

GDP FLUCTUATIONS AND LONG-RUN ECONOMIC GROWTH: A Study of Selected South Asian Countries

Ghulam MOHEY-UD-DIN*
and Muhammad Wasif SIDDIQI**

This paper studies the relationship between GDP fluctuations and long-run economic growth by using macro-panel approach (with small N and large T) in a panel of five selected South Asian countries (SSAC) including Bangladesh, India, Nepal, Pakistan and Sri Lanka, over a period of 1980-2010. For this purpose, modern non-stationary panel techniques such as the cross section dependence test, unit root test under cross sectional dependence, panel cointegration and Group Mean Fully Modified OLS (GM-FMOLS) estimation are applied. The study finds a significant long-run cointegrating relationship between GDP fluctuations and long-run growth in the SSAC and GM-FMOLS estimates and shows that this link is negative. It indicates that GDP fluctuations have a significant negative impact on long-run growth in the SSAC and these fluctuations of GDP may be detrimental for long-run growth in developing countries. Therefore, the governments of such countries shouldn't rely on growth-oriented policies only but should equally focus on managing these fluctuations in GDP to achieve sustained and stable growth rate.

I. Introduction

According to the traditional viewpoint, the business cycle and economic growth are considered two isolated fields in macroeconomics [Ramey and Ramey (1995), Martin and Rogers (2000), Siegler (2005), Tochkov and Tochkov (2009), Lee (2010). Commonly, it is believed that fluctuations in GDP are transitory in nature and these short-run deviations from trend have no correlation or causal-link with long-run economic growth. Thus, the syllabus of macroeconomics is normally separated into growth theory and business-cycle theory. However, this belief has been challenged by recent studies which have found significant relationship between growth and volatility [Fatás (2002), Hnatkovska and Loayza (2004)]. A negative link was found between volatility and growth in the seminal papers of Ramey and Ramey (1995) and then Fatás (2002), Acemoglu, et al. (2003), Hnatkovska and

* Urban Economist, The Urban Unit, Government of Punjab, ** Senior Visiting Professor, Department of Economics, Government College University, Lahore, Pakistan.

Authors are thankful to anonymous referees of the journal for their valuable suggestions on the paper.

Loayza (2004), and many others who found similar results. Even so, the relationship between volatility and growth is not always negative. It may either be positive or negative depending on the mechanisms driving the relationship [Imbs (2002)].

A positive link may develop if volatility is associated with occurrence of recession which lead to higher research and development and/or the destruction of least productive firms. Then the higher long-run growth can occur alongside higher volatility [Schumpeter (1939), Shleifer (1986), Hall (1991, Caballero and Hammour (1994), Aghion and Saint-Paul (1998a)]. But, this argument requires deep financial markets, active firm turnover and the ability to conduct the counter-cyclical educational and innovation expenditures. These characteristics are usually associated with developed economies [Hnatkowska and Loayza (2004)]. On the other hand, if recessions are linked with aggravating financial and fiscal constraints, as it is likely to occur in developing countries, these recessions can lead to less human capital development, lower productivity-enhancing expenditures and, thus, lower growth rates [Martin and Rogers (1997), Talvi and Vegh (2000)]. Moreover, to avert the economic recessions, governments may adopt policies such as labor-market restrictions, which make firms less flexible and less willing to innovate, thus, the negative link between volatility and long-run growth may further be deepened [Hnatkowska and Loayza (2004)].

Therefore, the study of fluctuations and growth is more important for developing countries and there is a need to study this volatility-growth relationship in a special context of developing countries. The present study focuses on analyzing the relationship between short-run GDP fluctuations and long-term growth in five selected South Asian countries (SSAC) including Bangladesh, India, Nepal, Pakistan and Sri Lanka for the period of 1980-2010. The paper is organized as follows - Section-II reviews the available existing literature followed by Section III which presents the theoretical framework. Section IV provides the data and methodology whereas Section V gives results and analysis. Finally, Section VI concludes the paper and gives policy recommendations.

II. Review of Literature

The study of the relationship between GDP fluctuations and economic growth got much attention after the seminal work of Ramey and Ramey (1995) that challenged the typical view of a dichotomy in the literature of growth and business fluctuations in macroeconomics. The study found that countries with higher volatility have lower growth. However, this link is not always negative as it could either be positive or negative as pointed out by Imbs (2002) who says that the link between growth and volatility depends on the mechanisms driving the relationship.¹

¹The Summary of Empirical Literature reviewed with explanation and justification is given in Table A-1 of the Appendix.

1. Literature on Negative Growth-Volatility Link

On the one hand, this relationship might be negative as in a sample of 92 countries and in another sample of 24 OECD countries Ramey and Ramey (1995) found that countries with higher volatility have lower growth. The addition of standard control variables further strengthens this negative relationship. Turnovsky and Chattopadhyay (1998) found that government expenditure volatility terms of trade volatility and monetary volatility have strong negative effects on the equilibrium growth rate. Martin and Rogers (2000) found that countries and regions having higher volatile growth and unemployment rates have lower growth rates. Caballero (2001) showed that the worsening impact of volatility and uncertainty on economic growth is due to the country's structural characteristics. Fatás (2002) concluded that business cycles cannot be regarded as the temporary deviations from a long-term trend and found that countries with more volatile fluctuations display lower long-term growth rates.

Hnatkovska and Loayza (2004) found that macroeconomic (GDP) volatility and long-run economic growth rate are negatively related and this negative relationship actually reflects the harmful effect of volatility on growth. Döpke (2004) found that a positive business cycle shock has a small negative impact on long-run productivity. Fatás and Mihov (2005) found that policy-volatility has a strong and direct negative impact on economic growth. Kose, et al. (2005) highlighted that generally there is a negative relationship between volatility and growth but the nature of this relationship keeps on changing over time, across different country-groups. Siegler (2005) found that there is a robust negative partial correlation between volatility and growth, after controlling other factors related to economic growth. Tochkov and Tochkov (2009) pointed out that provinces in South Korea have higher volatility had lower growth, but this is largely due to common shocks across all provinces.

2. Literature on Positive Growth-Volatility Link

The relationship between GDP fluctuations and long-term growth may be positive on the other hand, for instance, Aghion and Saint-Paul (1998a) found that the productivity improvements will be counter-cyclical if productivity growth is costly in terms of the current production. While, the productivity improvements will be pro-cyclical if the cost of productivity improvements is independent of current production. Similarly, Dejuan and Gurr (2004) also found a weak positive relationship between volatility and growth. Comin and Mulani (2007) presented an endogenous growth model and found that as market shares of firms become less persistent, the allocation of resources from the development of general innovations shift to the development of R&D innovations. This results in an increase in R&D and firm-level volatility but there is a decline in aggregate volatility.

3. *Literature on Mixed Growth-Volatility Link*

Despite the studies (quoted above) which show both the negative and positive link between growth and fluctuations, some of the researchers find mixed results. Kroft and Lloyd-Ellis (2002) found that the majority of the negative relationship comes from the interaction between growth and business cycle movements. The correlation of economic growth with high-frequency volatility was ambiguous or even positive.

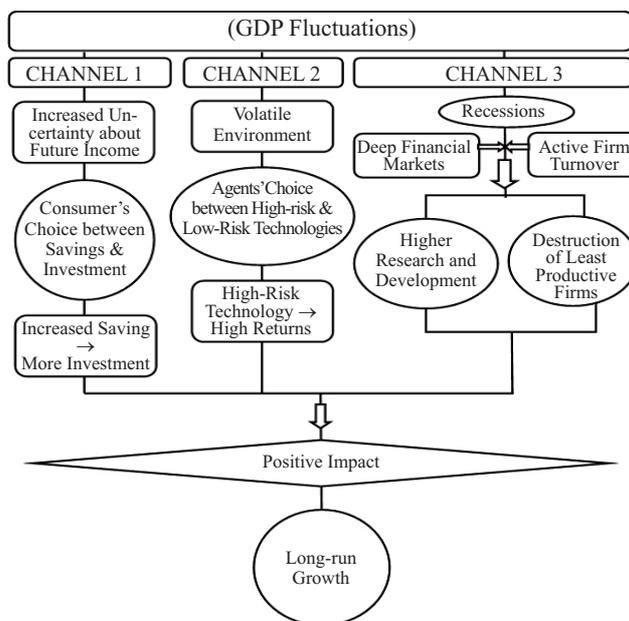
Herrero and Vilarrubia (2005) found that a low or moderate level of volatility can actually enhance the economic growth, whereas very high volatility is definitely detrimental to the economic growth. These results showed the existence of a 'Laffer Curve' type relationship between volatility and growth. Imbs (2006) found that, at the sectoral level the growth and volatility links positively; whereas, for aggregated level, the same data-set supported the well-known negative correlation between the aggregate growth and aggregate volatility.

III. Theoretical Framework

After a review of the existing available literature, there seems an undisputed view that GDP volatility is related to long-run growth in some way. However, there is neither a theoretical agreement nor reliable empirical evidence that may guide us to consider that the relationship is negative, positive or nonexistent [Edwards and Yang (2009)]. For example, Imbs (2002) says that links between fluctuations and growth might be positive or negative, depending on the mechanisms driving this relationship.

Theoretically, on the one hand, links between GDP fluctuations and long-run growth may be positive, for instance, Edwards and Yang (2009) pointed-out the three different channels suggesting a positive link between GDP volatility and growth. A diagrammatic representation of this positive link between growth and fluctuations is shown in Figure 1.

Firstly, this positive link can be drawn through the channel of consumers' choice between saving and consumption under the increased uncertainty (volatility) about future income. An increase in volatility and uncertainty makes the consumer more inclined to save which results in increased investment and thus higher output growth [Sandmo (1970, Mirman (1971)]. Secondly, according to Edwards and Yang (2009) the positive volatility-growth links can be derived through channel of agents' choice between high-expected-return technologies and or low-expected-return technologies [Black (1987)]. Under this scenario, if agents jointly choose the riskier technologies in a volatile environment, then the growth should be higher in subsequent periods. Thirdly, as pointed out by Edwards and Yang (2009) and Hnatkowska and Loayza (2004) another possible mechanism for a positive relationship is associated with the concept of creative destruction. If these



Source: Developed by authors based on Hnatkovska and Loayza (2004); Edwards and Yang (2009).

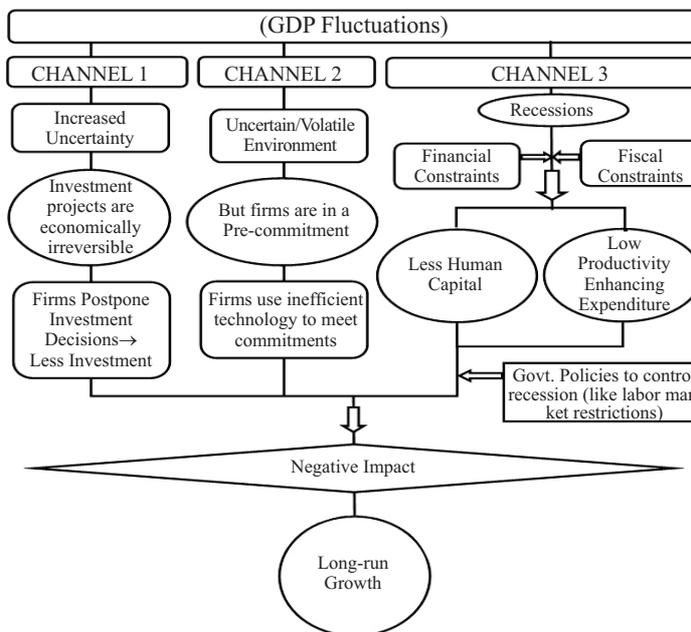
FIGURE 1

Positive Link between Fluctuations and Growth

fluctuations are linked with the occurrence of recessions and these recessions lead to higher research and development along with the destruction of least productive firms, then higher long-run growth can occur alongside higher volatility [Aghion and Saint-Paul (1998a), (1998b)]. However, this can happen usually for developed countries having deep financial markets, active firm turnover, and the ability to conduct the counter-cyclical educational and innovation expenditures [Hnatkovska and Loayza, (2004)].

On the other hand, the theoretical work has also presented the possibility of a negative link between growth and GDP volatility. Hnatkovska and Loayza (2004) and Edwards and Yang (2009) have discussed some scenarios to show the negative growth-volatility link. A diagrammatic representation of this negative link between growth and fluctuations is shown in Figure 2.

- i) As Edwards and Yang (2009) highlight that negative link can establish when investment projects are economically irreversible and firms under increased uncertainty may opt to defer their decisions to invest. This type of waiting-for-better-information behaviour might result in a lower growth rate [Bernanke 1983], Pindyck (1991)].
- ii) Edwards and Yang (2009) has pointed-out, another scenario, that in general equilibrium model of Ramey and Ramey (1991) when firms are in a pre-com-



Source: Elaborated by authors based on Hnatkovska and Loayza (2004), Edwards and Yang (2009).

FIGURE 2

Negative Link between Fluctuations and Growth

mitment they may use an inefficient production technology to meet their commitments, which can then lead to lower growth.

In addition, Edwards and Yang (2009) derived the negative growth-volatility link through another scenario of labour in a learning-by-doing environment [Martin and Rogers (1997), (2000)]. Under this scenario, in times of recession learning-by-doing opportunities are lost and human capital accumulation is slowed leading to a negative growth-volatility relationship [Edwards and Yang (2009)]. Similarly, this scenario is also explained by Hnatkovska and Loayza (2004) showing that a negative link between fluctuations and growth might exist, more likely in case of developing countries which are facing deteriorating financial and fiscal constraints. In such cases, recessions can lead to less human capital development, lower productivity-enhancing expenditures and thus smaller growth rates [Martin and Rogers (1997), Talvi and Vegh (2000)]. Moreover, managing these economic recessions could prompt governments to adopt policies, like labor-market restrictions that make firms less flexible and less innovative, thus further deepening a negative link between volatility and long-run growth [Hnatkovska and Loayza (2004)].

IV. Data and Methodology

1. Research Hypotheses

Based on the literature reviewed and the theoretical framework given above, this study intends to test the following hypothesis:

Hypothesis – I: There exists a long-run co-integrating relationship between GDP fluctuations and GDP Growth in the SSAC.

Hypothesis – II: There exists a negative link between GDP fluctuations and GDP Growth in the SSAC.

2. Data Description

The annual data on GDP per capita, GDP per capita growth rate for the period 1980-2010 for SSAC is taken from the world development indicators World Bank (2012). The volatility or fluctuation in GDP is measured using five-years moving standard deviation of per capita GDP from the trend, while the long-run growth is measured by five-years moving average of per capita GDP growth rate as most of the cross-section studies uses mean per capita growth rate as proxy of long-run growth. The data of all the control variables including financial development (FINDEV), Investment (INVT) proxied by gross fixed capital formation as percentage of GDP, Government Size (GOVT) proxied by share of government expenditures on final consumption as percentage of GDP, Openness (OPEN) proxied by volume of trade (sum of imports and exports) as percentage of GDP, Population growth rate (POPGR) and initial GDP² (IGDPP) is also taken from the World Bank (2012).³

3. Measurement of GDP Fluctuations

Since, ‘GDP fluctuations’ or ‘volatility’ is the core variable in the present study, therefore the first step before empirical analysis is to measure the GDP fluctuations. Most of the literature follows the standard deviation of GDP growth rate (or per capita growth rate) as a measure of GDP fluctuations in the cross-section studies or panel studies, and the five-years moving standard deviation in time-series studies. But, standard deviation may be an unsatisfactory proxy of volatility [Pritchett (1998) and Breen and García-Peñalosa (1999)].⁴

² Initial GDP per capita is measured by natural logarithm of ten years’ rolling back window of GDP per capita (GDPP), i.e., the current year initial GDP per capita is ten years back GDP per capita as used by Khan (2010).

³ Detailed variable description along with sources of data has been given in Table A-2, Appendix.

⁴ Breen and García-Peñalosa, 1999, explains it with an example of two countries with the following growth patterns: country A has annual growth rates of 4, 2, 4, 2, 4, and 2 (per cent), while country B has 4, 4, 4, 2, 2, and 2 (per cent). Both countries will have the same standard deviation (i.e., 1.095) but obviously, country A has the higher level of volatility than B.

Among other alternatives, ARCH/GARCH model can be used for time-series analysis but these are mostly suitable for financial variables and other variables (i.e., exchange rate, prices, etc.) where high frequency data is available. Lensink, et al. (1999) pointed out that to measure volatility the application of GARCH models requires high-frequency observations and long time series; moreover, the GARCH-type models of volatility are also criticized due to the possible misspecification of the conditional mean equation. Therefore, for measuring GDP fluctuation the current study uses standard deviation from trends (SDFT) which is closer to the definition of GDP fluctuations⁵ because it shows the deviation of growth rate of GDP from its trend values. The formula for SDFT can be written by replacing Mean of $GDPPCg_t$ with Trend value of $GDPPCg_t$ year t ($GDPPCgT_t$) in the simple standard deviation formula [Equation (1)]:

$$SDFT = \sqrt{\frac{1}{n-1} \sum_{t=1}^n (GDPPCg_t - GDPPCgT_t)^2} \quad (1)$$

where, $GDPPCg_t$ is GDP per capita growth rate in year t, $GDPPCgT_t$ is the trend value of GDP per capita growth at time t, n is the total number of years. To measure SDFT using the above formula, first of all the series of GDP per capita growth rate of each country (individually) has been decomposed into trend and cyclical components using the Hodrick-Prescott (HP) filter [Hodrick and Prescott (1997)] with a smoothing parameter set at 6.25 [as suggested by Ravn and Uhlig (2002) for annual data]. Then the standard deviation of cyclical component is calculated to get the SDFT. Hodrick and Prescott (1997) originally found the value of smoothing parameter (λ) as 1600 for US quarterly data. Rand and Tarp (2002) found that business cycles in developing countries are significantly shorter in duration than the cycles in developed countries. Therefore, the present study uses the choice of $\lambda=6.25$ suggested by Ravn and Uhlig (2002) for annual data. The standard deviation of cyclical component gives the same value of SDFT [as in the formula given in Equation (1)] which can be proved as under:

$$\text{Cyclical Component of } GDPPCg_t (Cyc_t) = GDPPCg_t - GDPPCgT_t \quad (2)$$

Therefore, the SD of Cyc_t will be;

$$SD \text{ of } Cyc_t = \sqrt{\frac{1}{n-1} \sum_{t=1}^n (Cyc_t - \overline{Cyc})^2} \quad (3)$$

$$\text{But, } \overline{Cyc}_t = 0 \text{ as } \sum (GDPPCg_t - GDPPCgT_t) = 0 \quad (4)$$

⁵ GDP Fluctuation refers to the deviations of GDP growth rate (or per capita growth rate) around its trend or potential level.

Thus, after putting these values of Cyc_t and $\overline{Cyc_t}$ from Equation (2) and (4), respectively, in Equation (3):

$$SD \text{ of } Cyc_t = \sqrt{\frac{1}{n-1} \sum_{t=1}^n (GDPPCg_t - GDPPCgT_t)^2} \quad (5)$$

Hence, it is proved that,

$$SD \text{ of } Cyc = SDFT$$

The SDFT (SD of Cyc) provides a measure of volatility in GDP growth during the whole period of 1980-2010. To compare the decade-wise trends of GDP fluctuations in the SSAC, this study also calculates the SDFT for the sub-periods of ten years. The above calculation (of SDFT or SD of Cyc) gives an aggregate measure of volatility, but for the empirical analysis the annual (year-by-year) time-series data on GDP fluctuation is needed. For this purpose the five-years moving SDFT is used, this provides a series of GDP fluctuations for an adjusted period of 1982-2008. Now, for five-years moving SDFT Equation (1) becomes as under:

$$\text{Five years moving } SDFT_t = \sqrt{\frac{1}{5-1} \sum_{t=2}^{t+2} (GDPPCg_t - GDPPCgT_t)^2} \quad (6)$$

An annual series of GDP fluctuations has been generated by using the formula [Equation (6)] and the time-period is adjusted to 1982 to 2008 from 1980 to 2010, due to using the five-years moving method.

4. *Econometric Methodology*

Most of the existing studies having micro-panel data used the country average simple arithmetic mean and standard deviation of GDP per capita growth rate of the time-period under study as a proxy of long-run growth and volatility, respectively. While, some panel-data studies used the country-average for the sub-periods by dividing the time-period in decades or even smaller sub-periods. Since this study is also interested in testing the consistency of GDP fluctuations and growth relationship over time, this method of country-average is not suitable in this case. Due to small country-sample, the present study uses the five-year moving average. The study also uses five-years moving average of GDP per capita growth rate as a proxy of long-run growth and five-years moving standards deviation from trend of GDP per capita growth rate which is used to measure the GDP fluctuations.

The existing panel data studies, until very recently, ignored the issue of non-stationarity in the panel-data [Asteriou (2006)]. Similarly, the existing panel data studies on GDP volatility and growth, seems to ignore the issue of non-stationarity in the panel-data. However, in a macro-panel model (with small N and large T), like present study, the existence of non-stationarity is more likely. Therefore, this study employs

the panel cointegration framework. But, before proceeding to the cointegration analysis, first the order of integration is to be checked, by applying the unit root tests. Along with the unit root analysis another recently developed concept of the cross sectional dependence is also gaining lot of attraction in the recent non-stationary panel literature. Therefore, the current study employs the Cross Sectional Dependence (CD) test by Pesaran (2004) before applying the panel unit root test.

a) Cross Sectional Dependence Test

Pesaran (2004) suggests a simple test for testing the cross-sectional dependence (CD) which can be applied to the variety of panel-data models including stationary and non-stationary dynamic heterogeneous panels. This CD test is based on the average of pair-wise correlation coefficients of OLS residuals from the individual regressions in the panel [Baltagi (2005), p. 247]:

$$CD = \sqrt{\frac{2T}{N(N-1)} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij} \right)} \quad (7)$$

b) Panel Unit Root Test

The first step in determining the potential cointegrated relationship is to test whether the variables of interest are stationary or non-stationary. There are many tests available for testing the unit root in panel data like Breitung (2000), Hadri (2000), Levin, et al. (2002) test (known as LLC test), and Im, et al. (2003) test (known as IPS test), etc. But all these tests assumes cross sectional independence. As mentioned earlier it is more likely that our data may have cross-sectional dependence, therefore, none of these above-mentioned tests can be used.

Accordingly, the current study employs the Breitung and Das (2005) panel unit root test. The main advantage of this test is that it can also be applied in the presence of cross-sectional dependence. In case of cross-sectional dependence the robust value of lambda is calculated to account for the cross-sectional dependence otherwise in case of cross-sectional independence the simple value of lambda is calculated [Breitung and Das (2005)].

c) Panel Cointegration Test

After confirming the order of integration of variables of interest, and if the variables are non-stationary, the next step is to check for cointegration, because the use of traditional OLS may give spurious results in presence of the unit root. Therefore, the current study uses the panel cointegration technique. For the panel cointegration test, the current study employs Pedroni [(1997), (1999) and (2004a)] panel cointegration tests. The main advantage of using Pedroni panel cointegration test is that

it accounts for cross-section dependence, if common time dummies added as Banerjee and Lluís (2006) pointed out that most panel data tests (including Pedroni) assume cross-section independence, except for common time effects. Therefore, the addition of common time effects (common time dummies) may account for the problem of cross-sectional dependence.

The panel regression model to analyze the long-run cointegrating relationship between growth and GDP fluctuations for Pedroni panel cointegration test, can be represented as under:

$$LGR_{i,t} = \alpha_i + \delta_t \sum_{m=1}^M \beta_{mi} FLUC_{mi,t} + e_{i,t} \quad (8)$$

where LGR = Long-run growth rate, and FLUC = GDP fluctuations.

Using the above equation, the null of no cointegration is tested through seven test statistics developed by Pedroni (1999). The first four statistics (Panel-v, Panel- ρ and Panel-t (PP and ADF)) are based on pooling the residuals along the within dimension of the panel. The rest of three statistics (Group- ρ and Group-t (PP and ADF)) are based on pooling the residuals along the between dimension of the panel [Pedroni (1999)].

d) Panel Estimation using Group Mean FMOLS Approach

The panel cointegration test provides information about the long-run equilibrium relationship among the variables but they do not estimate the cointegrating vectors. For this purpose, the present study uses the group mean (panel) fully modified ordinary least squares (GM-FMOLS) developed by Pedroni [(2001a), (2001b), (2004b)] which is an extension of time-series fully modified OLS (FMOLS) by Phillips and Hansen (1990).

The main advantage of using GM-FMOLS estimator is that it not only gives consistent estimates of β parameters in relatively small samples, but it also controls for the likely endogeneity of the regressors and serial correlation [Ramirez (2010), AlYousef (2013)]. This technique also control for the likely cross-sectional dependence by including common time dummies in the model [Pedroni (2001a), Lee (2007)]. Another method which allow estimation in the presence of cross-sectional dependence is the Pesaran (2006) CCEMG estimator, but all the mean group family estimators are variants of mean group estimators and according to Pesaran, et al. (1999), “mean group estimator is asymptotically normal for large N and large T ... it is unlikely to be a good estimator when either T or N is small”. Therefore, this study prefers GM-FMOLS over mean group family. Moreover, Tsangarides, et al. (2007) pointed out that GM-FMOLS estimators have satisfactory size and power properties even for small panels, as long as T is larger than N, and in the presence

of homogeneous cointegrating vector mean-group, estimators have better small sample performance than within the group estimators. Tsangarides, et al. (2007) further highlighted the PMG estimator and imposes long-run homogeneity which can also produce inconsistent estimates of the average values of parameters, if the assumption of homogeneity is violated in practice. Therefore, the present study employs the GM-FMOLS with common time dummies to estimate the long-run cointegrating vector.

To model the relationship between GDP fluctuations and long-run growth, this study follows the methodology of Ramey and Ramey (1995), Fatás (2002), and Hnatkovska and Loayza (2004) and construct a simple model, represented as:

$$LGR_{i,t} = \alpha_i + \beta_i FLUC_{i,t} + \varepsilon_{i,t} \quad (9)$$

where, LGR is a long-run growth, FLUC is a GDP Fluctuations, α is an intercept, β_i is elasticity coefficient (to be measured to examine the relationship between growth and fluctuations) and is expected to be negative for developing countries, as in the case of SSAC, ε is residual of equation or random error-term; while i represents the country and t represents the time-period (a year, in the case of this study).

Adding control variables in Equation (3) helps to analyze whether the simple link between GDP fluctuations and long-term growth is channelled through regular growth determinants [Hnatkovska and Loayza (2004)]. Therefore, after adding control variables Equation (9) can be represented as:

$$LGR_{i,t} = \alpha_i + \beta_i FLUC_{i,t} + \gamma_i X_{i,t} + \varepsilon_{i,t} \quad (10)$$

where, X represents a set of control variables including IGDPP (natural logarithm of Initial GDP per capita, a proxy of transitional convergence or developmental level of the country), FINDEV is financial development. For cross-country growth analysis these control variables were suggested by Levine and Renelt (1992) and, along with other control variables were also used by Ramey and Ramey (1995), Fatás (2002) and Hnatkovska and Loayza (2004). Along with these variables some other determinants of growth like Investment (INVT), Government Size (GOVT), Trade Openness (OPEN) and Population growth rate (POPGR) are also added as control variables used by [Khan (2010)].

All idiosyncratic (individual country) coefficients ($\hat{\beta}_{FM,i}^*$) and associated t-statistic for each country (i) are estimated by using Equation (10). The Group Mean (Between-Dimension) panel estimates ($\hat{\beta}_{GFM}$) can be calculated by using the following formula [Pedroni (2004b)].

$$\hat{\beta}_{GFM} = N^{-1} \sum_{i=1}^N \left(\sum_{t=1}^T (P_{it} - \bar{P}_i) \right)^{-1} \times \left(\sum_{t=1}^T (P_{it} - \bar{P}_i) s_{it}^* - T \hat{\gamma}_i \right) \quad (11)$$

where,

$$s_{it}^* = (S_{it} - \bar{S}_i) - \frac{\hat{\Omega}_{2li}}{\hat{\Omega}_{22i}} \Delta p_{it}$$

$$\hat{\gamma}_i = \hat{\Gamma}_{2li} + \hat{\Omega}_{2li}^\circ - \frac{\hat{\Omega}_{2li}}{\hat{\Omega}_{22i}} (\hat{\Gamma}_{22i} + \hat{\Omega}_{2li}^\circ)$$

In Equation (11) expression after the summation over i is similar to the conventional idiosyncratic time-series estimator ($\hat{\beta}_{FM,i}^*$), therefore, the between dimension panel estimator ($\hat{\beta}_{GFM}$) can be simply constructed by,

$$\hat{\beta}_{GFM,i}^* = N^{-1} \sum_{i=1}^N \hat{\beta}_{FM,i}^* \quad (12)$$

where, $\hat{\beta}_{FM,i}^*$ is the conventional time-series (individual country) FMOLS estimator of i th member of panel. Similarly, related t-statistic for the between dimension panel estimator can be measured by the following formula given by Pedroni (2004b).

$$t_{\hat{\beta}_{GFM,i}^*} = N^{-1/2} \sum_{i=1}^N t_{\hat{\beta}_{FM,i}^*} \quad (13)$$

where, $t_{\hat{\beta}_{FM,i}^*}$ is the conventional time-series (individual country, i) t-statistic, of i th member of panel, associated with related $\hat{\beta}_{FM,i}^*$. The formula of $t_{\hat{\beta}_{FM,i}^*}$ by Pedroni (2004b) is given as:

$$t_{\hat{\beta}_{FM,i}^*} = (\hat{\beta}_{FM,i}^* - \beta_\circ) \left(\hat{\Omega}_{1li}^{-1} \sum_{t=1}^T (P_{it} - \bar{P}_i)^2 \right)^{1/2} \quad (14)$$

V. Results and Analysis

1. Cross Sectional Dependence Testing

The results of CD Test by Pesaran (2004) are given in Table 1 which shows that except the GDP fluctuations (FLUC) and Government Size (GOVT) the null of no cross-sectional independence can be rejected.

All variables except the FLUC and GOVT are found as cross-sectionally dependent variables, whereas, GDP fluctuations (FLUC) and Government Size (GOVT) are found as cross-sectionally independent variables.⁶

⁶ Pesaran (2004) CD Test implemented using XTCD Stata Module by Eberhardt (2011).

2. Panel Unit Root Testing

Table 2 depicts the results of Breitung and Das (2005) panel unit root test at level. The value of lambda (λ) statistic shows that at level all variables are non-stationary at 5 per cent level of significance. The robust values of lambda (λ) are given to account for cross-sectional dependence except the FLUC and GOVT which are the cross-sectionally independent. Similarly, Table 3 shows the results of Breitung and Das (2005) panel unit root test at the first difference.

Results of Breitung and Das (2005) panel unit root test shows that all variables are integrated of order one, i.e., I(1).

TABLE 1
Cross Sectional Dependence (Growth and GDP Fluctuations)

Variable	CD-test	p-value	Corr	abs (corr)
OPEN	4.740	0.000	0.289	0.375
GOVT	-1.110	0.265	-0.068	0.339
FINDEV	9.860	0.000	0.600	0.600
LGR	2.950	0.003	0.180	0.321
INVT	3.530	0.000	0.215	0.275
FLUC	0.540	0.588	0.033	0.242
POPGR	10.390	0.000	0.633	0.633
IGDP	15.770	0.000	0.960	0.960

Notes: Under the null hypothesis of cross-section independence $CD \sim N(0,1)$ Source: Author's Calculation.

TABLE 2
Breitung and Das (2005) Panel Unit Root Test (at Level)

Lambda Statistic (Probability in parenthesis)							
FINDEV	INVT	FLUC	GOVT	IGDPP	LGR	OPEN	POPGR
With Intercept Only							
3.2224 (0.9994)	0.1908 (0.5757)	-0.4644 (0.3212)	-1.0303 (0.1514)	7.3986 (1.0000)	0.0082 (0.5033)	1.3295 (0.9082)	-0.4406 (0.3928)
With Intercept and Trend							
3.0679 (0.9989)	-0.0029 (0.4988)	-1.4907 (0.0680)	0.1809 (0.5718)	0.6553 (0.7439)	-0.3935 (0.3470)	1.7235 (0.9576)	-1.5776 (0.5730)

** and *** represent the rejection of null hypothesis of no unit root at 5% & 1% level of significance, respectively.

3. Panel Cointegration Testing

After affirmation of the order of integration of variables, the results of the bivariate Pedroni panel cointegration tests are shown in Table 4. The Pedroni's five panel test statistics (out of the total seven statistics) shows the existence of long-run equilibrium relationship between LGR and FLCU in case of model with intercept and no trend. The results are also same for the model with intercept and trend.

TABLE 3

Breitung and Das (2005) Panel Unit Root Test (at 1st Difference)

Lambda Statistic (Probability in parenthesis)							
FINDEV	INVT	FLUC	GOVT	IGDPP	LGR	OPEN	POPGR
With Intercept Only							
-4.9692***	-4.7282***	-7.4447***	-4.9800***	-5.496***	-3.104***	-4.1148***	-2.28***
(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0010)	(0.0000)	(0.0114)
With Intercept and Trend							
-1.6883*	-5.0905***	-6.7141***	-2.225**	-7.211***	3.5213***	-3.4999***	-2.6508***
(0.0457)	(0.0000)	(0.0000)	(0.0131)	(0.0000)	(0.0002)	(0.0002)	(0.0040)

** and *** represent the rejection of null hypothesis of no unit root at 5% and 1% level of significance respectively.

TABLE 4

GDP Fluctuations and Long-run Growth – Panel Cointegration Test for SSAC

Test Statistics	With Intercept and No Trend+		With Intercept and Trend+	
	Un-weighted	Weighted++	Un-weighted	Weighted++
panel v-stat	-0.6275	-0.4235	-0.1411	-0.353
panel rho-stat	1.3593	1.3926	1.7899	1.9396
panel pp-stat	-1.5277*	-1.6665*	-2.9384***	-2.3183***
panel adf-stat	1.5016*	1.3018	2.5776***	2.1030**
group rho-stat	2.1846***	-	2.6625***	-
group pp-stat	-1.9891**	-	-2.3614***	-
group adf-stat	1.8357*	-	2.2072***	-

Note: Null hypothesis: no cointegration, + common time dummy included to account for cross sectional dependence, ++ Panel stats are weighted by long run variances, *, ** and *** represent the rejection of null hypothesis of no unit root at 10%, 5% and 1% level of significance, respectively.

4. Group Mean FMOLS Results and Discussions

The long-run GM-FMOLS, i.e., Pedroni panel (group-mean) FMOLS estimates are presented in Table 5.⁷ The results of the GM-FMOLS estimations show a negative and highly significant relationship between the long-run growth rate and GDP fluctuations in SSAC and the Investment, Openness, Initial GDP has positive and significant relationship with long-run growth rate in SSAC. The investment and Openness has positive link with growth which is according to the theory [Khan (2010), Ramey and Ramey (1995) and many others]. In light of both the hypotheses [mentioned in Section IV(1)] are accepted hereby as there exists a long-run co-integrating relationship, the link of which is negative as well, in the SSAC.

Most of the literature shows that links between the initial GDP per capita is negative, however, some studies found positive link as Tabassum and Majeed (2008) found positive relation between these variables in the South and East Asia.

TABLE 5
Group Mean Fully Modified OLS (GM-FMOLS) Results

Dependent Variable: Long-run Growth (LGR)			
Variable	Coefficient		t – Statistics
FLUC	-0.72417		-10.6377***
INVT	0.140064		7.671727***
FINDEV	0.009261		1.290727
GOVT	-0.31143		-9.10337***
OPEN	0.03243		1.865097**
IGDPP	5.69959		3.292461***
POPGR	-0.8324		-5.01019***
Constant	0.53876		-0.32469
Diagnostic Testing			
Residual Stationarity	I(0)	CD Test for Residual	-0.6 (0.546)
F Test	166.093 (0.000)	RMSE	0.8209

*, ** and *** represents 10%, 5% and 1% significance level, respectively.

⁷ The GM-FMOLS model is estimated using RATS code (PANELFM) by Doan (2012).

Government size and population growth have negative and significant relationship with long run growth in SSAC which is according to the literature [Khan (2010), Ramey and Ramey (1995)]; while the financial development (FINDEV) has positive but insignificant relationship with growth which is also similar to the literature as the relationship is positive in the long-run [Khan (2010)].

The post estimation diagnostic tests are also shown in Table 5. These tests show that the F-test is significant and residuals are stationery. CD Test for residuals shows that they are cross-sectionally independent which shows that adding common time dummies resolve the issue of cross section dependence. The results of GM-FMOLS estimation show that relationship between the long-run growth and GDP fluctuations is significant and negative. The results are similar to those of Ramey and Ramey (1995), Fatás (2002), Acemoglu, et al. (2003), Hnatkovska and Loayza (2004) and many others found similar results.

VI. Conclusion and Policy Implications

This study investigates the impact of GDP fluctuations on long-run economic growth by employing the modern panel approach in a panel of five selected South Asian countries (SSAC) over the period of 1980-2010. For this purpose, modern non-stationary panel techniques such as cross section dependence test, unit root test under the cross sectional dependence, panel cointegration and Group Mean Fully Modified OLS (GM-FMOLS) estimation are applied.

The study finds presence of cross-section dependence and non-stationarity among variable. The Peroni panel cointegration shows that there exists a long-run cointegrating relationship between GDP fluctuations and long-run growth in the SSAC; GM-FMOLS estimates show that this link is negative. Thus, the results indicate that GDP fluctuations have a significant negative impact on long-run growth in the SSAC. The results are similar to those of Ramey and Ramey (1995), Fatás (2002), Acemoglu, et al. (2003), Hnatkovska and Loayza (2004) and many others who found similar results. The other determinants of the growth were added as control variables and were found significant and as per literature and theory.

These findings have serious policy implications for developing countries, generally and for South Asia, particularly. The significant negative impact of GDP fluctuations on long-run growth suggests that these fluctuations and volatility of GDP may be detrimental to long-run growth in developing countries. Therefore, the governments shouldn't rely only on growth-oriented policies but should equally focus on managing the volatility of GDP to achieve sustained and stable growth. Therefore, there is a need to identify the underlying sources and determinants of GDP fluctuations in order to devise a policy mechanism to curtail and manage these fluctuations. As, Caballero (2001) shows that the worsening impact of volatility and uncertainty on economic growth is due to the country's structural characteristics

like poor financial development, procyclical fiscal policy and deficient rule of law usually goes together with large public indebtedness. Thus, serious efforts are needed to improve country's structural characteristics and to control other sources of volatility to manage the GDP fluctuations.

*The Urban Unit, Government of Punjab, and
The Government College University, Lahore, Pakistan.*

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APPENDICES

TABLE A-1

Summary of Empirical Literature Reviewed

Study Name	Data and Methodology	Empirical Finding	Explanation/ Reasoning
Ramey and Ramey (1995)	A sample of 92 economies and in another sample of 24 OECD economies; Cross-section.	Countries having higher volatility have lower growth.	Volatility persuaded by government expenditures is negatively linked with growth.
Turnovsky and Chattopadhyay (1998)	A sample of 61 developing countries Cross-section.	For high volatile economies, the study found government expenditure volatility, monetary volatility and terms of trade volatility all to have strong negative effects on the equilibrium growth rate.	Developing economies have negative link as explained in theoretical framework.
Caballero (2001)	Case-studies of three Latin American countries (Argentina, Mexico and Chile).	Worsening impact of uncertainty (volatility) on economic growth.	Due to the country's structural characteristics, like poor financial development, pro-cyclical fiscal policy and deficient rule of law, which usually goes together with large public indebtedness.
Hnatkovska and Loayza (2004)	Cross-country correlation between volatility and long-run economic growth using cross sectional data, especially, the country-averages for the period of 1960-2000 of 79 nations along with 22 OECD countries.	GDP volatility and long-run economic growth rate are negatively related.	Institutionally poor experiencing intermediary level of financial development, underdeveloped economies or inability to carry out counter cyclical fiscal policies.

Contd....

TABLE A-1

(Continued)

Study Name	Data and Methodology	Empirical Finding	Explanation/ Reasoning
Döpke (2004)	Quarterly time-series data of the G7-countries covering the period of 1970-I to 2001-IV; VAR Model.	Business cycle shock has a small negative effect on long-run productivity. However, the results appeared to be not robust with changes in the empirical model.	G-7 (Developed economies), therefore, results are not robust. (in agreement with theoretical framework).
Fatás and Mihov (2005)	Cross-section of 91 nations.	Policy-volatility have a strong and direct negative impact on economic growth.	Policy volatility appears as a primary determinant of macroeconomic performance. The study signified the role of political institutions in determining the policy outcomes.
Kose, Prasad and Terrones (2005)	Annual data for a period of 1960-2000 on a sample of 85 economies (21 industrial and 64 developing).	There is a negative relationship between growth and volatility during this whole period but the nature of this relationship kept on changing over time and across different country-groups.	As explained in theoretical framework.
Siegler (2005)	Panel data set of 12 nations over the period of 1870 - 1929.	There is a significant negative relationship between growth and volatility, even after controlling for the other related factors.	Result confirmed the results of recent empirical studies of the post-World War II period.
Tochkov and Tochkov (2009)	provincial data from South Korea over a period of 1985-2003.	Provinces with higher volatility had lower growth.	Results for common shocks across all provinces shows the agreement with theoretical framework.

Contd....

TABLE A-1

(Continued)

Study Name	Data and Methodology	Empirical Finding	Explanation/ Reasoning
Dejuan and Gurr (2004)	10 Canadian provinces' data over the period of 1961–2000.	The results of cross-section and panel-data estimations indicated a weak positive relationship between growth and volatility.	Developed country data (in agreement with theoretical framework).
Herrero and Villarubia (2005)	Over 100 countries during the period 1978-2002.	A low or moderate level of volatility can actually enhance the economic growth whereas very high volatility is definitely detrimental to the economic growth.	Shows the existence of a “Laffer Curve” type relationship between volatility and growth.
Imbs (2006)	47 countries using a yearly sectoral data-set of manufacturing activities published by UNIDO for the period from 1970 to 1992.	At the sectoral level, the growth and volatility links positively. This positive correlation was statistically significant and economically sizeable, especially in a reduced sample of OECD countries, whereas, for aggregate level, the same data set provided support for the well-known negative relationship between aggregate growth and aggregate volatility.	Inclusion of OECD countries in sample (as per theoretical framework, advanced economies may have positive link).
Lee (2010)	Panel data of G7 countries over the period 1965–2007.	There is a positive link between higher output growth and higher volatility of the innovations to growth.	Developed country data (in agreement with theoretical framework).

TABLE A-2
Variable Description

Acronym	Variable Description/Measurement	Source
FLUC	GDP Fluctuations: Five-years moving standard deviation (SD) of per Capita GDP growth from trend (five-years moving SD of cyclical component, decomposed by HP filter) is used as an indicator of GDP.	Authors' Calculation based on WDI* data on GDP per capita growth.
LGR	Long-run Growth: Usually measured by mean growth rate. But, here the annual data is required, therefore, five-years moving average (mean) of GDP per capita growth rate is used as an indicator of Long-run Growth.	Authors' Calculation based on WDI data on growth rate of GDP per capita.
FINDEV	Financial Development: Domestic private credit to GDP ratio (%) is used as indicator of Financial Development.	WDI 2012, Online
IGDPP	Initial GDP per capita: Natural logarithm of ten year rolling back window of GDP per capita (GDPP) is used as an indicator Initial GDP per capita, i.e. current year initial GDP per capita is the ten year back GDP per capita (Khan, 2010).	WDI 2012, Online
OPEN	Trade Liberalization / Openness: Volume of Exports + Imports as a share of GDP (%) is used as an indicator of Trade Openness.	WDI 2012, Online
INVT	Investment: Gross Fixed Capital Formation as percentage of GDP is taken as an indicator of Investment.	WDI 2012, Online
GOVT	Size of Government: Final consumption expenditures by government as a percentage of GDP is used as an indicator of Size of Government.	WDI 2012, Online
POPGR	Population growth rate (in %)	WDI 2012, Online

* World Development Indicators.