Determinants of Growth Volatility in Small Island Developing States: Empirical Evidence From A Panel Data Analysis[1]

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Abstract

This paper examines determinants of growth volatility in Small Island Developing States (SIDS) using a balanced panel of 24 SIDS over 1995-2012. It employs the Hodrick-Prescott filter and quantifies growth volatility by the rolling standard deviation of the cyclical component of economic growth. Empirical analysis adopts a reduced form approach and the difference and system Generalized Method of Moments (GMM) estimator. It is found that tourism dependency and inflation volatility have positive impacts on growth volatility, while terms of trade, product diversification and migration are negatively associated with growth volatility. The findings have important policy implications on mitigating growth volatility in SIDS.

Introduction

High level of growth volatility experienced by small island countries has been and continues to be a major challenge for these economies. Smaller economies are more susceptible to internal and external shocks given their size, dependence on external trade, distance from major trading partners, lack of established financial system, poorly diversified economy, and vulnerability to natural disasters. There is sufficient evidence in the literature to conclude that small countries suffer more economic growth volatility than relatively bigger countries (Furceri and Karras, 2007). Needless to say this fluctuation in income may have a direct or indirect impact on the level of social welfare provison in an economy. Thus, understanding the contributing factors of this instability in SIDs is important in designing measures to either mitigate or adapt to same.

This paper aims to identify the key determinants of economic growth volatility in small developing island countries. What roles do macroeconomic factors such as trade openness, financial sector development, level of economic development, government policies and economic structure play in determining the magnitude of economic growth volatility? Answers to these questions have significant welfare implications, as with volatility comes a degree of uncertainty that affects income and future output.

Quest to explain macroeconomic volatility has produced a sizeable amount of theoretical and empirical studies in recent years. A number of studies tried to explain growth volatility through its links to (i) trade and financial market integration (see, for example, Ahmed and Suardi, 2009; Edwards,2009; Bekaert et al., 2006; Rose and Spiegel, 2009; and Ahamada and Coulibaly, 2011); (2) government size size (Gali, 1994; Fatás and Mihov, 2001);, (3) composition and democracy (Afonso and Furceri, 2010 and Yang, 2008), and (4) institutional quality and macroeconomic policies (Acemoglu et al., 2002). However, there appears to be lack of concensus on causes of economic volatility in empirical literature. Moreover, the results are sensitive to country samples, aggregation period, the set of control variables, and the estimation technique.

This study examines determinants of growth volatility in SIDS using the difference and system GMM dynamic panel estimator. Small island developing states in the current study are defined as small in population and economic scale, and isolated by sea. SIDS, which are defined by United Nations Department of Economic and Social Affairs, share similar sustainable development challenges, including: small population, limited resources, remoteness and isolated by sea, susceptibility to natural disasters, vulnerability to external shocks, and excessive dependence on international trade (UN, 2014). As a result of available data on relevant variables over the period 1995-2012, are

[1] This paper is produced as the study conducted in the context of the project 'Macroeconomic Volatility and Regional Fiscal and Monetary Policies in Latin America, Caribbean, Asia and the Pacific' which is managed by the Global Development Network (GDN) and funded by the Inter-American Development Bank (IDB), thankful to the People's Republic of China for contributing the funds. The authors alone are responsible for the views expressed in this paper. The authors wish to thank Yongzheng Yang, Patrick Guillaumont, Guillermo Perry, Lekha Chakraborty, Angel Melguizo, Manuel Maleki, Anindya Chaudhuri, and Anthony Birchwood for helpful comments.

covered in this study. According to United Nations, these SIDS are broken down into three geographical regions: the Caribbean, the Pacific, and Africa, India Ocean, Mediterranean and South China Sea (the AIMS). While SIDS face many similar challenges as most developing countries, there are some special economic challenges that are unique to most of these small states. These include small and isolated economies, diseconomies of scale in production and exchange of goods and services, small domestic markets, limited natural resource bases, heavy reliance on a few sectors in the economy (mainly agriculture and tourism), high vulnerability to natural disasters, and significant and rising transportation cost. These features make SIDS vulnerable to external and internal shocks

Literature Review

It is widely agreed that macroeconomic volatility negatively influences economic growth (Berument et al., 2014; Badinger, 2010; Ramey and Ramey, 1995; Yang et. al., 2016). In addition, the negative impacts of volatility are likely to be felt more by the poor as consumption behaviour is more sensitive to fluctuation in income at low levels of income (Mobarak, 2005; Klomp and Haan, 2009).

Many studies have theoretically and empirically examined the causes of macroeconomic volatility; however, the debate is largely unsettled. Nevertheless, these studies have identified a number of factors that may cause macroeconomic volatility; their impacts are likely to be sensitive to many factors including geographical location and country size. One stream of studies theoretically and empirically examined the link between financial sector development and macroeconomic volatility. Some studies believe that a well-established financial system should enhance an economy's ability to absorb shocks, and, therefore, mitigate cyclical fluctuations. Aghion et al. (1999) in their study demonstrated that economies with less developed financial systems appear to be more unstable and achieve lower economic growth. They argued that when economies have less developed financial systems, supply and demand for credit are more cyclical. They further professed that lack of financial sector development in less developed countries could be one of the reasons for high growth volatilities in those countries.

Acemoglu and Zilibotti (1997) pointed out that financial sector development have an important role in explaining volatility by identifying importance of diversification in reducing risk. Improving financial sector development facilitates greater diversification, promotes investment, and, as a result, investment risk and volatility is reduced. In contrast, some

studies (such as Gertler and Gilchrist, 1994; Kashyap and Stein, 1995& 2000) argue that financial sector development will exacerbate macroeconomic volatility. They argued that financial sector development may increase financial imperfections arising from information asymmetries or other structural constraints and thus contribute to macroeconomic volatility.

Yeh et al. (2013) examined the impact of financial structure on growth and volatility using data from 40 countries over the period 1960-2009 within an autoregressive distributed lag (ARDL) model. They found that while financial structure had a positive impact on growth, it significantly increased growth volatility. Nevertheless, in small island countries financial sector development is likely to encourage greater entrepreneurial development and hence reduce macroeconomic volatility.

Turning to the effect of trade integration on macroeconomic volatility, trade openness can promote sectoral specialization, which in turn increases country proneness to sector-specific shocks which are crucial for generating growth volatility (Sutherland and Hoeller, 2013; Krugman, 1993). Therefore, small economies with less diverse export structure are more subject to sector-specific shocks, and, given the negative association between size and openness, to external shocks. In small countries, the share of trade in GDP is usually large and their export are more specialized in few export commodities and markets, and thus, increasing trade openness in small economies increases economic volatility (Easterly and Kraay, 2000). Ahmed and Suardi (2009) using a sample of 25 Sub-Saharan African countries over the period 1971-2005 examined the determinant of long term output and consumption volatility. They found that trade openness had a negative impact on growth and consumption volatility.

The third stream of studies examined the impact of macroeconomic policies such as inflation volatility, monetary policy and budget deficit on macroeconomic volatility. Policy uncertainty may play a role in explaining cross-country differences in economic volatility. When the variability of policies increases, it may increase macroeconomic uncertainty, which will be reflected in economic growth variability. Thus inflation volatility is likely to be positively related to macroeconomic volatility. Aizenman and Marion (1991) argue that investors and entrepreneurs care more about the stability of economic policies than the stability of the regime itself. Debrun et al. (2008) report that the stability of monetary policy (measured by the exponential deviation of inflation from a 2% target) decreases economic volatility in OECD countries.

Gali (1994) examined the relationship between government size

and macroeconomic stability in 22 OECD countries within a cross-section framework. The study found a negative relationship between government size and output volatility. Fatás and Mihov (2001) examined the relationship between government size and volatility for 20 OECD countries and found that the negative impact of government size on macroeconomic volatility become bigger when controlled for simultaneity problem. Similar finding is also reported by Kim and Lee (2007) over OECD countries. Moreover, Mohanty and Zampolli (2009) examined the link between government size and macroeconmic volatility in OECD countries using panel data analysis; the study found negative association between government size and volatility. On the other hand, some studies (such as Acemoglu et al., 2002; Mohanty and Zampolli, 2009) argue that countries with large government sectors are more volatile and have more severe crises. They argue that larger government expenditures are often associated with huge government debts. In the presence of high debt, a recesion could lead to expectation of discretionary fiscal tightening. Hence businesses and consumers are likely to reduce their expenditure when it is needed most. In addition, a reasonabaly large public debt can lead to increase in long term interest.

Another stream of studies show that the quality of institutions is an important determinant of macroeconomic volatility (Acemoglu et al., 2003; Rose and Spiegel, 2012). Acemoglu et al. (2003) outlined a number of channels through which institutions may affect macroeconomic volatility. First, in the absence of good institutions, rulers have few restrictions limiting their actions. With change in government, the ruling party may use their authority to redistribute state wealth and income amongst themselves which may create economic disturbance. Second, with fewer restrictions governing politicians, politicians may benefit more by winning power and suffer greater loss from not getting the right to govern. Therefore, there is likely to be more tussle between various political parties to gain power as to enjoy the benefits, which create intense economic volatility. Third, trust plays a more important role in economic cooperation. Such relationships are vulnerable to shocks which may affect output in the absence of good institutions. Fourth, in the absence of strong institutions contractual agreements are inadequate and hence economic dealings are vulnerable to shocks. Fifth, in the absence of strong institutions, politicians are likely to pursue politically motivated policies to gain votes then to promote sustainable economic development. Last, in absence of good institutions, businesses may be forced to invest in a sector that allows quick withdrawal of invested capital. Acemoglu et al. (2003) and Carmignani et al. (2011) found institutions that restricted

the discretion of government reduced the volatility in the economy. In addition, Mobarak (2005) show that higher degrees of democracy reduces volatility. Yang (2008) disputes this hypothesis and proves in his study of 138 countries using Generalized Method of Moments (GMM) techniques that democracy as a cushion to growth volatility is not as robust as advocated by previous works. He points out that despite the popular view of better quality institutions and constitutions, this alone does not promote a less volatile bussiness cycle. Instead, Yang (2008) suggests, the gains from democracy may be negated by an ethnically homogenious society, suggesting that volatility is likely to be lower and significant in more heterogenic societies. This may be interpreted to mean that policies are better scrutinized and political accountability may be more pronounced in non-homogeneious states. On the contrary, however, the diversity of the nation's population can lead to social conflict and infighting, which destablizes the economy as pointed out by Easterly and Levine (1995). These include civil wars and coups which has been experienced on a few occassions in the PICs.

Some studies argue that factors such as initial income, income, diversification and productivity are important determinants of volatility. Economic diversification is seen as long term strategy to reduce economic volatility. Successful diversification reduces volatility by making the economy less vulnerable to economic shocks. Klomp and Haan (2009) examined causes of economic growth volatility using data from more than 100 countries over the period 1960 to 2005. They found that initial GDP, diversification index, human capital, government expenditure as % of GDP, and institutions, were negatively related to volatility. On the other hand, recession, productivity shock, terms of trade (TOT) shock and political instability were positively related to volatility. Tang (2002) found that growth volatility was negatively related to initial income and initial productivity; countries with higher initial incomes or productivities on average experienced less volatility relative to countries with lower initial incomes or productivities. Improvements in human capital also had a diminishing impact on growth volatility; countries with higher initial human capital stock also experienced lower volatility. Cover and Mallick (2012) found that technology shock and aggregate demand shock explained most of the variance in output in UK economy.

Amongst a limited number of studies for SIDS, Briguglio (1995) quantified economic vulnerability in the form of an index, and attributed economic vulnerability faced by SIDS to lack of product diversification, dependence on narrow range of products, lack of specialists (mainly

caused by emigration), high dependence on foreign exchange earnings (which is ascribed to limited natural resource endowment), problems with policies, and high degree of dependence on foreign aid.

Model, Data and Methodology

The Model

This study aims to explain growth volatility and its role in economic growth in small island developing states. We did not use structural theory to link various macroeconomic factors and volatility. Following Rose and Spiegel (2009) and Jackman (2014), this study used reduced form approach examining existing determinant of macroeconomic volatility and subjecting it to intense sensitivity analysis. All explanatory variables considered are determined by existing empirical literature. A panel regression framework as follows was employed:

$$vol_{it} = \beta_0 + \sum_{k=1}^{K} \beta_k X_{k,it} + \varepsilon_{it}$$

where the dependent variable vol_{it} is growth volatility.

Growth volatility in the current study is calculated in the following two steps:

(1) The Hodrick-Prescott filter is used to separate the trend and cyclical components of GDP per capita growth. This method 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).

(2) Volatility is measured by the rolling standard deviation of the cyclical component over each sub-period. The window size is set at 3 years.[2]

Calculation shows that growth volatility in the sampled SIDS was averaged at a rate of 0.72% per annum. The Pacific had the highest volatility of 0.9% per annum, followed by the Caribbean (0.7%) and AIMS (0.6%). Subscripts i and t denote country and time period respectively, and βs are marginal effects to be estimated. Note that β_0 may

[2] Window size of 4 years was also used in this study. It was found that the window size had no significant impact on the estimated results. Given the small sample of SIDS and short time span employed in this study, we use the 3-year window to maintain degrees of freedom for estimation purpose. The 3-year window is adopted by studies including Kathavate and Mallik (2012) and Jackman (2014).

be country variant if panel fixed effects are identified, and then $\beta_{0,i}$ should be used rather than β_0. Similarly, the error term ε_{it} should be decomposed into country specific error u_i and random regression error e_{it} if panel random effects are identified instead.

Inspired by the theoretical and empirical volatility literature described in the preceding section and in particular earlier studies of Easterly and Kraay (2000) and Briguglio (1995) on vulnerability of SIDS, the current study considers a wide range of explanatory variables. Limited by data availability for the sampled SIDS, the following key explanatory variables, $X_{k,\text{it}}$, are included in the current empirical analysis:

1. *Economic growth*: The impact of the economic growth rate on economic growth volatility may depend on the level of an economy's development. As argued by Acemoglu and Zilibotti (1997), diversification opportunities in an economy with indivisible risky projects are limited in the early stage of development due to scarcity of capital. As a result, growth is random and subject to crises. Economic growth can be either positively or negatively related to growth volatility. Economic growth is measured by growth of GDP per capita at 2010 prices. It is denoted as 'gy_{it}'.

2. Tourism dependency: Most SIDS lack abundant natural resources and competitive manufacturing industries to develop merchandise export. But these small states are endowed with white beaches and abundant sunshine. Hence, developing the less costly tourism industry becomes the major development strategy for most SIDS. However, excessive reliance on tourism industry can put these small economies at risk, because tourism is vulnerable to shocks such as political instability, currency devaluation and global economic downturns. Therefore, as evidenced in Jackman (2014), tourism dependency should be more or less positively associated with a small economy's growth volatility. Tourism dependency is measured by number of tourist arrivals relative to total destination country's population. It is denoted as 'ta_{it}'.

3. Product diversification: denoted as '$manu_{it}$', this is measured by the manufacturing value added-to-GDP ratio. It makes a small economy less affected by climate change related vulnerability in the agricultural sector and aforementioned shocks related vulnerability in the tourism industry (Briguglio, 1995).

Furthermore, manufacturing industries add values to primary and intermediate products and strengthen a small economy's export base. This particularly improves SIDS' comparative advantages. Therefore, product diversification is expected to enhance SIDS' growth stability and have a negative effect on growth volatility.

4. Terms of trade: A small economy would benefit from increased terms of trade which allows the economy to buy more imports for any given level of export, which hence improves the nation's welfare. For most SIDS without a diversified industrial base, a decline in terms of trade either reduces primary and intermediate inputs or discourages exports, or both. Any of these would have a damaging effect on employment, investment and output. Hence, terms of trade should be negatively associated with growth volatility. As there is lack of data on terms of trade, this variable is measured by the imports volume-to-exports volume ratio. It is denoted as 'tot_{it}'.

5. Emigration: Emigration may lead to shortage of skilled workers in a SIDS. It, on the other hand, brings to SIDS considerable amounts of remittances which help smooth shocks in domestic investment and consumption volatility. Remittances also help a recipient country's financial development, which in turn enhances an economy's ability to absorb shocks and mitigates cyclical fluctuations (Acemoglu and Zilibotti, 1997; and Aghion et al., 1999). Therefore, emigration, which though might lead to reduction in productivity, helps to reduce growth volatility in SIDS. Emigration is measured by the number of emigrants relative to total population of the sending country. It is denoted as '$emigr_{it}$'.

6. Policy variability (real interest rate volatility): An increase in policy variability may increase macroeconomic uncertainty, which in turn increases economic growth variability. However, if policies, particularly monetary policies, are proactively amended in response to social and economic changes of an economy, such policy variability is expected to bring balance to the economy. As an important means of monetary policy, amendments in real interest rates are made to stabilize growth volatility through stabilizing investments and consumption in the economy. Accordingly, real interest rate volatility should by and large reduce growth volatility. Real interest rate volatility is calculated in the same way as growth volatility described above. It is denoted as '$rintvol_{it}$'.

7. Policy impulse (inflation volatility): Policy variability would lead to a sequence of changes in an economy. A change in inflation is an inevitable result of such changes. An increase in inflation volatility reduces the forecastability of macroeconomic indicators. Hence, as an impulse to policy variability, inflation volatility is positively related to macroeconomic volatility. Inflation volatility is calculated in the same way as growth volatility described in above. It is denoted as '$infvol_{it}$'.

8. ODA volatility (denoted by '$odavol_{it}$'): Same as ODA's growth impacts, ODA volatility's growth volatility impacts have long been debated in the literature. On one hand, unexpected scale-up of ODA could be due to natural disaster or balance of payment assistance; therefore volatility in ODA in this sense can mitigate a SIDS' suffering from these unexpected shocks. On the other hand, windfall of aid could be due to poor institutions, lack of capacity or political instability; such unanticipated changes in ODA flow, however, make ODA less productive as recipient countries' governments may decide to discontinue, postpone or not to implement new projects that are funded by donors' fund (Lensink and Morrissey, 2000). If these turn true, an increase in ODA volatility would increase a SIDS' growth volatility. ODA volatility is calculated in the same way as growth volatility described above. It is denoted as '$odavol_{it}$'.

The aforementioned variables and their measures that are used in Equation (1) are summarized in Table 1.

Other variables which were tried in this study include: governance indicators from World Bank's Worldwide Governance Indicators, two-year lagged real GDP per capita, government expenditure (% of GDP) and its volatility, broad money (% of GDP) and its volatility, domestic credit to private sector (% of GDP) and its volatility, foreign direct investment (% of GDP) and its volatility, health expenditure (% of GDP), gross fixed capital formation (% of GDP), improved water source (% of population with access), improved sanitation facilities (% of population with access), telephone lines (per 100 people), and urban population (% of total population). The performances of variables are not reported due to their statistical insignificance in the SIDS' growth volatility model.

Table 1. Key Variables

Variables	Measure	Notation
Growth volatility	Rolling standard deviation of Hodrick-Prescott filtered economic growth of GDP per capita at 2010 prices. Window size = 3 years	vol_{it}
Economic growth	Rolling average of growth of GDP per capita at 2010 prices. Window size = 3 years	gy_{it}
Tourism dependency	Rolling average of number of tourist arrivals-to-total destination country's population ratio. Window size = 3 years	ta_{it}
Product diversification	Rolling average of manufacturing value added-to-GDP ratio. Window size = 3 years	$manu_{it}$
Terms of trade	Rolling average of imports volume-to-exports volume ratio. Window size = 3 years	tot_{it}
Emigration	Rolling average of number of emigrants-to-total sending country's population ratio. Window size = 3 years	$emigr_{it}$
Policy variability	Real interest rate volatility, calculated as rolling window standard deviation of Hodrick-Prescott filtered real interest rate. Window size = 3 years	$rintvol_{it}$
Policy impulse	Inflation volatility, calculated as rolling window standard deviation of Hodrick-Prescott filtered inflation. Window size = 3 years	$infvol_{it}$
ODA volatility	Rolling window standard deviation of Hodrick-Prescott filtered ODA received-to-recipient country's GDP ratio. Window size = 3 years	$odavol_{it}$

Data

Data employed in the study were obtained from World Bank's World Development Indicators (2015 Update) and World Bank's Worldwide Governance Indicators (2014 Update). Multiple imputations were employed to fill a few missing values in variables, including manufacturing value added, international migrant stock, real interest rate, and ODA received. Limited by availability of quality data, 24 countries are included in the final regression, including 11 countries from the

Caribbean region, 6 countries from the Pacific region, and 7 countries from the AIMS. Table 2 summarizes the list of SIDS under study and statistics of key macroeconomic indicators. Calculation shows that the core variable, namely growth volatility, in the sampled SIDS was 0.72% per annum over the sample period 1995-2012. The Pacific had the highest volatility level of 0.9% per annum, followed by the Caribbean (0.7%) and the AIMS (0.6%).

Due to the calculation of volatility indices and to have sufficient observations for empirical analyses, this study employs window size of three years and divides the whole time period 1995-2012 into six time spans: 1995-1997, 1998-2000, 2001-2003, 2004-2006, 2007-2009, and 2010-2012. Rolling average or rolling standard deviation of relevant variables over each time span are calculated accordingly.

Methodology

A significant concern in the current study was the possibility of biased estimates attributable to the potential endogeneity of real GDP per capita growth, real interest rate volatility, inflation volatility and ODA volatility, as they are likely to be affected by the dependent variable growth volatility. Another concern in the estimation was addressing country specific heterogeneous effects, ignorance of which would lead to omitted variable bias. The solution to the aforementioned challenges is the adoption of the difference and system general method of moments dynamic panel (GMM dynamic panel) estimator. The GMM dynamic panel estimator separates fixed effects from idiosyncratic errors that are heteroskedastic and correlated within but not across individuals. This estimator instruments the differenced variables with all their available lags in levels, and instruments the untransformed variables with suitable lags of their own first differences (Arellano and Bond, 1998; Roodman, 2009). This estimator provides consistent estimation results for dynamic panels with small number of time periods and large number of cross sections. Furthermore, robust panel corrected standard errors are used to address the possibility of country-wise heteroskedasticity, and error autocorrelation is addressed by the employment of a second order autoregressive process.

Table 2: Key Economic Indicators by Country/Region (averages over 1995-2012)

	Population			GDP					Sectoral	
	1. 000's	2. Gwth %	3. Urban/ Total	4. GDP US$m 2010	5. Per Capita US$ 2010	6. Gwth/ Cap. Cons. 2010	7. Volat-ility	8. Gross FCF	9. Manu VA % of GDP	10. Trst
Bahamas	322	1.7	82	7,613	23,646	1.5	0.89	25.7	4.5	1516
Belize	263	2.6	46	1,227	4,632	0.9	0.03	20.1	11.3	211
Dominica	71	0	66	409	5,785	2.7	0.28	21.8	5.9	73
Dominican Rep	9,137	1.5	66	58,885	6,571	-3.1	0.22	17.5	24.7	3271
Grenada	103	0.3	36	682	6,623	3.5	0.66	32	4.9	120
Guyana	758	0.5	29	1,639	2,149	3	0.78	25.8	7.2	115
St. Kitts & Nevis	48	1.3	32	596	12,293	1.8	0.44	40.7	8.2	99
St. Lucia	164	1.2	24	1,033	6,279	1.3	0.09	26.9	4.9	277
St. Vinc/ Grens.	109	0.1	46	594	5,471	3.2	0.58	27.7	6.2	76
Suriname	488	1.2	66	5,026	10,645	-12	3.28	18.7	16.7	117
Trinidad & Tob.	1,291	0.4	10	19,595	15,111	2.4	0.58	20.9	6.9	369
Caribbean (av)	**1,159**	**1**	**45.7**	**8,845**	**9,019**	**0.5**	**0.7**	**25.3**	**9.2**	**568**
Fiji	824	0.7	49	3,248	3,942	0	0.2	19.2	14.2	472
Papua N Guinea	5,901	2.5	13	9,053	1,578	-4.7	2.7	17.9	7.6	85
Samoa	179	0.6	21	497	2,770	2.1	0.09	14.8	14.2	98
Solomon Islands	453	2.5	17	939	2,209	-6.5	1.35	13.9	7.7	17
Tonga	100	0.5	23	394	3,950	-1.2	0.65	23.8	8.6	38
Vanuatu	204	2.3	23	487	2,338	2.4	0.38	24.3	5.6	68
Pacific (average)	**1,277**	**1.5**	**24.3**	**2,436**	**2,798**	**-1.3**	**0.9**	**19**	**9.7**	**130**
Cabo Verde	459	1.3	56	1,144	2,447	3.5	0.26	35.5	8.7	191
Comoros	583	2.5	28	434	736	0.9	0.08	13.3	5.2	23
Guinea-Bissau	1,384	2.2	40	633	453	-4.4	1.6	11.5	8.7	26
Maldives	291	1.9	33	1,394	4,682	3.4	0.72	27.8	6.4	563
Mauritius	1,220	0.8	42	8,948	7,340	0	0.35	23.8	20.7	729
Seychelles	83	1	51	1,335	16,190	-2.3	0.74	36.1	12.1	144
Singapore	4,342	2.4	100	154,290	34,683	3.3	0.32	29.4	24.4	7017
AIMS (average)	**1,195**	**1.7**	**50**	**24,025**	**9,504**	**0.6**	**0.6**	**25.3**	**12.3**	**1242**
All SIDS (avrg)	**1,199**	**1.3**	**42**	**11,671**	**7,605**	**0.1**	**0.72**	**23.7**	**10.2**	**655**

[Keys: 1. Population (persons, thousand) ; 2. Population growth (%); 3. Urban population (% of total population); 4. GDP (2010 US$, millions) ; 5. GDP per capita (2010 US$); 6. Growth of GDP per capita (constant 2010 US$); 7. Volatility of growth of GDP per capita (%, H-P filtered); 8. Gross fixed capital formation (% of GDP); 9. Manufacturing, value added (% of GDP); 10. Tourist arrivals (persons, thousand)]

Cont/- .... Table 2: Key Economic Indicators by Country/Region (averages over 1995-2012)

	Openness				Monetary & Fiscal Policies				Overseas Resources	
	11 Exports (% of GDP)	12 Imports (% of GDP)	13 Terms of trade	14 FDI (% of GDP)	15 Money (% of GDP)	16 Dom credit (% of GDP) to pvte	17 Real i (%)	18 Infl. (%)	19 ODA (% of GDP)	20 Emigrat (% of pop
Bahamas	21	105	488	5.5	62.3	67	2.9	2	0.1	9.7
Belize	27	57	211	6.5	60.3	51	13.3	2	2.1	15.7
Dominica	26	76	293	7.7	76.9	53	7.5	1.9	6.8	6.1
Domini Rep	20	36	185	3.9	32.9	25	12.7	10.4	0.4	4.2
Grenada	12	50	428	10.8	90.7	69	6.9	2.5	3.2	9.4
Guyana	71	78	109	7.9	75.2	47	6.4	5.9	13.4	1.2
St. Kitts & N	14	70	502	16	111	62	6.1	3.6	2	9.1
St. Lucia	12	132	1116	10.6	81.9	85	8.5	2.8	2.8	5.1
St. Vinc/ Gr	18	66	372	15.2	73.1	52	7.5	2.6	4.2	6.6
Suriname	33	35	106	-3.6	41.5	18	-3.3	32.1	4.2	6.5
Trini & Tob.	58	37	63.1	7.8	47.4	38	8.5	6.1	0.1	3
Carib (av)	**28.4**	**67.5**	**352**	**8**	**68.5**	**51.5**	**7**	**6.5**	**3.6**	**7**
Fiji	35	48	139	5.3	55.7	58	4.4	3.8	2	2
Papua NG	90	42	46.7	2.1	39	20	5.2	8.5	6.2	0.5
Samoa	30	81	272	2	40.8	35	8.4	4.3	13.6	3.8
Solomon Is.	49	44	91.2	5.4	27.4	21	7.2	8.7	25.6	1.4
Tonga	8	45	596	2	39	42	6.5	5.9	13	1.4
Vanuatu	35	70	200	7.3	95.2	45	4.8	2.5	13.2	0.6
Pac (avge)	**41.2**	**55**	**224**	**4**	**49.5**	**36.8**	**6.1**	**5.6**	**12.3**	**1.6**
Cabo Verde	2	47	2069	6.4	73.1	43	10.5	3.4	17.1	2.4
Comoros	8	38	482	0.8	25.8	12	7.3	3.1	11	2.4
Guinea-Bis	25	36	145	1.2	24.1	6	6.8	10.7	24.7	1.6
Maldives	11	64	600	5.5	45.5	36	7.7	4.8	4.4	1.1
Mauritius	31	48	157	2.1	90.2	69	11.8	5.9	0.8	3
Seychelles	29	82	279	11	81	25	5.4	6.1	2.9	9.4
Singapore	150	139	92.7	15.8	111	99	4.7	1.8	0	34.4
AIMS (av)	**36.6**	**64.9**	**546**	**6.1**	**64.4**	**41.4**	**7.7**	**5.1**	**8.7**	**7.8**
All SIDS avg	**34**	**64**	**188**	**6.5**	**62.5**	**45**	**7**	**5.9**	**7.2**	**5.9**

[Keys: 11: Exports of goods and services (% of GDP); 12: Imports of goods and services (% of GDP); 13: Terms of trade (index, out of 100); 14: FDI (% of GDP); 15: Money and quasi money (% of GDP); 16: Domestic credit to private sector (% of GDP); 17: Real interest rate (%); 18: Inflation (%); 19 Official development assistance (% of GDP); 20: Emigration (% of total population.]

Results

The GMM dynamic panel estimator uses 10 instruments in the levels equation in estimating the determinants of growth volatility in SIDS. Since the number of 10 instruments in the levels equation is less than the number of SIDS, the Hansen over-identification test in the presence of heterskedasticity is robust. The chi-squares statistics across different model specifications are all less than respective critical values at the 5% significance level, leading to the non-rejection of the null hypothesis that instruments used in the estimation are sufficient and exogenous. The Arellano-Bond test for second-order serial correlation of residuals (described in Arellano and Bond, 1998) yields z-statistics which are all less than the 5% significance level, suggesting that errors are not correlated within SIDS. The overall significance of individual regressions is evidenced by the Wald chi-squares statistics which are all highly significant at the 1% level. Furthermore, robustness of estimation output is tested by using different sets of explanatory variables and different samples of SIDS.

Tests on the scenarios stated above are summarized in Table 3 where three model specifications using the full sample are presented in Columns (1)-(3); and Columns (4)-(6) presents regression results with different samples of SIDS.

Based on the general model in Regression (3), the effect of economic growth on growth volatility turns out highly insignificant. This suggests that in the sampled SIDS, growth volatility is not related to economic growth. There are two other factors which have expected signs but are statistically insignificant, namely, real interest rate volatility and ODA volatility. This suggests that real interest rate volatility, as a means to timely revise policies to adapt to changes in economic performance, more or less helps reduce growth volatility; while volatility in ODA more or less interrupts recipient countries' plans of utilizing the funds and deteriorates growth volatility.

Among the remaining factors that are significant for at least 10% significance level, tourism dependency and policy impulse are positively associated with growth volatility in SIDS. It is found that, given other factors remaining unchanged, a 10 percentage point increase in the tourist arrivals-to-destination country's population ratio leads to an increase of 0.02 percentage points in growth volatility, and such effect is statistically significant at the 5% level.

Given substantial differences among SIDS with respect to tourism

dependency, for instance, average tourist arrivals-to-population ratios in Guinea-Bissau and Papua New Guinea were just around 1% while the ratio in Bahama was 477% over 1995-2012, the maximum contribution of tourism dependency to the difference in growth volatility in the sample was 0.95 (=(477–1)*0.002) percentage points.

Similarly, policy impulse, measure by inflation volatility, has a devastating effect on growth stability. According to regression results, a 10 percentage point increase in inflation volatility is associated with an increase of around 5 percentage points in growth volatility, keeping other factors fixed. And such harmful effect is highly significant at the 1% level. Given that the range of the Hodrick-Prescott filtered inflation volatility was 6.47% among the sampled SIDS, the maximum contribution of policy impulse to the difference in growth volatility in the sample was as large as 3.24 (=6.47*0.5) percentage points.

The other three factors that are considered in the current study, namely sectoral diversification, terms of trade, and emigration, are found helpful to mitigate growth volatility in SIDS.

Specifically, sector diversification, which is measured by the manufacturing vale added-to-GDP ratio, by and large strengthens small and remote economies' capacity of resilience to sector-specific shocks and hence lessens growth volatility. It is found that a 10 percentage point increase in the ratio of manufacturing value added-to-GDP reduces growth volatility by 0.25 percentage points, all else remaining equal. Given the range of the manufacturing value added-to-GDP ratio (about 25% among the sampled SIDS), the maximum contribution of sectoral diversification to reducing growth volatility was as 0.63 (=25*0.025) percentage points. However, such contribution is only weakly significant at around 10% level.

Terms of trade proves to effectively affect growth volatility. It is observed that, a 10 percentage point increase in terms of trade leads to a decline of 0.02 percentage points in growth volatility, keeping everything else constant. Given substantial differences in terms of trade among SIDS, for instance, average terms of trade index was around 4% in Cabo Verde and St. Lucia, while in Papua New Guinea the index was around 217%, the maximum terms of trade's contribution to reducing growth volatility was as significant as 0.43 (=(217–4)* 0.002) percentage points. And such contribution is also statistically significant at the 5% level.

Table 3. GMM dynamic panel estimation on determinants of growth volatility in SIDS

Explanatory variables	Reg. (1) Coeff	Reg. (1) (*z*-stat) [*p*-value]	Reg. (2) Coeff	Reg. (2) (*z*-stat) [*p*-value]	Reg. (3) Coeff	Reg. (3) (*z*-stat) [*p*-value]	Reg. (4) Ceoff. (*z*-stat)	Reg. (5) Ceoff. (*z*-stat)	Reg. (6) Ceoff. (*z*-stat)
Constant	1.320	(2.18) [0.030]	1.452	(2.88) [0.004]	1.447	(2.83) [0.005]	1.120(0.88)	-.186(-0.42)	1.008(1.53)
Economic growth					-.001	(0.09) [0.928]			
Tourism dependency	.002	(2.15) [0.031]	.002	(2.15) [0.032]	.002	(2.00) [0.046]	.001(0.98)	.003(1.95)	.002(1.61)
Sectoral diversification	-.035	(-1.74) [0.082]	-.025	(-1.57) [0.115]	-.025	(-1.59) [0.113]	-.037(-0.93)	.020(1.05)	-.025(-1.15)
Terms of trade	-.002	(-1.80) [0.072]	-.002	(-2.19) [0.028]	-.002	(-2.14) [0.033]	-.001(-0.79)	.0000(0.25)	-.002(-1.04)
Emigration	-.019	(-1.46) [0.144]	-.027	(-1.83) [0.068]	-.027	(-1.80) [0.072]	-.025(-0.28)	-.012(-1.71)	-.015(-0.87)
Policy variability			-.650	(-1.11) [0.269]	-.639	(-1.04) [0.299]			
Policy impulse	.484	(5.79) [0.000]	.542	(5.34) [0.000]	.543	(5.50) [0.000]	.546(3.66)	-.127(-0.56)	.554(7.29)
ODA volatility	.345	(1.45) [0.148]	.322	(1.33) [0.183]	.330	(1.27) [0.202]	.226(0.14)	.694(4.47)	.291(1.29)
# instruments for levels eq.	10		10		10		10	10	10
Hansen over-identification chi^2-stat [*p*-value]	0.40 [0.941]		0.27 [0.874]		0.26 [0.611]		1.76[0.623]	3.82[0.282]	1.82[0.611]
AR(1) in first differences *z*-stat [*p*-value]	1.25 [0.210]		1.46 [0.145]		1.37 [0.172]		0.77[0.442]	1.47 [0.142]	1.23[0.218]
AR(2) in first differences *z*-stat [*p*-value]	-0.79 [0.431]		-1.10 [0.272]		-1.08 [0.281]		-0.60[0.549]	1.08[0.280]	-0.65[0.514]
Wald chi^2 [*p*-value]	102.31 [0.000]		97.87 [0.000]		103.13 [0.000]		113.35[0.00]	110.65[0.00]	141.01[0.00]
# SIDS	24		24		24		16 (Carib. & Pacific)	14 (AIMS & Pacific)	18 (AIMS & Caribbean)
# time spans	5		5		5		5	5	5
Total observations	120		120		120		80	70	90

Emigration's mitigating role on growth volatility is also evident, as a result of remittances helping to stabilize investment and consumption in SIDS. Regression results suggest that a 10 percentage point increase in the emigrants-to-sending country's population ratio is associated with a decline of 0.27 percentage points in growth volatility of the sending country, other factors remaining unchanged. Such effect is statistically significant at the 10% level. Emigration rates differ considerably among SIDS, with the lowest rate seen in Vanuatu (0.34% in 2010) and the highest rate seen in Singapore (38.74% in 2010). The maximum emigration's contribution to reducing growth volatility was as substantial as 1.04 (=(38.74–0.34)*0.027) percentage point.

The above findings are consistent across different model specifications in Columns (1)-(3). This seems to indicate the robustness of the GMM dynamic panel estimation of the growth volatility model as shown in the equation given above. In addition, these findings are also generally held in regressions with different sub-samples of SIDS, as shown in Columns (4)-(6).

Conclusion and Policy Suggestions

To explain growth volatility in Small Island developing states, this paper considered a wide range of factors covering different aspects including economic growth, tourism dependency, sectoral diversification, terms of trade, emigration, policy variability, policy impulse, and volatility in official development assistance. Empirical analysis was based on a balanced panel study of 24 SIDS over the period 1995-2012. The difference and system GMM dynamic panel estimator was employed to estimate the determinants of growth volatility in SIDS.

Our findings suggested that in order to mitigate growth volatility while aiming at high economic growth, small, remote and volatile developing economies, though cannot do anything to change their innate features, can focus on the following aspects:

- In order to strengthen the tourism industry's capacity of resilience to external shocks, SIDS should enhance tourism market diversification, tourism product diversification, and service quality;
- SIDS should made attempts to reduce its over reliance on a single sector, the tourism sector, as the major exchange earner. Policies should be targeted at encouraging the manufacturing sector by adding more value to the agriculture sector through food processing and canning;
- SIDS should improve more bilateral and multilateral trade relationships to encourage greater migration of people across countries. Migration is negatively associated with growth volatility as remittances provide stable flows of foreign finance during economic crises. Besides permanent migration, SIDS should negotiate more seasonal worker schemes with developed countries. This is not only vital for reducing growth volatility but also provides much needed income to the unemployed; and SIDS should avoid huge variations in inflation caused by modification of policies.

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