

Fiscal Policy, Institutions and Economic Growth in Asian Economies: Evidence from the Pedroni's Cointegration Approach

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Abstract

This paper investigates the relationship between fiscal policy, institutions and economic growth in Asian between 1982 and 2001 through the application of Pedroni's Cointegration approach. It examines three different channels through which fiscal policy can affect long run economic growth in Asia. The first channel is when components of fiscal policy affects the real per capita GDP and the second channel is when the institutions included in components of fiscal policy affects the real per capita GDP. The third channel is when institutions interact with aggregate of government expenditure and aggregate of fiscal policy affects the real per capita GDP. The Pedroni Cointegration result establishes a long run relationship between fiscal policy, institutions and economic growth. We find positive and statistically significant impact of health and education expenditure, aggregate of government expenditure, aggregate of fiscal policy and institutions on real per capita GDP. We also find that the defence expenditure, distortionary taxation and budget balance are significantly and negatively related to real per capita GDP. Furthermore, we find that aggregate of government expenditure and aggregate of fiscal policy variables interact with institutions variable and have a potential impact on long-run steady-state levels of growth.

Keywords: Economic growth, Fiscal policy, Institutions, Panel cointegration, FMOLS

1. Introduction

In the debate on economic policy, fiscal policy is predominantly viewed as an instrument to mitigate short-run fluctuations of output and employment. By a variation in government spending or taxation, fiscal policy aims at altering aggregate demand in order to move the economy closer to potential output. Fiscal policy was neither a cause of the crisis nor a critical determinant of economic growth. Nevertheless, its role in both the pre-crisis and post-crisis period in Asian countries has been seen as crucial, primarily in terms of its contribution to economic growth.

There are large differences among the Asian countries in their levels of living and other circumstances, as well as the policies that they have pursued. Larger government size is likely to be an obstacle to efficiency and economic growth because the taxes necessary to support government expenditures distort incentives to work and to invest, absorb funds that otherwise would have been used by the private sector in profitable investment opportunities, generally reduce efficient resource allocation, and hence reduce the level of output. In addition, government operations are often carried out inefficiently, and the regulatory process imposes excessive burdens and costs on the economic system. Thus, countries with greater government expenditure as a proportion of output should experience lower economic growth. These arguments, together with the debt crises experienced have led many countries to start a mass deregulation of market and privatization of public enterprises. Based on the above argument, and as we mentioned earlier, Keynesian economics predicts government expenditure should lead to economic growth.

When looking at the growth performance in the Asian countries in recent decades, two observations are noteworthy. First, growth has declined and become stagnant significantly since 1985. Secondly, government expenditure does not inhibit the full exploitation of the growth potential of Asian economies. There is a broad consensus that these developments in fiscal policies contribute to the relatively weak growth performance in the Asian countries.

Fiscal positions vary significantly across countries and sub regions. Significant fiscal deficit and accumulation of public debt are relatively new phenomena for most Asian economies. However, expenditure growth outpaced revenue growth in many Asian economies, leading to persistent budget deficits and high indebtedness. Weak fiscal positions have left little room for further fiscal expansion in most Asian economies when faced by economic slowdown. Moreover, measuring fiscal policy has always posed a difficult challenge.

The Asian economies provide a sample large enough to allow for some generalization but small enough for analysis in sufficient detail to account for the complexity of law and legal institutions within economies. The rules of institutions histories of the Asian economies have common characteristic and important differences, and they are received entire legal systems from the West. Asian countries differed from each other in terms of initial conditions, the institutional context, and government policies. These differences have led many to argue that there is no single Asian recipe for success. It is plausible that many of these differences account for the variation in economic performance in the region as well. Of course, it is well recognized that institutions have played a key role in most Asia's success. But do institutional differences also explain why some countries in Asian countries have done better than others?

The objective of this study is to examine the long run relationship between the components of fiscal policy, institutions and economic growth in Asian countries. Thus, this study aims at filling a gap in research devoted solely to investigating the relationship between fiscal policy and economic growth using of newly developed methods of panel cointegration by Pedroni (2004 and 2001) and panel FMOLS estimator (Pedroni, 1996 and 2000).

This paper is organized as follows. Section 2 contains a brief literature review. In section 3, the model is applied to the thirteen Asian economies. Section 4 presents empirical results and the last section concludes.

2. Review of Related Literature

The most recent empirical literature, mainly based on panel data regressions, shows that economic growth is significantly affected by fiscal policies, although there remains some lack of agreement on the sign of the effects. On the other hand, Caselli *et al.* (1996) found robust positive contribution of the government expenditure ratio (net of defence and educational expenditure) to growth. In a similar way, Kneller *et al.* (1999) found that public expenditure and taxation only affected growth if they were productive and distortionary, respectively; productive government expenditure was found to positively affect growth, whereas distortionary taxation was found to be harmful for growth. With this distinction they argued that both sides of the government budget should be considered in estimating the impact of fiscal policy on growth, as their financing offset the growth-enhancing effects of productive expenditure. Gerson (1998) and Tanzi and Zee (1997) surveyed the theoretical and empirical literature on the effect of fiscal policy variables (tax policy, public expenditure policy, budget policy) on economic growth. They concluded that fiscal policy variables influenced economic growth through their impact on the determinants of growth.

There are researchers of international econometric studies in recent years which have found a powerful negative effect of taxation on long-term GDP growth; Cashin (1995) studied 23 OECD countries over the 1971-1988 period. He found that 1% point of GDP increase in tax to GDP ratio lowers output per worker by 2%. Engen and Skinner (1993) found that 2.5% point increase in tax to GDP ratio reduces GDP growth by 0.2% to 0.3%. Bleaney *et al.* (2001) found that 1% of GDP increase in distortionary tax revenue reduces GDP growth by 0.4% points.

Devarajan *et al.* (1996) investigated the relationship between the compositions of public expenditure and economic growth. Their empirical results suggested that expenditures that were normally considered productive could become unproductive if there was an excessive amount of them. Landau (1997), Barro and Sala-i-Martin (1995), Hansson and Henrekson (1994), Chen and Gupta (2006), and Gbesemete and Gerdtham (1992) studied the impact of government expenditure for human capital – education and health – on economic growth. They found that government expenditure in education, health, and other services have an effect on economic growth.

Rodrik (1997) found that an index of institutional quality [drawn from work by Knack and Keefer (1995) and Easterly and Levine (1997)] did exceptionally well in rank-ordering East Asian countries according to their growth performance. Vijayaraghavan and Ward (2001) examined the relationship between institutional infrastructure and economic growth rates across 43 nations between the years 1975-90. Security of property rights, governance, political freedom and size of government were the indicators used in the study, facilitating identification of the most important institutions that account for the observed variations in economic growth rates among nations. Results indicated that security of property rights and sizes of government were the most significant institutions that explained the variations in economic growth rates.

There are many non-economic factors interact with the economic growth process. For example, institutional economics in the tradition of North and Thomas (1973) and North (1990) examine the link between economic

development and institutions while there is a tradition in political science since Lipset (1959) that explains political institutions and democracy in terms of economic development. Foellmer (1974) is the first contributor in which the problem of stochastic interaction was explicitly treated. He showed that if the characteristics of agents, for example their preferences are random but dependent on those of others, the effect of large numbers of agents is not enough to eliminate uncertainty at the aggregate level. Many have argued that it is enough to look at the behaviour of the average agent since the law of large numbers will wash out the effects of the random interactions between agents. Minier (1998) focuses on both direct effects of democracy on growth and indirect influences of democracy on growth through education and the rule of law.

3. Empirical Model

As follows Hoeffler (2002), in the Solow model growth in output per worker depends on initial output per worker [$y(0)$], the initial level of technology [$A(0)$], the rate of technological progress (g), the savings rate (s), the growth rate of the labour force (n), the depreciation rate (δ), and the share of capital in output (α). Thus, the model predicts that a high saving rate will affect growth in output per worker positively, whereas high labour force growth (corrected by the rate of technological progress and the rate of depreciation) will have a negative effect on growth in output per worker. The basic Solow model is

$$\ln y(t) - \ln y(0) = \ln y(0) + \ln A(0) + gt + \frac{\alpha}{1-\alpha} \ln(s) - \frac{\alpha}{1-\alpha} \ln(n+g+\delta) \quad (1)$$

where $y(t)$ denotes the logarithm of output per worker in period t .

In the augmented version of the Solow model investment in human capital is an additional determinant of growth in output per worker

$$\begin{aligned} \ln y(t) - \ln y(0) = \ln y(0) + \ln A(0) + gt + \frac{\alpha}{1-\alpha-\beta} \ln(s_k) + \frac{\beta}{1-\alpha-\beta} \ln(s_h) \\ - \frac{\alpha}{1-\alpha} \ln(n+g+\delta) \end{aligned} \quad (2)$$

where s_k and s_h denote the proportion of output invested in physical and human capital, respectively.

Equations (1) and (2) have for example been used as the framework for empirical analysis by Mankiw *et al.* (1992), Islam (1995) and Caselli (1996). In this section, a simple model is set out that provides an organizing framework for thinking about the ways in which the elements and components and aggregate of government expenditure and components and aggregate of fiscal policy affect growth. Therefore, we adopt the framework introduced by Mankiw *et al.* (1992), Demetriades and Law (2006), Ghura and Hadjimichael (1996), Hoeffler (2002), and Knight *et al.* (1993). This study provides a growth model from the conventional growth accounting framework and the production function below takes the standard neoclassical form with a minor modification which includes human capital in the Cobb-Douglas production function:

$$Y(t) = K(t)^\alpha H(t)^\beta [A(t)L(t)]^{1-\alpha-\beta}, 0 < \alpha < 1. \quad (3)$$

where Y is real output at time t , K and L are the stocks of physical capital and labour, respectively, at time t , H is the stock of human capital, A is a similar measure for physical capital, and α and β the share of capital and human capital on output. A is a labour-augmenting factor reflecting the level of technological development and efficiency in the economy and the subscript t indicates time. This equation states merely that at any moment, the total output of the economy depends on the quantity and quality of physical capital employed, the quantity of labour employed, and the average level of skills of the labour force. Output can only increase if K , L , A , or H also increases, and perpetual increases in output per worker can only occur if the stock of capital per worker or the average quality of labour or of capital also increases perpetually.

The steady-state output per worker or labour productivity (y^*) grows according to the following equation:

$$\ln\left(\frac{Y}{L}\right)^* = A_0 + \theta \ln P + \frac{\alpha}{1-\alpha-\beta} \ln s_k + \frac{\alpha+\beta}{1-\alpha-\beta} \ln(n+g+\delta) \quad (4)$$

The above equation introduces a set of variables (P) which is assumed as exogenous that could affect economic growth in the long run. With the introduction of endogenous growth theory, P is no longer assumed as exogenous. The endogenous treatment of P allows us to suggest a possible set of explanatory variables. This model differs from neoclassical production functions in two important categories of variables namely technology related variables and policy related variables. The key assumption about productivity growth here is that a typical developing country

purchases technology knowledge abroad from various suppliers. What technology will be purchased depends on the price of foreign technology as well as trade and exchanged rate policies that impact the final cost of the imported technology (Ramirez and Nazmi, 2003). In our model, we concentrate on policy related variables and we introduce government expenditure and fiscal policy is included as a proxy for policy related variables.

Therefore, we proposed the **Basic Model**:

$$\ln Y_{it} = \beta_0 + \beta_1 GOVPOL_{it} + \beta_2 \ln S_{kit} - \beta_3 \ln(n + g + \delta)_{it} \quad (5)$$

where Y_{it} is real GDP per capita, $GOVPOL_{it}$ is a control variables of government expenditure and fiscal policy variables, S_{kit} is the savings in physical capital, $(n + g + \delta)$: n is the rate of labour growth, g is the rate of technology growth or technological progress and δ is the rate of depreciation. The addition of g and δ is assumed to be constant across countries and over time, following Islam (1995), Mankiw *et al.* (1992) and Caselli *et al.* (1996), technological progress and the depreciation rate were assumed to be constant across countries and that they sum up to 0.05. The natural logarithm of the sum of population growth and 0.05 was calculated for $\ln(n + g + \delta)$. β_0 is a constant term and β_1, β_2 and β_3 are estimated parameters in the model.

As with studies of the impact of health, education and defence expenditure on economic growth, some dispersion of results is a natural outcome of differences in data sets and specifications. Given the above discussion and Equation (5), the proposed empirical **Model 1** is as follows for the effect of components of government expenditure on economic growth:

$$\ln Y_{it} = \beta_0 + \beta_1 \ln he_{it} + \beta_2 \ln ee_{it} + \beta_3 \ln de_{it} + \beta_4 \ln FP_{it} + \beta_5 \ln S_{kit} - \beta_6 \ln(n + g + \delta)_{it} + \varepsilon_{it} \quad (6)$$

where Y_{it} is real GDP per capita, he_{it} is a government expenditure on health to GDP, ee_{it} represents government expenditure on education to GDP, de_{it} is a government expenditure on defence to GDP, FP_{it} is an aggregate of independent fiscal policy variables as a share of GDP (obtained by summing up public sector wages and salaries, expenditure on other goods and services, transfers and subsidies, interest payment on government debt, capital expenditure (minus government expenditure on health, education and defence), tax revenues, non-tax revenue, and grant), S_{kit} , and $(n + g + \delta)$ are as defined earlier in Equation (5), i is a cross-section data for countries referred to, and t is a time series data, ε_{it} is an error term. The constant is denoted β_0 while $\beta_1 - \beta_6$ are the coefficients showing how much a unit increases in each individual variable will affect the growth rate in economic growth.

From Equation (5) also, we proposed empirical **Model 2** for the effect of fiscal policy on economic growth as follows:

$$\ln Y_{it} = \beta_0 + \beta_1 \ln dt_{it} + \beta_2 \ln bb_{it} + \beta_3 \ln GE_{it} + \beta_4 \ln S_{kit} - \beta_5 \ln(n + g + \delta)_{it} + \varepsilon_{it} \quad (7)$$

where dt_{it} is a distortionary taxation as a share of GDP (obtained by taxes on income and profit + social contribution + taxes on payroll and + taxes on property), bb_{it} represents budget balance as a share of GDP [obtained by (tax revenue + nontax revenue + grants) – (current expenditure + capital expenditure (minus government expenditure on health, education and defence))], GE_{it} is an aggregate of independent government expenditure variables as a share of GDP (obtained by summing up the government expenditure on health, education, and defence), Y_{it} , S_{kit} , $(n + g + \delta)_{it}$, i , $\beta_0 - \beta_5$ are as defined earlier in Equation (5).

Rearranging Equation (6) and Equation (7), it yields an estimation equation for the relationship between components of government expenditure, component of fiscal policy, aggregate of independent government expenditure variables, aggregate of independent fiscal policy variables, institutions and economic growth as follows:

Model 3

$$\ln Y_{it} = \beta_0 + \beta_1 \ln he_{it} + \beta_2 \ln ee_{it} + \beta_3 \ln de_{it} + \beta_4 \ln FP_{it} + \beta_5 \ln INS_{it} + \beta_6 S_{kit} - \beta_7 \ln(n + g + \delta)_{it} + \varepsilon_{it} \quad (8)$$

Model 4

$$\ln Y_{it} = \beta_0 + \beta_1 \ln dt_{it} + \beta_2 \ln bb_{it} + \beta_3 \ln GE_{it} + \beta_4 \ln INS_{it} + \beta_5 \ln S_{kit} - \beta_6 \ln(n + g + \delta)_{it} + \varepsilon_{it} \quad (9)$$

Model 3 and Model 4, where INS_{it} is an institutions indicator which is obtained by summing up the five indicators (corruption, bureaucratic quality, rule of law, government repudiation of contracts, and risk of expropriation).

In order to examine the interaction effects between aggregate of independent government expenditure variables and institutions and aggregate of independent fiscal policy variables and institutions on economic growth, Equation (8) and Equation (9) is extended to exclude the components of government expenditure and components of fiscal policy and include an interaction term as follows:

Model 5

$$\ln Y_{it} = \beta_0 + \beta_1 \ln GE_{it} + \beta_2 \ln FP_{it} + \beta_3 \ln INS_{it} + \beta_4 \ln(GE_{it} * INS_{it}) + \beta_5 \ln S_{kit} - \beta_6 \ln(n + g + \delta)_{it} + \varepsilon_{it} \quad (10)$$

Model 6

$$\ln Y_{it} = \beta_0 + \beta_1 \ln GE_{it} + \beta_2 \ln FP_{it} + \beta_3 \ln INS_{it} + \beta_4 \ln(FP_{it} * INS_{it}) + \beta_5 \ln S_{kit} - \beta_6 \ln(n + g + \delta)_{it} + \varepsilon_{it} \quad (11)$$

Model 5 and Model 6, where $(GE_{it} * INS_{it})$ and $(FP_{it} * INS_{it})$ are interactions between the aggregate of independent government expenditure variables and institutions and the aggregate of independent fiscal policy variables and institutions.

3.1 Panel Unit Root Tests

We start with LLC which found that the main hypothesis of panel unit root is as follows:

$$\Delta y_{it} = \Phi_i y_{i,t-1} + \sum_{L=1}^{p_i} \rho_{i,L} \Delta y_{i,t-L} + \varepsilon_{i,t} \quad m = 1, 2, \dots \quad (12)$$

where y_{it} refers to variable $\ln rgdpc_{it}, \ln he_{it}, \ln ee_{it}, \ln de_{it}, \ln ge_{it}, \ln fp_{it}, \ln INS_{it}, \ln s_{kit}, \ln(n + g + \delta)_{it}, \ln(GE * INS)_{it}, \ln(FP * INS)_{it}$ and Δ refers to the first difference. The hypothesis test is $H_0 : \Phi_i = 0$ for existence of unit root whereas $H_a : \Phi_i < 0$ for all i for non-existence of unit root. As p_i is unknown, Levin, Lin and Chu (LLC) suggest a three-step procedure in the test. In the first step, obtain the ADF regression which has been separated for each individual in the panel and generate two orthogonalized residuals. The second step requires an estimation of the ratio of long run to short run innovation standard deviation for each individual. The last step requires us to compute the pooled t -statistics.

Im, Pesaran and Shin (1997) denoted IPS proposed a test for the presence of unit roots in panels that combines information from the time series dimension with that from the cross section dimension, such that fewer time observations are required for the test to have power. Since the IPS test has been found to have superior test power by researchers in economics to analyze long-run relationships in panel data, we will also employ this procedure in this study. IPS begins by specifying a separate ADF regression for each cross-section with individual effects and no time trend:

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{i,t-j} + \varepsilon_{it} \quad (13)$$

where $i = 1, \dots, N$ and $t = 1, \dots, T$

IPS uses separate unit root tests for the N cross-section units. Their test is based on the Augmented Dickey-fuller (ADF) statistics averaged across groups.

Finally, Maddala and Wu (1999) denoted as MW developed a test based in the probability values of all root unit individual tests. An alternative approach to panel unit root tests uses Fisher's (1932) results to derive tests that combine the p -values from individual unit root tests. The statistic is given by

$$-2 \sum_{i=1}^N \log(\pi_i) \rightarrow \chi_{2N}^2 \quad (14)$$

where π_i is the p -value of the test statistic in unit i , and is distributed as a $\chi^2(2N)$ under the usual assumption of cross-sectional independence. When the Fisher test is based on ADF test statistics, we must specify the number of

lags used in each cross-section ADF regression. Maddala and Wu (1999), showed that it is more powerful than the t -bar in IPS test.

3.2 Panel Cointegration Tests

The next step is to test for the existence of a long-run relationship among real per capita GDP growth rates and the independent variables using panel cointegration tests suggested by Pedroni (1999, 2004). We will make use of seven panel cointegrations by Pedroni (1999, 2004), since he determines the appropriateness of the tests to be applied to estimated residuals from a cointegration regression after normalizing the panel statistics with correction terms.

Pedroni (1999, 2004) proposes the heterogeneous panel and heterogeneous group mean panel test statistics to test for panel cointegration as follows:

3.2.1 Panel ν -statistic:

$$T^2 N^{3/2} Z_{\hat{\nu}, N, T} = T^2 N^{3/2} \left(\sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1} \quad (15)$$

3.2.2 Panel ρ -Statistic:

$$T \sqrt{N} Z_{\hat{\rho}, N, T-1} = T \sqrt{N} \left(\sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1} \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} (\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i) \quad (16)$$

3.2.3 Panel t -Statistic (non-parametric):

$$Z_{tN, T} = \left(\tilde{\sigma}_{N, T}^2 \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1/2} \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2 (\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i) \quad (17)$$

3.2.4 Panel t -Statistic (parametric):

$$Z_{tN, T}^* = \left(\tilde{s}_{N, T}^2 \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{*2} \right)^{-1/2} \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^* \Delta \hat{e}_{i,t}^* \quad (18)$$

3.2.5 Group ρ -Statistic:

$$TN^{-1/2} \tilde{Z}_{\hat{\rho}, N, T-1} = TN^{-1/2} \sum_{i=1}^N \left(\sum_{t=1}^T \hat{e}_{i,t-1}^2 \right)^{-1} \sum_{t=1}^T (\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i) \quad (19)$$

3.2.6 Group t -Statistic (non-parametric):

$$N^{-1/2} \tilde{Z}_{tN, T-1} = N^{-1/2} \sum_{i=1}^N \left(\sum_{t=1}^T \hat{e}_{i,t-1}^2 \right)^{-1/2} \sum_{t=1}^T (\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i) \quad (20)$$

3.2.7 Group t -Statistic (parametric):

$$N^{-1/2} \tilde{Z}_{tN, T}^* = N^{-1/2} \sum_{i=1}^N \left(\sum_{t=1}^T \hat{s}_i^{*2} \hat{e}_{i,t-1}^{*2} \right)^{-1/2} \sum_{t=1}^T \hat{e}_{i,t-1}^* \Delta \hat{e}_{i,t}^* \quad (21)$$

where

$$\hat{\lambda}_i = \frac{1}{T} \sum_{s=1}^{k_i} \left(1 - \frac{s}{k_i + 1} \right) \sum_{t=s+1}^T \hat{\mu}_{i,t} \hat{\mu}_{i,t-s}, \quad \hat{s}_i^2 = \frac{1}{T} \sum_{t=1}^T \hat{\mu}_{i,t}^2, \quad \hat{\sigma}_i^2 = \hat{s}_i^2 + 2\hat{\lambda}_i,$$

$$\tilde{\sigma}_{NT}^2 = \frac{1}{T} \sum_{t=1}^T \hat{L}_{11i}^2 \hat{\sigma}_i^2, \quad \hat{s}_i^{*2} = \frac{1}{T} \sum_{t=1}^T \hat{\mu}_{i,t}^{*2}, \quad (\tilde{s}_{N, T}^{*2} = \frac{1}{N} \sum_{i=1}^N \hat{s}_i^{*2})$$

$$\text{and } \hat{L}_{11i}^2 = \frac{1}{T} \sum_{t=1}^{k_i} \hat{\eta}_{i,t}^2 + \frac{2}{T} \sum_{t=1}^T \left(1 - \frac{s}{k_i + 1} \right) \sum_{t=s+1}^T \hat{\eta}_{i,t} \hat{\eta}_{i,t-s}$$

where the residuals $\hat{\mu}_{i,t}$, $\hat{\mu}_{i,t}^*$, and $\hat{\eta}_{i,t}$ are obtained from the following regressions:

$$\hat{e}_{i,t} = \hat{\gamma}_i \hat{e}_{i,t-1} + \hat{\mu}_{i,t}, \quad \hat{e}_{i,t} = \hat{\gamma}_i \hat{e}_{i,t-1} + \sum_{k=1}^{K_i} \hat{\gamma}_{i,k} \Delta \hat{e}_{i,t-k} + \hat{\mu}_{i,t}^*, \quad \text{and } \Delta y_{i,t} = \sum_{m=1}^M \hat{b}_{mi} \Delta x_{mi,t} + \hat{\eta}_{i,t}$$

3.3 Fully Modified Ordinary Least Squares (FMOLS) Estimation

In this section we adopt FMOLS procedure from Christopoulos and Tsionas (2003). In order to obtain asymptotically efficient consistent estimates in panel series, non-exogeneity and serial correlation problems are tackled by employing fully modified OLS (FMOLS) introduced by Pedroni (1996). Since the explanatory variables are cointegrated with a time trend, and thus a long-run equilibrium relationship exists among these variables through

the panel unit root test and panel cointegration test, we proceed to estimate the Equation (6) to Equation (11) by the method or fully modified OLS (FMOLS) for heterogenous cointegrated panels (Pedroni, 1996, 2000). This methodology allows consistent and efficient estimation of cointegration vector and also addresses the problem of non-stationary regressors, as well as the problem of simultaneity biases. It is well known that OLS estimation yields biased results because the regressors are endogenously determined in the $I(1)$ case. The starting point OLS as in the following cointegrated system for panel data:

$$y_{it} = \alpha_i + x'_{it}\beta + e_{it} \quad (22)$$

$$x_{it} = x_{i,t-1} + \varepsilon_{it}$$

where $\xi_{it} = [e_{it}, \varepsilon'_{it}]$ is the stationary with covariance matrix Ω_i . The estimator β will be consistent when the error process $\omega_{it} + [e_{it}, \varepsilon'_{it}]'$ satisfies the assumption of cointegration between y_{it} and x_{it} . The limiting distribution of OLS estimator depends upon nuisance parameters. Following Phillips and Hansen (1990) a semi-parametric correction can be made to the OLS estimator that eliminates the second order bias caused by the fact that the regressors are endogenous. Pedroni (1996, 2000) follows the same principle in the panel data context, and allows for the heterogeneity in the short run dynamics and the fixed effects. FMOLS Pedroni's estimator is constructed as follow:

$$\hat{\beta}_{FM} - \beta = \left(\sum_{i=1}^N \hat{\Omega}_{22i}^{-2} \sum_{t=1}^T (x_{it} - \hat{x}_t)^2 \right)^{-1} \sum_{i=1}^N \hat{\Omega}_{11i}^{-1} \hat{\Omega}_{22i}^{-1} \left(\sum_{t=1}^T (x_{it} - \bar{x}_t) e_{it}^* - T \hat{\gamma}_i \right) \quad (23)$$

$$\hat{e}_{it}^* = e_{it} - \hat{\Omega}_{22i}^{-1} \hat{\Omega}_{21i}, \quad \hat{\gamma}_i = \hat{\Gamma}_{21i} + \hat{\Omega}_{21i}^0 - \hat{\Omega}_{22i}^{-1} \hat{\Omega}_{21i} (\hat{\Gamma}_{22i} + \hat{\Omega}_{22i}^0)$$

where the covariance matrix can be decomposed as $\Omega_i = \Omega_i^0 + \Gamma_i + \Gamma_i$ where Ω_i^0 is the contemporaneous covariance matrix, and Γ_i is a weighted sum of autocovariances. Also, $\hat{\Omega}_i^0$ denotes an appropriate estimator of Ω_i^0 . In this study, we employed both the within-dimension and between-dimension panel FMOLS test from Pedroni (1996, 2000). An important advantage of the between-dimension estimators is that the form in which the data is pooled allows for greater flexibility in the presence of heterogeneity of the cointegrating vectors. Specifically, whereas test statistics constructed from the within-dimension estimators are designed to test the null hypothesis $H_0 : \beta_i = \beta_0$ for all i against the alternative hypothesis $H_A : \beta_i = \beta_A \neq \beta_0$ where the value β_A is the same for all i , test statistics constructed from the between-dimension estimators are designed to test the null hypothesis $H_0 : \beta_i = \beta_0$ for all i against the alternative hypothesis $H_A : \beta_i \neq \beta_0$, so that the values for β_i are not constrained to be the same under the alternative hypothesis. Clearly, this is an important advantage for applications such as the present one, because there is no reason to believe that, if the cointegrating slopes are not equal to one, which they necessarily take on some other arbitrary common value. Another advantage of the between-dimension estimators is that the point estimates have a more useful interpretation in the event that the true cointegrating vectors are heterogeneous. Specifically, point estimates for the between-dimension estimator can be interpreted as the mean value for the cointegrating vectors. This is not true for the within-dimension estimators (Pedroni, 2001).

3.4 Data and Choice of Variables

The data set consists of a panel of observations for thirteen Asian countries for the period 1982-2001.¹ Annual data are collected from the World Development Indicator (World Bank CD-ROM 2005), Asian Development Bank (ADB, 2004), and The Government Finance Statistics (GFS, various years). Following Demetriades and Law (2006), the data set on institutional quality indicators employed from the International Country Risk Guide (ICRG). The first three variables are scaled from 0 to 6, whereas the last two variables are scaled from 0 to 10. Higher values indicate 'better' rating for institutional quality and vice versa. The scale of corruption, bureaucratic quality and rule of law was first converted to 0 to 10 (multiplying them by 5/3) to make them comparable to the other indicator. The institutions indicator is obtained by summing up the above five indicators.

4. Empirical Results

Table 1a and Table 1b report the results of the LLC, IPS, and MW panel unit root tests for the data on health expenditure (*he*), education expenditure (*ee*), defence expenditure (*de*), distortionary taxes (*dt*), budget balance (*bb*), aggregate of independent government expenditure variables (*GE*), aggregate of independent fiscal policy variables (*FP*), institutions (*ins*), saving rate (*s_k*), population growth rate ($n + g + \delta$), aggregate of independent government expenditure variables in institutions (*GE*ins*), and aggregate of independent fiscal policy variables in institutions (*FP*ins*) for both the scenarios of constant and constant plus time trend term.

Table 1a, presents the results of the LLC, IPS, and MW panel unit root tests at level indicating that all variables are $I(0)$ in the constant and constant plus time trend of the panel unit root regression. These results clearly show that the null hypothesis of a panel unit root in the level of the series cannot be rejected at various lag lengths. We can

conclude that most of the variables are non-stationary in with and without time trend specifications at level by applying the LLC, IPS and MW tests which are also applied for heterogeneous panel to test the series for the presence of a unit root. The results of the panel unit root tests confirm that the variables are non-stationary at level.

Table 1b presents the results of the tests at first difference for LLC, IPS and MW tests in constant and constant plus time trend. We can see that for all series the null hypothesis of unit root test is rejected at 95% critical value (1% level). Hence, based on LLC, IPS, and MW test, there strong evidence that all the series are in fact integrated of order one.

The findings of a unit root on the variables in this study are consistent with the results of a number of previous studies such as Campbell and Perron (1991), McCoskey and Selden (1998), Macdonald and Nagayasu (2000), Lee and Chang (2006), and Al-Awad and Harb (2005). Given the results of LLC, IPS, and MW tests, it is possible to apply panel cointegration methodology in order to test for the existence of the stable long-run relation among the variables.

4.1 Panel Cointegration Tests

The next step is to test whether the variables are cointegrated using Pedroni's (1999, 2001, and 2004) methodology as described previously for Model 1 to Model 6. This is to investigate whether long-run steady state or cointegration exists among the variables and to confirm what Oh *et al.* (1999) and Coiteux and Olivier (2000) state that the panel cointegration tests have much higher testing power than conventional cointegration test. Since the variables are found to be integrated in the same order $I(1)$, we continue with the panel cointegration tests proposed by Pedroni (1999, 2001, and 2004). Cointegrations are carried out for constant and constant plus time trend and the summary of the results of cointegrations analyses are presented in Table 2.

In constant level, we found that Model 1 indicates that 7 statistics reject null by hypothesis of no cointegration at the 1% level of significance except for the group-*adf* which is significant at 5% level. Model 3 used the same explanatory variables in Model 1 and institutions variable is added to the regression model. We found that Model 3 indicates that all 7 statistics reject the null hypothesis of no cointegration at the 1% level of significance except for the group-*adf* which is significant at the 5% level. In Model 2, the results are the same as in Model 1 indicating that the null hypothesis is rejected at the 1% level of significance except for the group-*adf* which is significant at the 5% level. In Model 4, institutions variable is added to the regression model, the results indicate that 7 statistics reject the null hypothesis of non cointegration at the 1% level of significance except for the group-*adf* which is significant at the 5% level. Model 5 and Model 6 which are with interaction term indicate that all 7 statistics reject the null hypothesis of non cointegration at the 1% level of significance except for the group-*t* which is significant at the 5% level.

Overall, results on the panel cointegration tests in Model 1 to Model 6 with constant level, however, show that independent variables do hold cointegration in the long run for a group of thirteen Asian countries with respect to real per capita GDP. As indicated by the panel non-parametric (*t*-statistic) and parametric (*adf*-statistic) statistics as well as group statistics that are analogous to the IPS-test statistics, the null hypothesis of non cointegration is rejected at the 1% and 5% level of significance. These results imply that taken as a group, the theory of growth through augmented Solow model for Model 1 to Model 6 does hold over the estimation period.

In the panel cointegration test for Model 1 to Model 6 with constant plus trend level, the results indicate that all 7 statistics reject the null hypothesis of non cointegration at the 1% level of significance. It is shown that independent variables do hold cointegration in the long run for a group of thirteen Asian countries with respect to real per capita GDP. However, since all the statistics conclude in favour of cointegration, and this, combined with the fact that the according to Pedroni (1999) the panel non-parametric (*t*-statistic) and parametric (*adf*-statistic) statistics are more reliable in constant plus time trend, we conclude that there is a long run cointegration among our variables in thirteen Asian countries.

5. Fully Modified OLS (FMOLS)

The previous section already confirmed that all variables in six equations (six models) are cointegrated. In other words, long run equilibrium does exist among the variables. This section discusses the estimated long-run equation. Following Pedroni (2000 and 2001), cointegrating explanatory variables for the data is estimated using the Fully Modified OLS (FMOLS) technique. In Table 3a and Table 3b and Table 4a and Table 4b, results are reported for Within Group (within-dimension) FMOLS and Panel Group (between-dimension) FMOLS estimators without and with common time dummies.

In Table 3a, within group FMOLS results without time dummies, all variables in Model 1 to Model 6 reported tests reject the null hypotheses at the 1% and 5% level of significance. While In Table 3b (panel group FMOLS) shows

that all variables in Model 1 to Model 6 reported tests reject the null hypotheses at the 1% and 5% level of significance. In Table 3a, the estimate of coefficient for government expenditure on health ($\ln he$) and government expenditure on education ($\ln ee$) and the estimate of the coefficient are positive (1.16 and 0.42, 0.27 and 2.55) and statistically significant at the 5% level. Table 3b shows that the estimate of coefficient for government expenditure on health ($\ln he$) and government expenditure on education ($\ln ee$) and the estimate of the coefficient are positive (1.81 and 0.66, 0.42 and 0.08) and statistically significant at the 1% level. Results in both table shows that education and health expenditures increase economic growth, which means that there is a long run cointegration between education and health expenditures and economic growth.

For defence expenditure ($\ln de$) for Model 1 and Model 3 in both tables, it also rejects the null hypotheses of non cointegration and the coefficient is negative [-7.16 and -4.25 (Table 3a) and -6.85 and -3.99 (Table 3b)] and statistically significant at 1% level. We conclude that results in both tables shows that increase in defence expenditures will decrease in economic growth, which means that there is still a long run cointegration between health expenditures and economic growth and defence expenditure have an adverse affect on economic growth.

The estimates of the coefficient for the aggregate of fiscal policy ($\ln FP$) in both models and both tables are positive (0.02) and statistically significant at the 5% level for both models in Table 3a and statistically significant at the 1% level for both models in Table 3b. The results in both tables show that the aggregate of fiscal policy positively affect growth meaning that there is a long run cointegration between the aggregate of fiscal policy and economic growth.

The estimate of the coefficient for the savings in physical capital (investment) ($\ln s_k$) is positive (0.12 and 0.16) for Model 1 and Model 3 and statistically significant at the 5% level in Table 3a. While Table 3b shows that the estimate of the coefficient for the savings in physical capital (investment) ($\ln s_k$) is positive (0.08 and 0.13) for both models and statistically significant at the 1% level. We conclude that investment in these models is one of the strongest correlates of economic growth; which means there is a long run cointegration. In Table 3a and Table 3b, the coefficient on population growth ($\ln(n + g + \delta)$) is negative [-0.31 and -0.21 (Table 3a) and -0.29 and -0.40 (Table 3b)] and statistically significant at the 5% level in Table 3a and statistically significant at the 1% level in Table 3b. We conclude that results in both table shows that increase in population growth will decrease economic growth, meaning that there is still a long run cointegration between population growth and economic growth and population growth have an adverse affect on economic growth.

Table 3a and Table 3b, used the same explanatory variables in Model 1 and institutions variable is added to Model 3. We found that there is a positive coefficient (0.19 in Table 3a and 0.03 in Table 3b) and statistically significant at the 1% level. The results in both tables show that the institutions positively affect growth which means that there is a long run cointegration between the institutions and economic growth. While the inclusion of institutions as an added regressor in the growth equation (Model 3) does not generally affect the sign or absolute magnitude of the estimates, they are not less precisely estimated than their counterparts in Model 1. This is not surprising given that institutions are positively correlated with some of the regressors

In Model 2 and Model 4 in Table 3a, all variables reported that tests reject the null hypotheses of non cointegration at the 1% and 5% level. While in Table 3b we found that all variables reported that tests reject the null hypotheses of non cointegration at the 1% level. Both tables show that there is a negative coefficient [-3.44 and -2.65 (Table 3a) and -2.57 and -2.25 (Table 3b)] and statistically significant at the 1% level for the distortionary taxation ($\ln dt$). The estimate of the coefficient of the budget balance ($\ln bb$) is also negative [-0.02 and -0.10 (Table 3a) and -0.06 and -0.07 (Table 3b)] and statistically significant at the 5% level in Table 3a and statistically significant at the 1% level in Table 3b. The results in both tables show that the distortionary taxation and budget balance have an adverse affect on economic growth which means that there is a long run cointegration between the distortionary taxation and budget balance and economic growth.

In Model 2 and Model 4, the estimate of the coefficient for the aggregate of government expenditure ($\ln GE$) is positive [2.08 and 2.02 (Table 3a) and 0.02 (Table 3b)] and statistically significant at the 1% level. We conclude that there is presence of a long run relationship between GDP and government expenditure. The estimate of the coefficient for the savings in physical capital (investment) ($\ln s_k$) is positive [0.14 (Table 3a) and 0.14 and 0.12 (Table 3b)] and statistically significant at the 5% level in Table 3a and statistically significant at the 1% level in Table 3b. These results are the same as in Model 1 and Model 3 and we conclude that investment and economic growth have a long run cointegration.

The coefficient on population growth ($\ln(n + g + \delta)$) is negative (-0.21) and statistically significant at the 5% level in Table 3a. On the other hand, the coefficient on population growth ($\ln(n + g + \delta)$) is negative (-0.29 and -0.45) and statistically significant at the 1% level in Table 3b in Model 2 and Model 4. As in Model 1 and Model 3 results

in both tables shows that there is still a long run cointegration between population growth and economic growth and population growth has an adverse affect on economic growth.

In Model 4, we used the same explanatory variables in Model 2 and institutions variable is added to the regression model. We found that there is a positive coefficient [0.17 (Table 3a) and 0.15 (Table 3b)] and statistically significant at the 5% level in Table 3a and statistically significant at the 1% level in Table 3b. The results from the analysis are significant in both tables and imply that the important role of institutions has a potential impact on long-run steady-state levels of growth. Thus, there is a long run cointegration between institutions and economic growth. While the inclusion of institutions as an added regressor in the growth equation (Model 4) does not generally affect the sign or absolute magnitude of the estimates, they are not less precisely estimated than their counterparts in Model 2. This is not surprising given that institutions are positively correlated with some of the regressors.

In Model 5 and Model 6 (with interaction term) in Table 3a and Table 3b, all variables reported that tests reject the null hypotheses of non cointegration at the 1% and 5% level of significance. For the aggregate of government expenditure ($\ln GE$), the estimate of coefficient is positive [0.07 and 0.72 (Table 3a) and 1.06 and 0.88 (Table 3b)] and statistically significant at the 5% level in Table 3a and statistically significant at the 1% level in Table 3b. Therefore, there is presence of a long run relationship between government expenditure and GDP. The estimate of the coefficient for the aggregate of fiscal policy ($\ln FP$) is positive [0.02 (Table 3a) and 0.02 and 0.04 (Table 3b)] and statistically significant at the 5% level in Table 3a and statistically significant at the 1% level in Table 3b. The aggregate of fiscal policy positively affect growth and there is a long run cointegration between the aggregate of fiscal policy and economic growth.

There is a positive coefficient [0.43 and 0.52 (Table 3a) and 0.05 and 0.10 (Table 3b)] and statistically significant at the 5% (Table 3a) and 1% (Table 3b) level for institutions ($\ln ins$) in Model 5 and model 6. Thus, there is a long run cointegration between institutions and economic growth. The estimate of the coefficient for the savings in physical capital (investment) ($\ln s_k$) is positive [0.13 and 0.16 (Table 3a) and 0.12 and 0.16 (Table 3b)] and statistically significant at the 5% level in Table 3a and statistically significant at the 1% level in Table 3b. We conclude that investment and economic growth have a long run cointegration. The coefficient on population growth ($\ln(n + g + \delta)$) is negative [-0.20 (Table 3a) and -0.49 and -0.37 (Table 3b)] and statistically significant at the 5% level in Table 3a and statistically significant at the 1% level in Table 3b. Both tables show that there is still a long run cointegration between population growth and economic growth and population growth has an adverse effect on economic growth. The interaction term between institutions and aggregate of government expenditure ($\ln GE * ins$) and institutions and aggregate of fiscal policy ($\ln FP * ins$) have positive coefficient (0.32 and 0.02 (Table 3a) and 0.34 and 0.02 (Table 3b)) and statistically significant at the 5% and 1% level in Table 3a and Table 3b for Model 5 and Model 6, respectively. We conclude that aggregate of government expenditure and aggregate of fiscal policy variables which interact with institutions variable and have a potential impact on long-run steady-state levels of growth. Thus, there is a long run cointegration between aggregate of government expenditure and aggregate of fiscal policy variables interact with institutions variable and economic growth. Again we found that while the inclusion of interaction term between aggregate of government expenditure and institutions and aggregate of fiscal policy and institutions as an added regressor in the growth equations (Model 5 and Model 6) do not generally affect the sign or absolute magnitude of the estimates, they are not less precisely estimated than their counterparts in Model 5 or Model 6.

Comparing the results reported in Table 3a and Table 3b, we found that the panel groups give higher values of estimation coefficient and higher values of significance (1% level) which would be a more accurate representation of the average long-run relationship. Therefore, we conclude that all variables are cointegrated and there is long run relationship.

Table 4a and Table 4b present the results of within group and panel group FMOLS with time dummies, respectively. In Table 4a, all variables reported that tests reject the null hypotheses of non cointegration at the 1% and 5% level of significance. On the other hand, Table 4b shows that all variables reported that tests reject the null hypotheses of non cointegration at the 1% and 5% level of significance. Model 1 and Model 3 in Table 4a and Table 4b, the estimate of the coefficient for the government expenditure on health ($\ln he$) is positive (1.69 and 2.92 (Table 4a) and 1.99 and 3.22 (Table 4b)) and statistically significant at the 5% (Table 4a) and 1% (Table 4b) levels, while the estimate of the coefficient for the government expenditure on education ($\ln ee$) government expenditure is also positive (2.07 and 2.29 (Table 4a) and 0.85 and 0.75 (Table 4b)) and statistically significant at the 5% level in Table 4a and statistically significant at the 1% level in Table 4b. Therefore, there is a long run cointegration between education and health expenditures and economic growth.

For defence expenditure ($\ln de$) for Model 1 and Model 3 in both tables, the null hypotheses of non cointegration is rejected and the coefficient is negative [-0.76 and -0.67 (Table 4a) and -4.22 and -3.22 (Table 4b)] and statistically

significant at 5% level in Table 4a and significant at the 1% level in Table 4b. Therefore, there is a long run cointegration and defence expenditure has an adverse affect on economic growth.

The estimate of the coefficient for the aggregate of fiscal policy ($\ln FP$) in both models and both tables are positive [0.03 (Table 4a) and 0.02 (Table 4b)] and statistically significant at the 1% level for both models in Table 4a and Table 4b. The results in both tables show that the aggregate of fiscal policy positively affect growth and there is a long run cointegration between the aggregate of fiscal policy and economic growth.

The estimate of the coefficient for the savings in physical capital (investment) ($\ln s_k$) is positive (0.13 and 0.99) for Model 1 and Model 3 and statistically significant at the 5% level in Table 4a. While Table 3b shows that the estimate of the coefficient for the savings in physical capital (investment) ($\ln s_k$) is positive (0.19 and 0.20) for both models and statistically significant at the 1% level. These results show that the investment in Table 3a and Table 3b have a long run cointegration with economic growth. In Table 4a and Table 4b, the coefficient on population growth ($\ln(n + g + \delta)$) is negative [-0.22 and -0.23 (Table 4a) and -0.24 and -0.34 (Table 4b)] and statistically significant at the 5% level in Table 4a and statistically significant at the 1% level in Table 4b. We conclude that there is still a long run cointegration between population growth and economic growth and population growth has an adverse affect on economic growth.

Table 4a and Table 4b, used the same explanatory variables in Model 1 and institutions variable is added to Model 3. We found that there is a positive coefficient (2.19 in Table 4a and 0.12 in Table 4b) and statistically significant at the 1% level. The results in both tables show that the institutions positively affect growth and there is a long run cointegration between the institutions and economic growth. The result is the same in Table 3a and Table 3b, when the inclusion of institutions as an added regressor in the growth equation (Model 3) does not generally affect the sign or absolute magnitude of the estimates; they are not less precisely estimated than their counterparts in Model 1.

In Model 2 and Model 4 in Table 4a, all variables reported that tests reject the null hypotheses of non cointegration at the 1% and 5% level. While in Table 4b we found that all variables reported tests that reject the null hypotheses of non cointegration at the 1% level. Both tables show that there is a negative coefficient [-0.03 (Table 4a) and -0.79 and -0.94 (Table 4b)] and statistically significant at the 5% (Table 4a) and 1% (Table 4b) levels for the distortionary taxation ($\ln dt$). The estimate of the coefficient of the budget balance ($\ln bb$) is also negative [-0.04 (Table 4a) and -0.06 and -0.02 (Table 4b)] and statistically significant at the 5% level in Table 4a and statistically significant at the 1% level in Table 4b. The results in both tables show that the distortionary taxation and budget balance have an adverse effect on economic growth which means that there is a long run cointegration between the distortionary taxation and budget balance and economic growth.

In Model 2 and Model 4 also we found that the estimate of the coefficient for the aggregate of government expenditure ($\ln GE$) is positive [2.18 and 2.13 (Table 4a) and 0.04 (Table 4b)] and statistically significant at the 5% level in Table 4a and statistically significant at the 1% level in Table 4b. We conclude that there is a presence of a long run relationship between GDP and government expenditure. The estimate of the coefficient for the savings in physical capital (investment) ($\ln s_k$) is positive (0.14 and 0.13 (Table 4a) and 0.20 and 0.21 (Table 4b)) and statistically significant at the 5% level in Table 4a and statistically significant at the 1% level in Table 4b. Therefore, we conclude that investment and economic growth have a long run cointegration. The coefficient on population growth ($\ln(n + g + \delta)$) is negative (-0.21) and statistically significant at the 5% level in Table 4a. On the other hand, the coefficient on population growth ($\ln(n + g + \delta)$) is negative (-0.26 and -0.27) and statistically significant at the 1% level in Table 4b. These results in both tables show that there is still a long run cointegration between population growth and economic growth and population growth has an adverse effect on economic growth.

In Model 4, we used the same explanatory variables in Model 2 and institutions variable is added to the regression model. We found that there is a positive coefficient [2.73 (Table 4a) and 0.18 (Table 4b)] and statistically significant at the 1% level in both tables. Therefore, we conclude that there the important role of institutions has a potential impact on long-run steady-state levels of growth. Thus, there is a long run cointegration between institutions and economic growth. Same as results from Table 3a and Table 3b, we found that when the inclusion of institutions as an added regressor in the growth equation (Model 4) does not generally affect the sign or absolute magnitude of the estimates, they are not less precisely estimated than their counterparts in Model 2.

In Model 5 and Model 6 (with interaction term) in Table 4a and Table 4b, all variables reported that tests reject the null hypotheses of non cointegration at the 1% and 5% level of significance in Table 4a and 1% level of significance in Table 4b. For the aggregate of government expenditure ($\ln GE$), the estimate of coefficient is positive [0.29 and 2.08 (Table 4a) and 2.23 and 2.53 (Table 4b)] and statistically significant at the 5% level in Table 4a and statistically significant at the 1% level in Table 4b. Therefore, there is a presence of a long run relationship between government expenditure and GDP. The estimate of the coefficient for the aggregate of fiscal policy ($\ln FP$) is positive [0.04 and

0.09 (Table 4a) and 0.02 and 0.48 (Table 4b)] and statistically significant at the 5% level in Table 4a and statistically significant at the 1% level in Table 4b. The aggregate of fiscal policy positively affect growth and there is a long run cointegration between the aggregate of fiscal policy and economic growth.

There is a positive coefficient [1.17 and 1.21 (Table 4a) and 0.25 and 1.64 (Table 4b)] and statistically significant at the 1% level for institutions ($\ln ins$) in Model 5 and model 6. Thus, there is a long run cointegration between institutions and economic growth. The estimate of the coefficient for the savings in physical capital (investment) ($\ln s_k$) is positive [0.14 and 0.16 (Table 4a) and 0.25 and 0.21 (Table 4b)] and statistically significant at the 5% level in Table 4a and statistically significant at the 1% level in Table 4b. We conclude that investment and economic growth have a long run cointegration. The coefficient on population growth ($\ln(n + g + \delta)$) is negative [-0.21 and -0.19 (Table 4a) and -0.29 and -0.27 (Table 4b)] and statistically significant at the 5% level in Table 4a and statistically significant at the 1% level in Table 4b. Both tables show that there is still a long run cointegration between population growth and economic growth and population growth has an adverse effect on economic growth. The interaction term between institutions and aggregate of government expenditure ($\ln GE * ins$) and institutions and aggregate of fiscal policy ($\ln FP * ins$) have positive coefficient [0.28 and 0.22 (Table 4a) and 0.50 and 0.14 (Table 4b)] and statistically significance at the 5% and 1% level in Table 4a and Table 4b for Model 5 and Model 6, respectively. We conclude that aggregate of government expenditure and aggregate of fiscal policy variables interact with institutions variable and have a potential impact on long-run steady-state levels of growth. Thus, there is a long run cointegration between aggregate of government expenditure and aggregate of fiscal policy variables which interact with institutions variable and economic growth. The results are the same in Table 3a and Table 3b, when the inclusion of interaction term between aggregate of government expenditure and institutions and aggregate of fiscal policy and institutions as an added regressor in the growth equations (Model 5 and Model 6) do not generally affect the sign or absolute magnitude of the estimates, they are not less precisely estimated than their counterparts in Model 5 or Model 6.

Comparing the results reported in Table 4a and Table 4b, we found that the panel groups give higher values of estimation coefficient and higher values of significance (1% level) which would be a more accurate representation of the average long-run relationship. Therefore, we conclude that all variables are cointegrated and there is long run relationship.

Overall, our results in Table 3a to Table 4b the panel estimators' tests show that the within groups estimator without and with time dummies almost have the coefficient of panel relative all variables levels and are statistically significant at 1% and 5% levels. While, for the panel groups' estimator without and with time dummies have the coefficient of panel relative all variables levels and are statistically significant at 1% level. It is interesting to note that panel groups FMOLS estimators consistently produce larger estimates than do the within groups estimators. Therefore, our results are the same as Pedroni's (2001) arguments that the panel groups estimators produce consistent estimates of the average slope under the alternative hypothesis that the slopes are different from one another and vary across countries whereas the within groups estimators do not.

Conclusion

We assessed the empirical evidence on the link between fiscal policy and growth. The analyses of fiscal policy in thirteen Asian economies show that the authorities do make active use of fiscal policy. This implies that fiscal policy is practically possible and can be effective in influencing the real per capita GDP.

Our study attempts to identify the important role of institutions as determinants of economic growth rates in a sample of thirteen Asian countries. While the inclusion of institutions as an added regressor in the growth equations does not generally affect the sign or absolute magnitude of the estimates, they are not less precisely estimated than their counterparts. This is not surprising given that institutions are positively correlated with some of the regressors. The results from the analysis are significant, and provide support for the historical evidence presented by North and Thomas (1973), and North (1990). They show that the security of property rights provides incentives for economic growth in the world. Secure role of institutions also leads to an efficient allocation of government expenditure and fiscal policy.

Our study also provides another framework of a set of linkages to capture most of the important interaction among economic growth, institutions, government expenditure and fiscal policy. Economic indicator especially interacts with non-economic indicator. The positive results of the effect of interaction term between the aggregate of government expenditure and institutions, and the aggregate of fiscal policy and institutions on economic growth in thirteen Asian economies are really interesting. These interaction terms as an added regressor in the growth equations do not generally affect the sign or absolute magnitude of the estimates; they are not less precisely estimated than their counterparts.

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Notes

1. The countries chosen for our study are as follows: China, Hong Kong, China, Korea, Japan, Indonesia, Malaysia, Philippines, Singapore, Thailand, Bangladesh, India, Pakistan, and Sri Lanka

Table 1a. Panel Unit Root Tests: Level

	CONSTANT			CONSTANT + TREND		
	LLC	IPS	MW	LLC	IPS	MW
$\ln rgdpc$	-0.35(5)	1.72(0)	21.81(1)	2.1192)	1.15(1)	30.44(1)
$\ln he$	3.39(8)	3.40(0)	12.39(0)	0.52(0)	2.19(0)	18.80(0)
$\ln ee$	-1.32(0)	3.23(0)	15.01(0)	2.17(0)	2.57(0)	20.87(0)
$\ln de$	-0.58(0)	3.74(2)	23.82(3)	0.08(0)	1.49(0)	20.89(0)
$\ln dt$	-2.36(0)	-0.83(0)	23.92(0)	-0.76(0)	-0.57(0)	26.79(0)
$\ln bb$	-0.74(2)	-0.91(1)	33.98(1)	1.19(2)	-0.68(2)	28.15(2)
$\ln GE$	-1.52(0)	3.52(0)	17.41(0)	3.34(0)	1.58(1)	13.73(1)
$\ln FP$	-0.99(0)	3.51(0)	9.33(0)	0.42(1)	-0.59(0)	25.08(1)
$\ln ins$	0.04(0)	1.75(0)	12.95(0)	0.29(0)	1.04(0)	18.12(0)
$\ln s_k$	0.10(0)	-0.71(0)	33.11(0)	1.73(2)	-0.03(0)	25.25(0)
$\ln(n + g + \delta)$	-1.08(2)	-0.51(4)	22.38(4)	0.12(2)	-0.77(2)	28.97(2)
$\ln(GE * ins)$	-1.84(0)	3.26(0)	13.99(0)	1.97(0)	3.18(1)	19.21(1)
$\ln(FP * ins)$	-1.21(0)	3.18(0)	12.02(0)	1.60(0)	2.61(1)	12.59(1)

Notes: The number in () are Probability value. The lag length is chosen on the basis of the Akaike's Information Criteria (AIC) where we specify maximum lag order (k) in autoregression and then we select appropriate lag order according to the AIC. For LLC *t*-stat all reported values are distributed $N(0,1)$ under null of unit root or no cointegration.

Table 1b. Panel Unit Root Tests: First Difference

	CONSTANT			CONSTANT + TREND		
	LLC	IPS	MW	LLC	IPS	MW
$\ln rgdpc$	-7.51(0)*	-5.57(0)*	75.95(0)*	-8.25(0)*	-5.30(0)*	71.07(0)*
$\ln he$	-10.56(0)*	-10.14(0)*	137.29(0)*	-11.47(0)*	-9.67(0)*	121.72(0)*
$\ln ee$	-7.75(0)*	-8.69(0)*	118.59(0)*	-7.58(0)*	-7.63(0)*	99.14(0)*
$\ln de$	-11.06(0)*	-10.09(0)*	135.84(0)*	-11.51(0)*	-9.81(0)*	122.65(0)*
$\ln dt$	-12.73(0)*	-12.48(0)*	169.97(0)*	-11.58(0)*	-10.92(0)*	134.49(0)*
$\ln bb$	-17.06(0)*	-15.83(0)*	214.48(0)*	-14.57(0)*	-13.67(1)*	166.69(0)*
$\ln GE$	-5.00(0)*	-4.69(0)*	67.90(0)*	-5.49(0)*	-3.78(0)*	56.40(0)*
$\ln FP$	-14.17(0)*	-12.74(0)*	172.04(0)*	-13.29(0)*	-11.77(0)*	144.00(0)*
$\ln ins$	-7.49(0)*	-5.89(0)*	79.39(0)*	-6.68(0)*	-3.37(0)*	49.39(0)*
$\ln s_k$	-10.64(0)*	-9.03(0)*	121.18(0)*	-9.42(0)*	-6.53(0)*	85.39(0)*
$\ln(n + g + \delta)$	-19.09(0)*	-17.09(0)*	230.74(0)*	-16.87(0)*	-15.26(0)*	185.03(0)*
$\ln(GE * ins)$	-7.61(0)*	-8.88(0)*	121.80(0)*	-9.02(0)*	-8.58(0)*	110.92(0)*
$\ln(FP * ins)$	-9.16(0)*	-8.81(0)*	118.58(0)*	-9.34(0)*	-8.00(0)*	101.03(0)*

Notes: The number in () are Probability value. The lag length is chosen on the basis of the Akaike's Information Criteria (AIC) where we specify maximum lag order (k) in autoregression and then we select appropriate lag order according to the AIC. For LLC *t*-stat all reported values are distributed $N(0,1)$ under null of unit root or no cointegration.

Table 2. Panel cointegration tests for heterogeneous panel (dependent variable: real per capita GDP)

	Constant						Constant + Trend					
	M1	M2	M3	M4	M5 (with interaction)	M6 (with interaction)	M1	M2	M3	M4	M5 (with interaction)	M6 (with interaction)
Panel- ν	2.06*	2.62*	2.13*	2.34*	-2.24*	-2.40*	3.61*	3.27*	3.31*	3.97*	3.50*	3.95*
Panel- ρ	3.27*	3.53*	4.03*	4.08*	3.15*	3.34*	4.08*	4.45*	4.88*	5.13*	3.72*	4.12*
Panel- t	2.37*	2.62*	2.74*	2.65*	2.50*	2.97*	3.53*	3.13*	3.53*	3.84*	-3.22*	3.65*
Panel- adj	2.50*	2.96*	2.91*	2.68*	2.72*	2.24*	3.96*	3.11*	3.24*	3.83*	3.13*	3.18*
Group- ρ	4.33*	4.11*	5.01*	5.01*	4.31*	4.01*	4.56*	4.28*	5.06*	5.06*	4.46*	4.68*
Group- t	1.98*	2.33*	1.96*	2.43*	1.76**	1.83**	-2.45*	2.56*	2.28*	2.33*	2.63*	2.62*
Group- adj	1.94**	1.68**	1.91**	1.93**	2.62*	2.11*	-2.12*	2.66*	-2.10*	-2.08*	3.12*	3.35*

Notes. All statistics are from Pedroni's procedure (1999) which is the adjusted values can be compared to the $N(0,1)$ distribution.

Panel ν is a nonparametric variance ratio statistic. Panel ρ and panel t are analogous to the nonparametric Phillips-Perron p and t statistics respectively. Panel- adj is a parametric statistic based on the augmented Dickey-Fuller ADF statistic. Group- ρ is analogous to the Phillips-Perron p statistic. Group- t and group- adj are analogous to the Phillips-Perron t statistic and the augmented Dickey-Fuller ADF statistic respectively.

The Pedroni (2004) statistics are one-sided tests with a critical value of 1.64 ($k < -1.64$ implies rejection of the null), except the u -statistic that has a critical value of 1.64 ($k > 1.64$ suggests rejection of the null). Note that the means and variances used to calculate the Pedroni statistics are reported in Pedroni (1999).

*, ** indicates rejection of the null hypothesis of no-cointegration at 1% and 5%, level of significance. M1 to M6 – refer to Model 1 to Model 6

Table 3a. Within Group FMOLS Results, **Without Time Dummies** (Dependent variable: real GDP per capita)

	Model 1	Model 2	Model 3	Model 4	Model 5 Model 6 (with interaction)	
$\ln he$	1.16** (2.61)	-	0.42** (2.76)	-	-	-
$\ln ee$	0.27** (2.82)	-	2.55** (2.71)	-	-	-
$\ln de$	-7.16* (-5.61)	-	-4.25* (-3.28)	-	-	-
$\ln dt$	-	-3.44* (-4.44)	-	-2.65* (-3.10)	-	-
$\ln bb$	-	-0.02** (-2.54)	-	-0.10** (-2.12)	-	-
$\ln GE$	-	2.08* (-3.47)	-	2.02* (-3.04)	0.07** (2.20)	0.72** (2.65)
$\ln FP$	0.02** (2.40)	-	0.02** (2.47)	-	0.02** (-2.50)	0.02** (-2.49)
$\ln ins$	-	-	0.19* (-3.30)	0.17** (2.98)	0.43** (-1.94)	0.52** (-2.87)
$\ln s_k$	0.12** (-1.99)	0.14** (-2.05)	0.16** (-2.60)	0.14** (-2.39)	0.13** (-1.99)	0.16** (-2.32)
$\ln(n + g + \delta)$	-0.31** (-2.65)	-0.21** (-2.40)	-0.36** (-2.79)	-0.21** (-2.42)	-0.20** (-2.37)	-0.20** (-2.28)
$\ln(GE * ins)$	-	-	-	-	0.32** (2.81)	-
$\ln(FP * ins)$	-	-	-	-	-	0.02** (-2.04)

Note: The null hypothesis for the t -ratio is $H_0 = \beta_i = 1.0$; Figures in parentheses are t -statistics

(*) and (**) significant with 95% (90%) confidence level;

“within-dimension” reports Pedroni (1996) weighted within-dimension adjusted-FM.

Table 3b. Panel Group FMOLS Results, **Without Time Dummies** (Dependent variable: real per capita GDP)

	Model 1	Model 2	Model 3	Model 4	Model 5 Model 6 (with interaction)	
$\ln he$	1.81* (-3.26)	-	0.66* (-4.08)	-	-	-
$\ln ee$	0.42* (-3.25)	-	0.08* (-3.51)	-	-	-
$\ln de$	-6.85* (-5.85)	-	-3.99* (-3.50)	-	-	-
$\ln dt$	-	-2.57* (8.24)	-	-2.25* (9.78)	-	-
$\ln bb$	-	-0.06* (-6.12)	-	-0.07* (-6.66)	-	-
$\ln GE$	-	0.02* (5.15)	-	0.02* (-6.73)	1.06* (-3.56)	0.88* (11.19)
$\ln FP$	0.02* (3.08)	-	0.02* (-6.49)	-	0.02* (-4.69)	0.04* (-6.86)
$\ln ins$	-	-	0.03* (-4.21)	0.15* (-3.95)	0.05* (-4.71)	0.10* (-10.09)
$\ln s_k$	0.08* (-3.12)	0.14* (-9.41)	0.13* (-4.51)	0.12* (-7.04)	0.12* (-4.46)	0.16* (-4.95)
$\ln(n + g + \delta)$	-0.29* (-4.78)	-0.29* (-5.12)	-0.40* (-6.17)	-0.45* (-4.03)	-0.49* (-5.01)	-0.37* (-5.65)
$\ln(GE * ins)$	-	-	-	-	0.34* (3.40)	-
$\ln(FP * ins)$	-	-	-	-	-	0.02* (-4.52)

Note: The null hypothesis for the t -ratio is $H_0 = \beta_i = 1.0$; Figures in parentheses are t -statistics

(*) and (**) significant with 95% (90%) confidence level;

“between-dimension” reports Pedroni (1996, 2000) group mean panel FMOLS.

Table 4a. Within Group FMOLS Results, **With Time Dummies** (Dependent variable: real GDP per capita)

	Model 1	Model 2	Model 3	Model 4	Model 5 (with interaction)	Model 6
$\ln he$	1.69** (2.71)	-	2.92** (2.82)	-	-	-
$\ln ee$	2.07** (1.82)	-	2.29** (1.99)	-	-	-
$\ln de$	-0.76** (-2.62)	-	-0.67** (2.58)	-	-	-
$\ln dt$	-	-0.03** (-2.36)	-	-0.03** (-2.72)	-	-
$\ln bb$	-	-0.04** (-2.71)	-	-0.04** (-2.73)	-	-
$\ln GE$	-	2.18** (-3.39)	-	2.13** (-3.24)	0.29** (-1.99)	2.08** (2.15)
$\ln FP$	0.03* (3.43)	-	0.03* (3.39)	-	0.04* (4.39)	0.09* (3.36)
$\ln ins$	-	-	2.19* (-3.30)	2.73* (10.6)	1.17* (4.60)	1.21* (3.60)
$\ln s_k$	0.13** (-1.98)	0.14** (-2.05)	0.99** (-2.60)	0.13** (2.14)	0.14** (-2.24)	0.16** (-2.32)
$\ln(n + g + \delta)$	-0.22** (2.65)	-0.21** (2.40)	-0.23** (-2.34)	-0.21** (2.42)	-0.21** (2.37)	-0.19** (2.28)
$\ln(GE * ins)$	-	-	-	-	0.28** (-2.55)	-
$\ln(FP * ins)$	-	-	-	-	-	0.22** (-2.04)

Note: The null hypothesis for the t -ratio is $H_0 = \beta_i = 1.0$; Figures in parentheses are t -statistics

(*) and (**) significant with 95% (90%) confidence level;; “within-dimension” reports Pedroni (1996) weighted within-dimension adjusted-FM.

Table 4b. Panel Group FMOLS Results – **With Time Dummies** (Dependent variable: real per capita GDP)

	Model 1	Model 2	Model 3	Model 4	Model 5 Model 6 (with interaction)	
$\ln he$	1.99* (3.18)	-	3.22* (3.96)	-	-	-
$\ln ee$	0.85* (-3.96)	-	0.75* (-4.88)	-	-	-
$\ln de$	-4.22* (-7.31)	-	-3.22* (-8.53)	-	-	-
$\ln dt$	-	-0.79* (-4.48)	-	-0.94* (-5.67)	-	-
$\ln bb$	-	-0.06* (-4.53)	-	-0.02* (-8.71)	-	-
$\ln GE$	-	0.04* (-12.62)		0.04* (-4.67)	2.23* (-4.76)	2.53* (11.11)
$\ln FP$	0.02* (-4.12)	-	0.02* (-6.70)	-	0.02* (-3.62)	0.48* (-3.60)
$\ln ins$	-	-	0.12* (9.80)	0.18* (-3.69)	0.25* (-3.34)	1.64* (-4.30)
$\ln s_k$	0.19* (-4.38)	0.20* (-8.81)	0.20* (-3.21)	0.21* (3.05)	0.25* (-3.50)	0.21* (-3.09)
$\ln(n + g + \delta)$	-0.24* (-4.09)	-0.26* (-9.23)	-0.34* (-4.33)	-0.27* (-4.33)	-0.29* (-5.98)	-0.27* (-5.09)
$\ln(GE * ins)$	-	-	-	-	0.50* (-5.13)	-
$\ln(FP * ins)$	-	-	-	-	-	0.14* (-6.14)

Note: The null hypothesis for the t -ratio is $H_0 = \beta_i = 1.0$; Figures in parentheses are t -statistics

(*) and (**) significant with 95% (90%) confidence level;

“between-dimension” reports Pedroni (1996, 2000) group mean panel FMOLS