information problem, also leading to inefficiency of the financial market.

- Governance

Six measures of governance level are obtained from World Bank's World Governance Indicators, including:<sup>3</sup>

1. Voice and accountability ( $VA_{it}$ ), capturing perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.
2. Political stability and absence of violence/terrorism ( $SV_{it}$ ), capturing perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism.
3. Government effectiveness ( $GE_{it}$ ), capturing 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.

<sup>3</sup> Source: Kaufmann, Kraay and Mastruzzi (2010), "The Worldwide Governance Indicators: Methodology and Analytical Issues", the World Bank Policy Research Working Paper No.5430.



4. Regulatory quality ( $RQ_{it}$ ), capturing perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.
5. Rule of law ( $RL_{it}$ ), capturing 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 policy, and the courts, as well as the likelihood of crime and violence.
6. Control corruption ( $CC_{it}$ ), capturing 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.

These governance indicators are individually standard normal random variables with zero mean, unit standard deviation and ranging approximately from -2.5 to 2.5. Higher value of an indicator suggests a better governance level. While it is expected that better governance is generally more effective in allocating resources, not all the above governance indicators have same growth effects because of different ways they might influence an economy. Further, since countries under study are among low ranking countries with respect to governance level and there lacks noticeable differences of governance among them; governance’s growth impact in this group of countries may not be linear.

- Interactive terms between aid volatility and respective country dummies (denoted by  $aidvol_t \times Country_i$ )  
While as discussed in the above that aid volatility may not be harmful to some countries which need cushions when experiencing shocks; aid volatility may be harmful to countries which lack absorption capacity. Furthermore, aid’s cushion effect may work better in countries suffering from natural disasters while it may not work in countries with a lot of riots.
- Country- and time-specific dummy variables (dumit)  
It is worth noting that different countries may suffer from different types of shocks, and a same shock like the global financial crisis may have different effects on different countries. A series of dummy variables are therefore further used to address country specific impacts of internal shocks (political instability and natural disasters) and external shocks (commodity price changes and financial crises). These dummy variables are artificially generated based on authors’ observation of regression residuals from the second order autoregressive process with time trend of growth of real GDP per capita,  $gy_{it} = \eta_0 + \eta_1 gy_{it} + \eta_2 gy_{it} + \eta_3 time_t + \omega_{it}$ . These dummies are hence country- and time-specific variables. Three dummies that enter regressions are summarized in Table 3.

Constrained by the quality of data, series such as private investment, foreign direct investment, and education are not included in the current analysis.

With regards to methodology, a significant concern in the aid-growth literature is the possibility of biased estimates attributable to the potential endogeneity of aid with respect to growth, because the recipient country’s economic growth may affect donors’

decision on the amount of aid. Such correlation could be negative (see for instance, Hepp, 2008), or positive (see for instance, Rajan and Subramanian, 2008). Similarly, public investment and financial depth may also be endogenous in the above model since they can be determined by economic growth. Another concern in the estimation is addressing country specific heterogeneous effects, ignorance of which would lead to omitted variable bias. The solution to the above problems in the current study is the adoption of the fixed effects instrumental variables estimator (FEIV) and the general method of moments (GMM), which produce consistent estimates in large samples. Furthermore, to address the possibility of country-wise heteroskedasticity, we use a balanced panel with robust panel corrected standard errors in estimating the above equation. And error autocorrelation is addressed by the employment of a first order autoregressive process.

#### 4. Data and Descriptive Statistics

This study considers a homogenous sample covering 24 countries in the Asia-Pacific region over the period 1996-2012. The sample period is constrained by the availability of data on public investment, and the choice of sample countries are made based on consistently aid-dependent developing and least developed countries in this region. Among all countries, ten are from the Pacific region, including Fiji, Kiribati, Marshall Islands, Federated States of Micronesia, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu; and the rest are Asian countries including Armenia, Bangladesh, Bhutan, Cambodia, Georgia, Kyrgyz Republic, Lao PDR, Maldives, Mongolia, Nepal, Pakistan, Sri Lanka, Tajikistan, and Vietnam. Note that, due to the lack of data on private credit, three Pacific Island countries (Kiribati, Marshall Islands and Tuvalu) are excluded in some regressions. The homogeneity of the sampled Asia-Pacific countries is not rejected by the Chow test for parameter stability with the F stat being 0.4820, which is calculated based on the final model specification using three sets of sampled countries, namely all 24 countries, 10 Pacific Island countries, and 14 Asian countries.

Due to the feature of the aid volatility model as shown in Equation (1) as well to use as many time points as possible, the whole sample period is divided into six sub-periods: sub-period one covers only 2 years 1996-1997, sub-periods two to six each covers 3 years in sequence of 1998-2000, 2001-2003, 2004-2006, 2007-2009, and 2010-2012.

For each sub-period, the starting year of each sub-period is taken as  $ly0_{it}$ ; and rolling averages are calculated for variables  $gy_{it}$ ,  $aid_{it}$ ,  $aidsq_{it}$ ,  $aidcub_{it}$ ,  $pinv_{it}$ ,  $pinvsq_{it}$ ,  $credit_{it}$  and governance indicators. Volatility of aid,  $aidvol_{it}$ , is obtained in the following three steps:

1. Divide normalized aid (each year's aid volume divided by country specific average aid volume received over the sampled period 1996–2012, multiplied by 100) by normalized GDP (each year's GDP divided by country specific average of GDP over 1996–2012, multiplied by 100). This is to remove the need to standardize aid by the use of some denominator, thus contaminating the volatility of aid with that of the denominator and any covariance between numerator and denominator (Hudson and Mosley, 2008, p2098).
2. Use the Hodrick-Prescott filter to separate the trend and cyclical components of aid. Separation of the cyclical component from trend component is widely used in studies

such as Hudson and Mosley (2008), Bulir and Hamann (2008), Chauvet and Guillaumont (2009), Kathavate and Mallik (2012), and Hudson (2014).<sup>4</sup>

3. Take rolling standard deviation of the cyclical component over each sub-period. Such method is seen in most volatility studies.

The same procedure is applied to calculated public investment volatility ( $pinvol_{it}$ ), government revenue volatility ( $revvol_{it}$ ), and volatility of real GDP per capita growth to capture shocks ( $gyvol_{it}$ ).

Multiple data sources are used to compile the dataset. Data on GDP per capita growth, GDP per capita, net official development assistance received, and domestic credit to private sector are obtained from *World Bank's World Development Indicators 2014*; central government's capital investment and government revenue (excluding grants) come from *the Asian Development Bank's Key Indicators for Asia and the Pacific 2013*; and regulatory quality and control of corruption (together with other institution indices) is obtained from *World Bank's World Governance Indicators 2013*. Descriptive statistics by sub-period and by country are summarized in Tables 1a and 1b.

As shown by the summary statistics, there are certain degrees of heterogeneity among the sampled countries with respect to population size, income level, economic growth, ODA received, public investment, government revenue (excluding grants) and private credit. However, there are no distinguished differences among these countries with respect to governance quality.

While the Pacific Island countries are generally small, the smallest countries in the current sample are Tuvalu, Marshall Islands and Kiribati; and the largest countries include Papua New Guinea, Fiji and Solomon Islands. The smallest Asian countries in the current sample are Bhutan and Maldives; and Pakistan and Bangladesh are two largest countries in the whole sample.

The lowest real GDP per capita among all sampled countries over the sampled period is seen in Asian countries such as Bangladesh, Cambodia, Kyrgyz Republic, Lao PDR, Nepal, Tajikistan, Vietnam and Pakistan, while the highest real GDP per capita is seen in another Asian country, Maldives. Pacific Island countries have less income disparity with Papua New Guinea, Solomon Islands and Kiribati having the lowest income and Fiji having the highest income among the small Pacific economies. Over the sampled period 1996-2012, economic recession was evident in three Pacific Island countries, namely Solomon Islands, Marshall Islands and Federated States of Micronesia, while the rest Pacific Island countries also suffer from stagnant economic growth.

With respect to ODA/GDP ratios, countries such as Pakistan, Fiji, Bangladesh, Sri Lanka, Vietnam and Maldives are marked as low aid recipients whose average ODA/GDP ratios are less than 5%, while many Pacific Islands countries including Tuvalu, Marshall Islands, Federated States of Micronesia, Solomon Islands and Kiribati are marked as high aid recipients. Aid volatility is demonstrated in Figures 1a and 1b, from which we see countries receiving relatively high ODA(% of GDP) generally have higher level of variation

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<sup>4</sup> Hudson (2014), due to relatively few data points in his sample, regresses aid on a time trend and its square to calculate the trend, and takes squared deviations from this trend as volatility.

Table 1a. Summary statistics by period and country: Asian countries

Country	Year	Average population (thousand persons)	Average GDP per capita (constant 2005 US\$)	Average GDP per capita growth (%)	Average ODA-to-GDP ratio (%)	Average investment-to-GDP ratio (%)	Average government revenue-to-GDP ratio (%)	Average private credit (% of GDP)	Average government effectiveness	Average regulatory quality	Average rule of law
Armenia	1996–2000	3,118.8	802	6.10	12.59	2.69	15.11	7.55	-0.50	-0.21	-0.44
	2001–2006	3,031.1	1,381	12.85	7.60	3.60	15.57	7.32	-0.22	0.10	-0.41
	2007–2012	2,972.0	2,109	3.65	3.81	5.14	21.72	27.39	-0.14	0.30	-0.42
Bangladesh	1996–2000	127,435.0	327	3.10	2.65	6.47	9.21	23.17	-0.58	-0.95	-0.95
	2001–2006	140,026.8	398	4.05	2.24	6.13	10.11	31.70	-0.74	-1.00	-0.95
	2007–2012	150,435.6	530	5.05	1.80	4.00	9.72	43.88	-0.76	-0.87	-0.80
Bhutan	1996–2000	536.1	916	4.15	16.16	19.04	19.96	8.87	0.65	-0.42	0.14
	2001–2006	624.3	1,185	4.80	12.05	19.33	18.07	15.12	0.37	-0.46	0.24
	2007–2012	710.7	1,735	7.10	8.15	17.13	23.14	36.79	0.43	-1.03	0.23
Cambodia	1996–2000	11,671.0	293	4.35	10.33	5.42	8.86	5.73	-0.95	-0.13	-1.09
	2001–2006	13,029.5	419	7.70	9.65	6.44	10.43	8.25	-0.90	-0.43	-1.17
	2007–2012	14,277.9	607	4.60	6.73	8.48	13.14	26.80	-0.89	-0.46	-1.06
Georgia	1996–2000	4,501.2	941	8.40	7.56	1.43	14.65	6.03	-0.68	-0.65	-1.37
	2001–2006	4,358.3	1,319	7.75	6.56	3.46	21.38	11.28	-0.55	-0.53	-0.86
	2007–2012	4,435.0	1,882	4.65	5.45	7.88	29.69	31.79	0.35	0.54	-0.20
Kyrgyz Republic	1996–2000	4,766.5	392	4.60	15.36	1.74	15.98	5.35	-0.34	-0.15	-0.79
	2001–2006	5,077.5	461	2.60	11.33	2.02	18.87	6.38	-0.71	-0.42	-0.93
	2007–2012	5,423.4	563	2.95	7.41	3.63	24.14	15.05	-0.73	-0.32	-1.27
Lao PDR	1996–2000	5,194.1	347	4.15	18.78	10.60	10.78	10.40	-0.70	-1.24	-0.93
	2001–2006	5,670.0	442	5.05	12.92	10.07	12.03	7.49	-1.02	-1.36	-1.09
	2007–2012	6,330.5	614	5.85	6.76	9.70	15.01	13.53	-0.89	-1.03	-0.91
Maldives	1996–2000	261.8	2,174	8.85	5.22	13.01	21.06	17.57	0.73	0.85	0.36
	2001–2006	290.2	3,367	8.75	3.67	9.01	21.29	29.99	0.11	0.44	0.15
	2007–2012	323.0	4,627	3.75	2.84	9.95	21.19	59.88	-0.24	-0.33	-0.30
Mongolia	1996–2000	2,356.3	746	1.90	18.74	3.43	23.17	7.50	-0.34	-0.14	-0.05
	2001–2006	2,485.6	912	5.70	12.53	4.23	30.34	21.51	-0.33	-0.30	-0.06
	2007–2012	2,693.9	1,334	7.45	5.23	8.67	34.94	44.18	-0.58	-0.25	-0.36

Country	Year	Average population (thousand persons)	Average GDP per capita (constant 2005 US\$)	Average GDP per capita growth (%)	Average GDP	Average ODA-to-GDP ratio (%)	Average public investment-to-GDP ratio (%)	Average government revenue-to-GDP ratio (%)	Average private credit (% of GDP)	Average government effectiveness	Average regulatory quality	Average rule of law
Nepal	1996-2000	22,162.5	283	2.40	7.89	8.61	10.26	27.06	-0.55	-0.51	-0.22	
	2001-2006	24,688.6	313	1.65	6.07	5.75	11.28	27.90	-0.66	-0.52	-0.64	
	2007-2012	26,703.5	368	3.35	5.31	5.27	14.24	51.96	-0.85	-0.69	-0.84	
Pakistan	1996-2000	137,046.6	586	0.60	1.41	3.93	17.38	24.45	-0.54	-0.54	-0.78	
	2001-2006	153,833.2	649	3.30	1.91	3.29	13.86	25.38	-0.42	-0.71	-0.82	
	2007-2012	171,584.4	752	1.10	1.38	3.91	14.13	22.62	-0.72	-0.60	-0.88	
Sri Lanka	1996-2000	18,769.2	968	3.95	2.43	5.08	17.77	29.23	-0.36	0.20	0.14	
	2001-2006	19,304.7	1,171	3.90	2.96	4.62	15.70	30.36	-0.23	-0.02	0.23	
	2007-2012	20,426.0	1,599	6.10	1.40	5.54	14.73	29.17	-0.14	-0.22	-0.04	
Tajikistan	1996-2000	6,018.7	216	-2.20	11.10	2.02	12.98	14.81	-1.41	-1.37	-1.60	
	2001-2006	6,607.9	309	7.25	11.71	4.28	17.36	13.31	-1.12	-1.16	-1.13	
	2007-2012	7,547.5	414	4.35	6.34	8.54	19.89	14.38	-0.99	-1.04	-1.21	
Vietnam	1996-2000	75,429.5	487	5.60	4.27	6.30	20.21	23.90	-0.43	-0.63	-0.37	
	2001-2006	80,962.1	643	5.65	3.57	8.79	24.72	50.14	-0.36	-0.62	-0.44	
	2007-2012	86,485.6	882	4.90	2.86	7.96	25.42	97.20	-0.24	-0.61	—	

Table 1b. Summary statistics by period and country: Pacific Island countries

Country	Year	Average population (thousand persons)	Average GDP per capita (constant 2005 US\$)	Average GDP per capita growth (%)	Average GDP	Average ODA-to-GDP ratio (%)	Average public investment-to-GDP ratio (%)	Average government revenue-to-GDP ratio (%)	Average private credit (% of GDP)	Average government effectiveness	Average regulatory quality	Average rule of law
Fiji	1996-2000	799.4	3214	1.10	2.04	6.10	27.14	31.97	-0.32	-0.24	-0.01	
	2001-2006	819.6	3543	2.00	2.01	4.82	24.76	58.95	-0.18	-0.35	-0.19	
	2007-2012	855.8	3585	-0.40	2.05	5.70	26.15	80.39	-0.75	-0.65	-0.73	

(Contd.)

Country	Year	Average population (thousand persons)	Average GDP per capita (constant 2005 US\$)	Average GDP per capita growth (%)	Average ODA-to-GDP ratio (%)	Average public investment-to-GDP ratio (%)	Average government revenue-to-GDP ratio (%)	Average private credit (% of GDP)	Average government effectiveness	Average regulatory quality	Average rule of law
Kiribati	1996–2000	80.1	1078	4.70	24.04	17.32	101.19		-0.49	-1.01	0.50
	2001–2006	88.1	1162	-1.10	23.01	34.97	82.91		-0.49	-0.90	0.60
	2007–2012	97.0	1158	0.85	25.45	10.86	68.73		-0.78	-1.28	0.28
Marshall Islands	1996–2000	51.9	2376	-4.55	57.24	6.86	26.05		-0.55	-0.79	-0.18
	2001–2006	52.1	2590	2.10	46.30	10.83	21.37		-1.03	-0.71	-0.02
	2007–2012	52.4	2785	1.40	42.66	9.11	20.57		-1.42	-0.93	-0.02
Micronesia, Fed. Sts.	1996–2000	108.1	2150	-0.85	45.97	13.24	24.11	29.64	-0.49	-0.84	0.46
	2001–2006	106.6	2332	0.75	45.43	7.23	20.63	20.82	-0.59	-0.24	0.30
	2007–2012	104.0	2360	0.60	40.92	15.43	21.25	20.35	-0.74	-0.78	0.17
Papua New Guinea	1996–2000	5,107.3	918	-2.35	7.53	4.83	25.28	17.15	-0.41	-0.53	-0.75
	2001–2006	5,878.8	802	-0.70	6.16	11.61	25.36	15.10	-0.64	-0.73	-1.05
	2007–2012	6,782.0	947	5.00	4.78	14.18	27.90	28.32	-0.73	-0.58	-0.92
Samoa	1996–2000	173.0	1724	3.40	12.37	13.20	27.47	25.41	0.34	-0.09	0.84
	2001–2006	178.3	2160	3.90	12.09	10.12	23.73	35.76	0.29	-0.02	0.97
	2007–2012	185.5	2342	0.30	14.82	8.60	26.62	45.08	0.06	-0.27	0.73
Solomon Islands	1996–2000	390.7	1141	-4.80	9.22	2.39	26.53	14.32	-0.86	-1.23	0.15
	2001–2006	452.1	860	-0.40	27.56	5.17	22.37	20.22	-1.45	-1.59	-1.09
	2007–2012	520.8	1015	3.20	39.63	7.84	36.62	28.18	-0.98	-1.15	-0.71
Tonga	1996–2000	97.0	2274	1.20	12.53	3.35	22.06	39.84	-0.35	-1.09	0.42
	2001–2006	100.0	2553	1.20	10.90	0.85	22.62	45.07	-0.66	-0.89	0.26
	2007–2012	103.7	2548	0.65	14.64	3.42	21.38	42.57	-0.37	-0.66	0.11
Tuvalu	1996–2000	9.3	2198	2.75	60.73	48.66	147.26	0.63	0.63	0.43	0.97
	2001–2006	9.6	2353	0.00	54.68	17.68	79.26	-0.36	-0.36	-0.09	1.21
	2007–2012	9.8	2535	2.40	60.50	11.50	55.35	-0.60	-0.60	-1.12	0.84
Vanuatu	1996–2000	178.3	1970	1.60	13.54	3.33	21.12	34.28	-0.51	-0.52	-0.22
	2001–2006	201.7	1875	-0.25	10.83	1.00	17.98	39.15	-0.65	-0.61	0.16
	2007–2012	233.6	2112	0.85	13.80	3.01	19.06	60.36	-0.32	-0.69	0.37

Data sources: Asian Development Bank's Key Indicators for Asia and the Pacific 2013, World Bank's World Development Indicators 2014, World Governance Indicators 2013, and authors' calculation.



of ODA/GDP ratios; these countries include Tuvalu, Marshall Islands, Federated States of Micronesia, Solomon Islands, Kiribati, Samoa, Lao PDR, and Mongolia. The coefficient of correlation between country specific average ODA/GDP ratios and standard deviation of ODA/GDP ratios is as high as 0.83. In most countries the ODA/GDP ratio generally trends down over the period 1996–2012, with a few exceptions in the Pacific Island countries such as Kiribati, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu. Yet, the non-downward trends of the ODA/GDP ratio in these countries could be due to their low resilience to climate changes or political instability (the latter as the case for Solomon Islands). Meanwhile, fluctuations in this ratio across countries also capture internal and external shocks that individual countries experienced, as those discussed in Section 3.

Public investment is extremely important in many least developed countries and some developing countries because it composes the major part of total investment in these countries. Among the sampled countries, the public investment-to-GDP ratio is highest in Tuvalu (25.94%), Kiribati (21.05%) and Bhutan (18.50%) while it is lowest in Vanuatu (2.45%), Kyrgyz Republic (2.46%) and Tonga (2.54%). The contribution of ODA towards public investment is evidenced from the strong correlation between ODA/GDP ratio and public investment-to-GDP ratio, with the coefficient of correlation being 0.59 for the whole sample. Such strong correlation is more evident among the Pacific Island countries (coefficient being 0.60) while less evident among the Asian countries (coefficient being 0.29).

In most countries government revenue is the major contributor to public investment, which is particularly true in small countries where the money economy is dominated by government activities. Tuvalu (93.96%) and Kiribati (84.28%) record the highest government revenue-to-GDP ratios among all sampled countries over the sampled period, due to the significance of fishing license sales and trust funds (the Tuvalu Trust Fund and Kiribati's Revenue Equalization Reserve Fund). The average government revenue-to-GDP ratio ranges between 9.68% (Bangladesh) to 29.48% (Mongolia) among the rest countries. Government revenue and public investment are highly correlated with the coefficient of correlation being 0.91; however, such correlation is very weak amongst the Asian countries with the coefficient of correlation being 0.08.

As mentioned in the above context that the sampled countries are among the low governance countries and that there are no distinguished differences among these countries with respect to governance quality. Taking regulatory quality as the example, except Bhutan, Maldives and Samoa, the rest sampled countries have negative regulatory quality indices on average over the whole sample period. It is also worth noting that many countries' regulatory quality declined over the period 2007–2012; these countries include Bangladesh, Kyrgyz Republic, Maldives, Mongolia, Nepal, Pakistan and Pacific Island countries except Solomon Islands, Tonga and Vanuatu. However, it should be noted that deterioration in regulatory quality in these countries is not directly associated with the global financial crisis; instead it could be due to other shocks such as changes in policies and political instability.

Coefficients of correlation between pair wise regressors are summarized in Table 2.

**Table 2.** Pair-wise correlation coefficients between regressors

	$ly0_{it}$	$aid_{it}$	$pinv_{it}$	$aidvol_{it}$	$pinvvol_{it}$	$revvol_{it}$	$credit_{it}$	$RQ_{it}$
$ly0_{it}$	1							
$aid_{it}$	0.3236	1						
$pinv_{it}$	0.162	0.3574	1					
$aidvol_{it}$	-0.3174	-0.209	-0.1506	1				
$pinvvol_{it}$	-0.1013	0.2994	0.1262	0.1242	1			
$revvol_{it}$	-0.194	0.4265	0.2279	0.147	0.738	1		
$credit_{it}$	0.4325	-0.2263	-0.0571	-0.3913	-0.3201	-0.4676	1	
$RQ_{it}$	0.3676	-0.2179	-0.0219	-0.0031	-0.054	-0.0524	0.0082	1

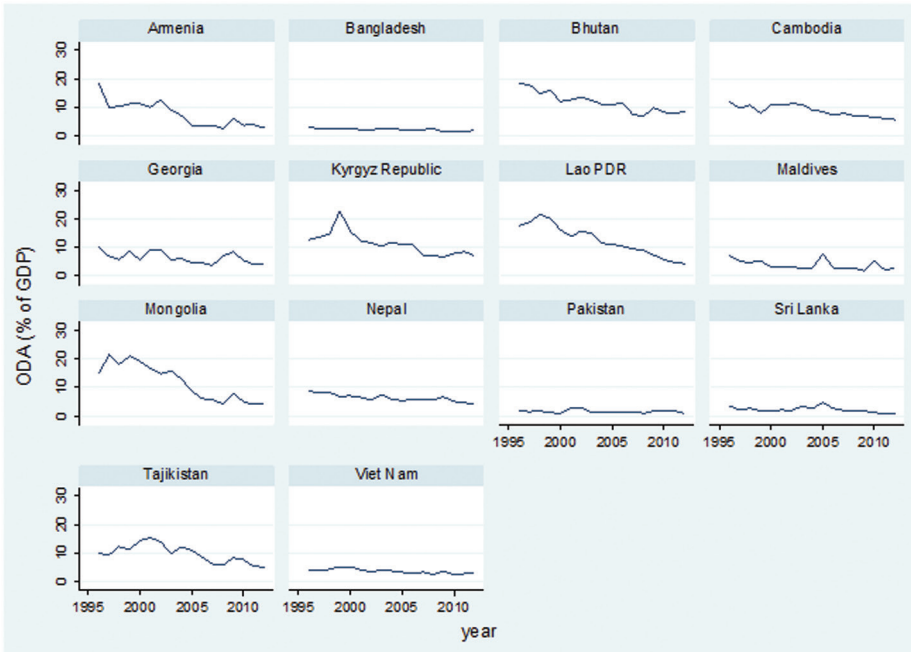
Note: Correlation between credit and regulatory and the other regressors are based on 104 observations, while the rest correlation coefficients are calculated based on 120 observations.

**Table 3.** List of shocks as captured by  $dum1_{it}$ ,  $dum2_{it}$ , and  $dum3_{it}$ 

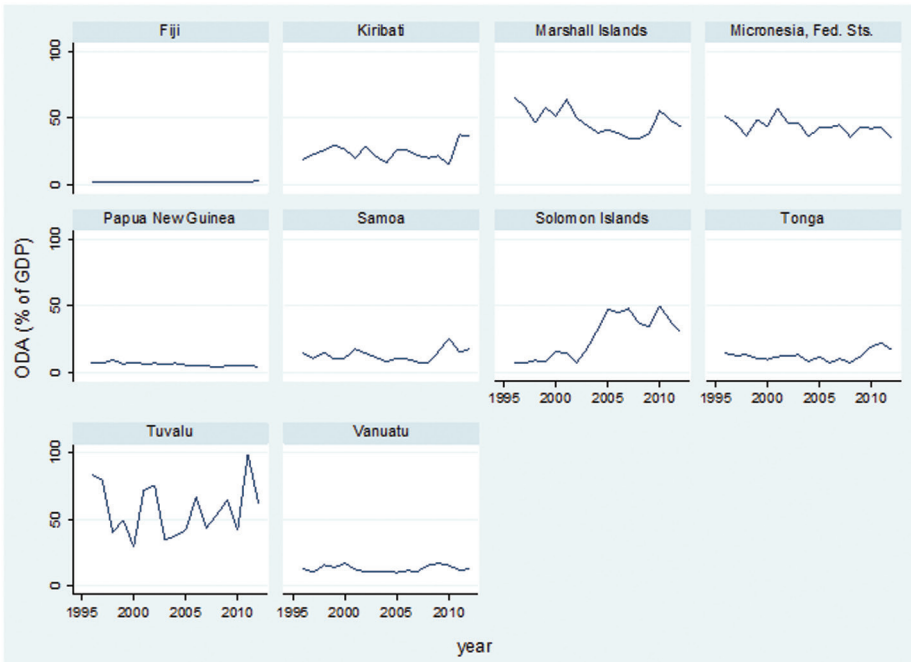
Dummy	Country	Sub-period	Country	Sub-period	Country	Sub-period
$dum1_{it}$	Tuvalu	1998–2000				
$dum2_{it}$	Bangladesh	1998–2000	Marshall Islands	1998–2000	Solomon Islands	1998–2000
	Bangladesh	2001–2003	Marshall Islands	2001–2003	Solomon Islands	2001–2003
	Bhutan	1998–2000	Nepal	1998–2000	Sri Lanka	1998–2000
	Bhutan	2001–2003	Nepal	2001–2003	Sri Lanka	2001–2003
	Bhutan	2004–2006	Nepal	2004–2006	Viet Nam	1998–2000
	Lao PDR	1998–2000	Pakistan	1998–2000	Viet Nam	2001–2003
	Lao PDR	2001–2003	Pakistan	2001–2003	Viet Nam	2004–2006
	Lao PDR	2010–2012	Papua New Guinea	2001–2003		
$dum3_{it}$	Micronesia, Fed. Sts.	1998–2000	Papua New Guinea	2004–2006		
	Armenia	2001–2003	Kiribati	2004–2006	Tuvalu	1998–2000
	Armenia	2004–2006	Kiribati	2010–2012	Tuvalu	2001–2003
	Georgia	1998–2000	Mongolia	2010–2012	Tuvalu	2004–2006
	Georgia	2001–2003	Solomon Islands	2010–2012	Tuvalu	2007–2009
	Georgia	2004–2006	Tajikistan	2001–2003	Tuvalu	2010–2012
	Georgia	2007–2009	Tonga	2007–2009	Vanuatu	2007–2009
	Georgia	2010–2012	Tonga	2010–2012		

## 5. Empirical Results

The FEIV estimator and GMM estimator yield very similar regression results, and we only report results from the GMM estimator to conserve space. The first order autoregressive process is employed to address autocorrelation and statistics are robust to



**Figure 1a.** Net ODA received (% of GDP) by country: Asian countries



**Figure 1b.** Net ODA received (% of GDP) by country: Pacific Island countries

heteroskedasticity. The Hansen J Chi-squares statistics to test for over identification of all instruments and Hausman Chi-squares statistics to test for endogeneity of endogenous regressors are conducted based on the final regression model as shown in the last column of Table 5. Instruments used in all tests include each sub-period's initial income level ( $ly0_{it}$ ), rule of law ( $RL_{it}$ ), volatility of real GDP per capita growth to capture shocks ( $gyvol_{it}$ ), and country- and time-specific dummy variables ( $dum_{it}$ ) as described in Section 3. Test statistics reported in Table 4.

It is evidenced that only the lagged dependent variable  $gy_{i,t-1}$  is endogenous in the first order autoregressive process of Equation (1), the rest regressors are exogenous with the application of valid instruments. This is within expectation. For instance, as discussed in the above, aid, aid volatility, public investment, public investment volatility, and government revenue volatility are often in response to shocks; public investment and domestic credit; private credit in very small economies is not significant and may not necessarily be influenced by small economies' economic growth; while governance, indexed by regulatory quality due to its role in promoting the private sector's economic activities, is more subject to governments' behavior than economic growth.

**Table 4.** Test for over identification of instruments and endogeneity of endogenous regressors

Endogenous regressors	Hansen J Chi <sup>2</sup> (p-value)	Hausman Chi <sup>2</sup> (p-value)
$gy_{i,t-1}$	0.083 (0.7729)	16.886 (0.0000)
$aid_{it}, aidsq_{it}, aidcub_{it}$	1.440 (0.2301)	3.285 (0.3497)
$pinv_{it}, pinvsq_{it}$	5.958 (0.1137)	0.449 (0.5028)
$aidvol_{it}$	5.796 (0.1220)	0.013 (0.9105)
$pinvol_{it}$	5.215 (0.1567)	0.541 (0.4620)
$revvol_{it}$	3.685 (0.2976)	1.592 (0.2071)
$credit_{it}$	2.613 (0.4553)	2.332 (0.1272)
$RQsq_{it}$	4.150 (0.2457)	1.752 (0.1857)
$credit_{it} \times RQ_{it}$	3.422 (0.3311)	1.400 (0.2367)

The GMM estimation is constrained to the use of small samples (120 observations in total for regressions excluding private credit, 104 observations in total when private credit is included in the last regression); hence  $t$ -statistics rather than  $z$ -statistics are reported. Regression results are summarized in Table 5.

Before proceeding to the interpretation of empirical findings, one significant observation from regression experiments needs to be pointed out: ssinteractive terms between aid volatility and country-specific time-invariant fixed effects are important in stabilizing the overall performance of regressions. This in turn suggests the significant influences of different types of shocks on different countries under study, in particular, countries vulnerable to external shocks, natural disasters and riots.

Our discussion of findings starts with the control variables' performance. The coefficients of initial GDP per capita are negative (ranging from -5.168 to -7.646) and highly significant for at the 1% significance level in all regressions. This provides a strong statistical evidence of conditional convergence, suggesting that least developed and

**Table 5.** Growth impacts of aid, public investment and government revenue volatility on growth in Asia and the Pacific

Explanatory variables	Dependent variable: GDP per capita growth $gy_{i,t}$					
	(1)	(2)	(3)	(4)	(5)	(6)
	Coeff.	(t stat)	Coeff.	(t stat)	Coeff.	(t stat)
$gy_{i,t-1}$	0.298	(1.90)*	0.236	(1.88)*	0.303	(2.28)**
$ly0_{i,t}$	-5.168	(-2.00)**	-6.437	(-3.18)***	-6.486	(-2.97)***
$aid_{i,t}$	-0.801	(-2.60)***	-0.883	(-3.73)***	-1.473	(-3.78)***
$aidsq_{i,t}$	0.029	(3.02)***	0.032	(4.53)***	0.065	(3.93)***
$aideub_{i,t}$	-0.0002	(-2.87)***	-0.0003	(-4.73)***	-0.0007	(-3.55)***
$pinv_{i,t}$			0.537	(4.21)***	0.542	(4.53)***
$pinvsq_{i,t}$			-0.015	(-4.49)***	-0.016	(-5.33)***
$aidvol_{i,t}$			1.914	(2.50)***	2.404	(2.88)***
$pinvol_{i,t}$			-1.102	(-0.19)	-0.9369	(-1.68)*
$revvol_{i,t}$					2.075	(1.61)*
$credit_{i,t}$					0.027	(0.90)
$credit_{i,t} \times RQ_{i,t}$					0.103	(2.64)***
$RQsq_{i,t}$					1.413	(1.90)**
$aidvol_{i,t} \times Marshall$	-0.496	(-0.31)	-2.871	(-1.83)*	-4.577	(-2.20)**
$aidvol_{i,t} \times Kiribati$	-3.628	(-0.71)	-5.619	(-1.29)	-7.632	(-2.95)***
$aidvol_{i,t} \times Samoa$	-1.246	(-0.79)	-2.671	(-1.68)*	-2.720	(-1.74)*
$aidvol_{i,t} \times Bhutan$	-2.983	(-1.19)	-6.076	(-2.36)**	-5.115	(-2.19)**
$aidvol_{i,t} \times PNG$	-29.066	(-2.32)**	-26.620	(-2.60)***	-31.950	(-3.24)***
$aidvol_{i,t} \times Tonga$	-2.395	(-1.46)	-4.846	(-2.16)**	-6.163	(-4.21)***
					0.302	(1.93)*
					-7.646	(-2.84)***
					-1.075	(-2.23)**
					0.045	(2.25)**
					-0.0005	(-2.16)**
					0.011	(2.40)**
					4.104	(3.60)***
					4.667	(1.66)*
					0.072	(1.58)
					0.123	(2.76)***
					1.106	(1.26)
					-3.657	(-2.13)**
					-11.730	(-3.29)***
					-27.279	(-2.16)**
					-9.233	(-4.21)***

Explanatory variables	(1)		(2)		(3)		(4)		(5)		(6)	
	Coeff.	(t stat)	Coeff.	(t stat)	Coeff.	(t stat)	Coeff.	(t stat)	Coeff.	(t stat)	Coeff.	(t stat)
$aidvol_{it} \times Vanuatu$	-1.015	(-0.27)	-2.00	(-0.59)	-1.460	(-0.26)	-5.847	(-1.01)	-0.663	(-0.13)		
$aidvol_{it} \times Maldives$	-1.122	(-0.29)	-4.324	(-1.18)	-3.894	(-1.07)	-7.543	(-2.23)**	-9.386	(-2.10)**		
$aidvol_{it} \times Nepal$	-0.780	(-0.35)	-1.281	(-0.62)	-7.426	(-2.13)**	-4.744	(-1.34)	-1.531	(-0.33)		
$aidvol_{it} \times Pakistan$	-2.100	(-1.00)	-2.396	(-1.28)	-2.462	(-1.23)	-1.505	(-0.71)	-1.469	(-0.44)		
$aidvol_{it} \times Tajikistan$	5.912	(2.60)***	10.475	(6.91)***	-4.265	(-2.24)**	-4.248	(-2.33)**	-6.030	(-2.83)***		
$dum1_{it}$	-1.520	(-1.63)*	-1.966	(-2.75)***	9.717	(5.73)***	9.512	(6.31)***	-1.707	(-2.75)***		
$dum2_{it}$	3.044	(2.11)**	3.613	(3.92)***	-1.543	(-2.55)***	-1.505	(-2.43)***	4.753	(5.61)***		
$dum3_{it}$					3.587	(4.28)***	3.643	(4.45)***	4.621	(4.44)***		
# of countries	24		24		24		24		21a		21a	
# of sub-periods	5		5		5		5		5a		5a	
# of observations	120		120		120		120		104a		104a	
Centered $R^2$	0.3309		0.4743		0.5095		0.5259		0.5491		0.5566	
Root mean error <sup>2</sup>	2.28		1.81		1.749		1.719		1.707		1.991	

**Note:**

In total, five country- and time-specific dummies are generated based on residuals from the second order autoregressive process with time trend of growth of real GDP per capita. Refer to the description in Section 3. Some dummies are dropped from corresponding regressions due to their respective exact collinearity with some included regressors. This is automatically detected by the statistics software. At maximum three dummies of this type are significant in the regressions; and the rest are used as instruments to correct for endogeneity bias.

\*, \*\*, \*\*\* respectively represent significance at the 1%, 5% and 10% levels.

a In the last regression where private credit is included in estimation, the number of countries is reduced from 24 to 21 due to the lack of private credit data for Kiribati, Marshall Islands and Tuvalu. And private credit data is also missing for Kyrgyz Republic's last sub-period 2010-2012.



developing countries consistently receiving significant amount of ODA in Asia and the Pacific tend to converge toward a steady-state path at a fast speed.

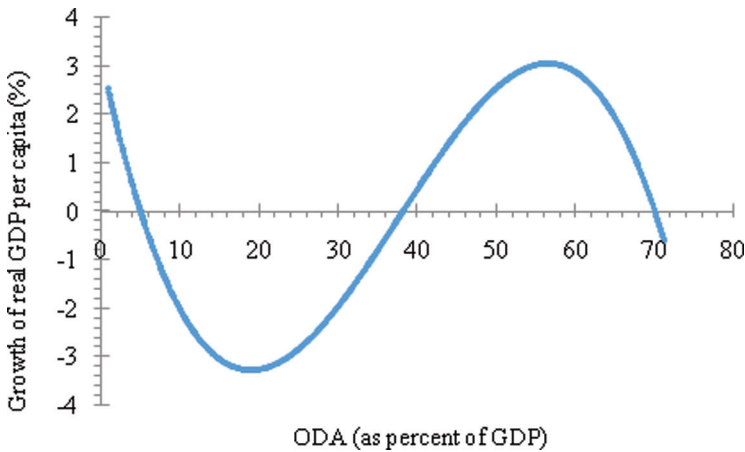
Private credit generally has a positive growth impact, which however should be accompanied with a better quality of governance. In the current study, regulatory quality ( $RQ$ ) is used to proxy governance due to its role in promoting the private sector's economic activities. Private credit itself does have a positive growth effect, but such effect is not statistically significant. Similarly, growth impact of  $RQ$  itself is positive but not statistically significant. And only the interactive term  $credit_{it} \times RQ_{it}$  has a positive impact though with weak significance at the 10% significance level. See Column (6). This to some extent is consistent with the fact that the financial development in most least developed and developing countries under study is under-developed, and that the financial sector is generally heavily regulated by governments.

ODA's growth impacts turn out complicated and such complicated effects are consistently evidenced in all model specifications. ODA-to-GDP ratio has a negative impact on economic growth; the coefficients are highly significant across all regressions, with the magnitude ranging between -1.075 and -0.771. However, such negative impact is subject to an increasing marginal returns effect, as evidenced by the squared ODA-to-GDP ratio which has a highly significant and positive coefficient ranging between 0.026 and 0.045 across regressions. And such increasing marginal returns start to decline once the ODA-to-GDP ratio reaches a certain high level. Based on the coefficients on  $aid_{it}$ ,  $aidsq_{it}$ , and  $aidcub_{it}$  in Column (4), two turning points are found as 19% and 56% respectively. This suggests that within this particular group of countries, ODA is insufficient for a recipient country to effectively implement long-term development schemes the ODA-to-GDP ratio is less than 19%; ODA's growth-promoting effect is evident if the ODA-to-GDP ratio is more than 19% but no higher than 56%; and excessively large ODA would reduce recipients' incentives to implement long-term schemes if the ratio is higher than 56%. The simulated effects of ODA on economic growth are demonstrated in Figure 2.

Public investment has a significant and positive impact on economic growth, which is subject to diminishing marginal returns. Such pattern is consistently evidenced in specifications without private credit. With the inclusion of private credit in the regression, as shown in Columns (5) and (6), public investment's positive but diminishing marginal returns effects turn into a pure positive quadratic function. This seems to suggest certain level of interaction between public investment and private credit.

Turning to analyses on growth impacts of volatility of various types, aid volatility has a consistent, significant and positive effect on growth of countries under study (Columns (3)-(6)). This suggests that ODA to these countries is countercyclical. However, it should also be noted that ODA's countercyclical effects are not experienced by some vulnerable or politically instable countries including Marshall Islands, Kiribati, Samoa, Bhutan, Papua New Guinea, Tonga, Vanuatu, Maldives, Nepal, Pakistan and Tajikistan (see all columns).

Public investment volatility proves non-beneficial to an economy. Its harmful is quantitative evident when private credit is included in the regression model though with weak statistical significance (Column (5)). This suggests that variation in public investment affects the continuity of least developed and developing countries' development schemes.



**Figure 2.** Simulated growth impacts of ODA in least developed and developing countries in Asia and the Pacific

The last, but not least, type of volatility, namely government revenue volatility, proves beneficial to these countries' economic growth. See Columns (3) and (5). This, together with the exogeneity of government revenue volatility, seems to confirm our hypothesis that governments of these countries actively adjust their fiscal policies according to changes in social and economic situations.

## 6. Conclusion

The main objective of this paper is to evaluate the relationship between aid volatility and economic growth in least developed and developing countries in Asia and the Pacific over the period 1996-2012. Empirical results indicate that aid's growth impact is not linear. Aid's negative impacts are evidenced if the ODA-to-GDP ratio is below a level of 19%; aid's impact is significantly positive if the ratio is between 19% and 56%; and its impact turns negative if the ratio is higher than 56%. Given that countries under study face major constraints in raising appropriate level of domestic revenue and in attracting foreign direct investment, these countries need significant amount of foreign aid flow for it to have any positive impact. Moreover, diminishing return to aid demonstrates limited absorptive capacities within recipient countries. A key implication is to provide sufficient but not too much aid, unless absorptive capacities can be quickly increased.

We further find that aid volatility has a positive impact on growth. This means that aid to most of the Asia-Pacific countries is countercyclical and it has played meaningful role in assisting countries to cope with large negative shocks such as natural disaster and export shocks.

In addition, we find that aid impact on growth could be significantly eroded by public investment volatility. Aid volatility is seen by researchers as one of the major determinant of public investment volatility as it contributes to revenue volatility. A key implication is to provide more stable aid for planned infrastructure and human capital development.

Countries in the region, particularly small states, require aid to weather unfolding crisis and prepare their economies for long-term development and structural adjustments. Therefore, short-term aid adjustments may be made to support initiatives that manage decreases in domestic revenue, changing trade environment or internal shocks. Aid provides budgetary support to recipient governments to overcome shortfall in balance of payments due to changes in the world trading environment. Necessary variation in aid should be made to support trade-related adjustments at the household level with respect to social protection.

To summarize, we find that aid is effective in stabilizing the Asia-Pacific economies. Accordingly, two policy recommendations are emerged. (i) Donors need to respond quickly and effectively to large adverse shocks, provide stable aid flow, and put recipient economies back to recovery path. (ii) Provide more long-term stable aid for key infrastructure, capacity building and human capital development programmes. Given that most countries under study are in the early stage of development and prone to large internal and external shocks, donors need to design a mixture of countercyclical and procyclical aid packages to provide stability and promote economic growth.

## Bibliography

- Agenor, P., and Aizenman, J.** 2010. "Aid volatility and Poverty traps." *Journal of Development Economics* 91:1–7.
- Alvi, E., and Senbeta, A.** 2012. "Foreign Aid: Good for Investment, Bad for Productivity." *Oxford Development Studies* 40:139–161.
- Angeles, L., and Neanidis, K.C.** 2009. "Aid effectiveness: The role of the local elite." *Journal of Development Economics* 90:120–134.
- Arellano, C., Bulir, A., Lane, T., and Lipschitz, L.** 2009. "The Dynamic Implications of Foreign Aid and its Variability." *Journal of Development Economics* 88:87–102.
- Chenery, H., and Strout, A.** 1966. "Foreign assistance and economic development." *American Economic Review* 56:679–733.
- Bacha, E.** 1990. "A three-gap model of foreign transfers and the GDP growth rate in developing countries." *Journal of Development Economics* 32:279–296.
- Burnside, C., and Dollar, D.** 2000. "Aid, Policies, and Growth." *American Economic Review* 90: 847–868.
- Bulir, A. and Hamann, J.** 2008. "Volatility of development aid: From the frying pan into the fire." *World Development* 36:2048–2066.
- Collier, P., and Goderis, B.** 2008. "Does Aid Mitigate External Shocks?" Discussion paper, World Institute of Development Economic Research, United Nations University.
- Chauvet, L., and Guillaumeont, P.** 2004. "Aid and Growth Revisited: Policy, Economic Vulnerability and Political Instability." In *Toward Pro-Poor Policies: Aid, Institutions and Globalization*, edited by B. Tungodden, N. Stern, and I. Kolstad. Washington, DC: World Bank.
- Chauvet, L. and Guillaumeont, P.** 2009. "Aid, Volatility, and Growth Again: When Aid Volatility Matters and When it Does not." *Review of Development Economics* 13:452–463.
- Celasun, O., and Walliser, J.** 2008. "Predictability of aid: Do fickle donors undermine aid effectiveness?" *Economic Policy* 23:545–594.
- Domar, E.** 1947. "Capital expansion, rate of growth, and employment." *Econometrica* 14:137–147.
- Drazen, A.** 2000. *Political Economy in Macroeconomics*. Princeton: Princeton University Press.

- Easterly, W.** 2003. "Can foreign aid buy growth?" *Journal of Economic Perspectives* 17(3):23–48.
- Economides, G., Kalyvitis, S., and Philippopoulos, A.** 2008. "Does foreign aid distort incentives and hurt growth? Theory and evidence from 75 aid-recipient countries." *Public Choice* 134:463–488.
- Gemmell, N., and McGillivray, M.** 1998. "Aid and Tax Instability in the Government Budget Constraints in Developing Countries." CREDIT Research Paper No. 98/1, University of Nottingham.
- Guillaumont, P., and Chauvet, L.** 2001. "Aid and Performance: A Reassessment." *Journal of Development Studies* 37: 66–87.
- Hansen, H., and Tarp, F.** 2001. "Aid and growth regressions." *Journal of Development Economics* 64:547–570.
- Hudson, J., and Mosley, P.** 2008a. "Aid volatility, policy and development." *World Development* 36:2082–2102.
- Hudson, J., and Mosley, P.** 2008b. "The macroeconomic impact of aid volatility." *Economics Letters* 99:486–489.
- Hudson, J.** 2014. "Consequences of Aid Volatility for Macroeconomic Management and Aid Effectiveness." *World Development*. 69:62–74.
- Kathavate, J., and Mallik, G.** 2012. "The impact of the Interaction between institutional quality and aid volatility on growth: Theory and evidence." *Economic Modelling* 29:716–724.
- Kimura, H., Mori, Y., and Sawada, Y.** 2012. "Aid Proliferation and Economic Growth: Cross-Country Analysis." *World Development* 40:1–10.
- Kodama, M.** 2012. "Aid Unpredictability and Economic Growth." *World Development* 40:266–272.
- Lensink, R., Morrissey, O.** 2000. "Aid Instability as a Measure of Uncertainty and the Positive Impact of Aid on Growth." *Journal of Development Studies* 36:31–49.
- Mekasha, T.J and Tarp, F.** (2013). Aid and Growth: What Meta-Analysis Reveals, *The Journal of Development Economics*, 49, 564–583.
- Museru, M.U., Toerien, F., and Gossel, S.** 2014. "The Impact of Aid and Public Investment Volatility on Economic Growth in Sub-Saharan Africa." *World Development* 57:138–147.
- Rajan, R., and Subramanian, A.** 2008. "Aid and growth: What does the cross-country evidence really show?" *Review of Economics and Statistics* 90:643–665.
- Roodman, D.** 2007. "The anarchy of numbers: Aid, development, and cross-country empirics." *World Bank Economic Review* 21:255–277.