The Cause of Higher Economic Growth: Assessing the long-term and short-term relationship between economic growth and government expenditure

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Abstract

This study examines the cause of higher (5% or more) economic growth rates in higher economic growth rates countries around the World over the past 35 years. It explores the long and short-term relationships between GDP and government expenditures in these countries. A panel data set of 60 countries over the period of 1976 to 2010 is deployed to implement Pooled Mean Group estimation (Pesaran et al., 1999). Countries are divided into three economic growth rates groups: high, middle and low. Panel-based/Error-Correction Models (ECMs) are used to estimate long-term equilibrium relationships and short-term dynamics between government expenditures and GDP growth rates. Results indicate that the hypothesis of a common long-term elasticity and a short-term dynamic relationship between GDP growth rates and government expenditures cannot be rejected for high group countries; while, for middle group countries this is only true for the long-term not for the short-term. No long-term or short-term relationship between these two variables exists for low growth rate countries.

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1. Introduction

The aim of this study is to investigate the cause of achieving higher economic growth rates (higher than 5%) in countries with higher growth rates around the World over a period of 35 years (1976-2010). The achievement of 5 or more than 5% growth is thought to be linked to government expenditures. I.e. high growth rates of 5 or more than 5% cannot be achieved without higher government expenditures. To determine the cause of higher economic growth, the links between economic growth and government expenditures are examined.

The main focus of this study lies in the dynamic properties of the relationship between these two variables. Specifically, the aim of this study is to answer the following questions: Is government expenditure linked to 5% or more growth output through a stable long-term relationship? How important is the speed at which expenditure adjusts to the level of potential output predicted in the long-run?

In two major respects, advanced knowledge of the dynamic relationship between government expenditure and GDP need to be considered. Firstly, this knowledge improves our understanding of long-term, structural, and public finance issues. It could, particularly, help in assessing the impacts on expenditures and, subsequently, on deficits arising from a structural deceleration in growth (e.g. associated with ageing populations or a decline in TFP growth); or equally, from an improvement in growth potential (e.g. related to structural reforms). Secondly, a more thorough understanding of the dynamic relationship between government expenditure and GDP aids in our conception of policy-relevant issues over a short to medium-term horizon.

It has been argued by many studies, that the key to attaining a benchmark against which to evaluate the stance of expenditure policy and, in turn, the stance of overall fiscal policy, is to dispose of a reliable amount of the structural relationship between government expenditure and potential output. Understanding what neutral expenditure policy would comprise of is necessary in order to judge whether expenditure policy is expansionary or contractionary. However, no clear a-priori explanation exists for what expenditure policy concerns, despite a broad consensus that a neutral revenues policy is such that government revenues move together with output, to an extent depending on structural factors such as the degree of progression of the tax system and the responsiveness of various tax bases with respect to output (the output elasticity of revenues).

A benchmark for neutral expenditure policy, based on empirical evidence, can be formulated by estimating the long-term relationship between government expenditure and GDP. Estimates of the speed at which government expenditures adjust to GDP in the long-run, following a shock in economic activity, would also prove useful for policy-making.

Government expenditure is assumed to be the main determinant of GDP growth. In other words, an increase or a decrease in government expenditure is assumed to have positive or negative effects on GDP growth, respectively. Three panel data sets of three group countries, including 60 countries in total, are deployed over a period of 35 years from 1976-2010.

In this study, an attempt is made to use pure data. In particular, non-cyclical, adjusted government expenditure and GDP data is used to determine what causes a 5% or more growth rate. A panel dimension of this data set is utilised in a way that: (i) improves the command of statistical tests for analysing the dynamic properties of macroeconomic series through panel unit root and co-integration tests; and in a way that (ii) attains country-specific information on adjustment dynamics by means of pooled mean group estimation (MPG).

We use Pooled Mean Group (PMG) estimators that allow for country-specific adjustment coefficients in long-term panel estimation (Pesaran, Shin, and Smith (1999)). Nowadays, PMG estimates are frequently used in applied econometric works. For example, we can point to the analysis of institutional effects on innovation and growth (OECD (2001)); modelling the Euro area demand of money (Golinelli and Pastorello,2002); the analysis of wealth effects on the consumption function (Barrel and Davis, 2004); exploring the impact of policies on fertility rates (D'Addio and Mira D'Ercole, 2005); explaining how to identify the determinants of sovereign risks in gold standard (Cameron and Tan, 2006); analysing the link between fiscal policies and trade balance (Funke and Nickel, 2006); and, analysing the effects of financial intermediation on economic activity (Loayza and Ranciere, 2006).

Panel unit-root tests are performed to assess whether or not the variables we use in this analysis are stationary. Then the existence of a long-term relationship between variables is verified using the residual-based Pedroni (1999) panel co-integration tests. Granger (1986) and Engle and Granger (1987) proposed models known as the Error Correction Models (ECMs) which we found useful as a more comprehensive method of causality testing when variables are co-integrated (Chang, 2002).The ECM model provides more information because through its application it is possible to estimate both short and long-run effects. According to Granger (1986), the Error-Correction Models produce better short-run forecasts and provide the short-run dynamics necessary to obtain long-run equilibrium (Ekanayake, 1999).

The empirical analysis in the remainder of the paper proceeds as follows. After the literature review in the second section, the methodology and data are discussed in the third section. This is proceeding by the fourth section in which the empirical results of our analysis are presented as follows: firstly, a description of the data set of government expenditure and potential output is inspected by means of graphical analysis. Secondly, panel unit root tests are performed to assess whether the variables we used in the analysis were stationary. Thirdly, the existence of a long-term relationship between primary expenditure and potential output is verified by means of the residual-based Pedroni (2000) panel co-integration tests. Fourthly, the dynamic relationship between government expenditure and GDP is analysed empirically by means of testing an error correction mechanism (ECM) with the PMG estimator. The last section is devoted to concluding remarks.

2. The Literature Review

The question of whether government expenditure affects economic growth has attracted considerable interest amongst economists and policy makers all over the world. Empirical studies in this area seem to be moving in two directions; towards the effects of government expenditure on economic growth, and towards how such growth can affect government spending in the economy.

Two theoretical approaches have debated the relationship between GDP and government expenditure. One perceived government expenditure to be an essential part of aggregate demand in the economy, through which the fluctuation of GDP was determined. This perception, which dominated during the 1950s and the 1960s, is now mainly referred to John Maynard Keynes and his followers. The second theoretical approach was Wagner's Law (a principle named after the German economist Adolph Wagner, 1835–1917). According to Wagner's Law, the development of an industrial economy will be accompanied by an increased share of public expenditure in gross national product.

In the first theoretical approach, causality runs from government spending to economic growth, whilst in the latter law postulates that causality runs in the opposite direction (Abu-Bader and Abu-Qarn, 2003). Following Keynes approach, public expenditure is seen as an exogenous factor to be used as a policy instrument to influence growth. On the other hand, Wagner argues that expenditure is an endogenous factor or an outcome, not a cause, of growth in national income (Ansari Et al., 1997).

The relationship between government expenditure and economic growth has been tackled from various angles by empirical literature. One angle investigates the determinants of government size across countries, concentrating on alternative explanations such as per-capita income (e.g., Peltzman (1980), Borcherding (1985)), the relative price of government-provided goods and services (Baumol, 1967), demographic structures (Heller and Diamond, 1990), and the size of (Alesina and Wacziarg ,1998) or the degree of openness in the economy (Rodrik, 1998). Moreover, a growing strand of research aims at clarifying cross-country structural differences in the size of government on the basis of political fundamentals that shape the extent of deficit bias related to free-riding in government expenditure provisions and governments' myopia (Persson and Tabellini, 1999; Persson et al., 2000; Milesi-Ferretti et al., 2002). It has also been shown that the way budgetary processes are structured affects the fiscal performance of countries (e.g. Von Hagen and Harden (1995), Hallerberg et al. (2001)).

This empirical literature also demonstrates a connection between expenditure and economic growth over time. Some of it aims to describe long-term tendencies in history (Tanzi and Scuckencht, 2000). Other parts of it concentrate more heavily on empirical estimations of the elasticity of government expenditure with respect to output; often overtly aiming to empirically test "Wagner's Law". For example, hypothesising that government expenditure increases disproportionally to economic activity. The fundamental notion here being that, generally, goods and services provided by the government sector - including redistribution via transfers and the activities of public enterprises - have income elasticity greater than one, i.e. are superior goods.

Initial analyses interpreted government expenditure as regressive to GDP without taking dynamic properties into account (e.g., Ram, 1987). Later, test specifications were implemented by taking non-stationarity and co-integration into account. As a result, a more structured modelling of expenditure dynamics was enabled, introducing the distinction between a long-term relationship and short-term adjustment (Kolluri et al., 2000; Akitoby and Cinyabuguma, 2004; Wahab, 2004). For example, implementing cross-country analyses allowed for dynamic specifications.

In some studies increasing government expenditure has had a positive effect on economic growth (Singh and Sahni, 1984; Ram, 1986, Holmes and Hutton, 1990). While, in other studies increasing government expenditure has had a negative effect on economic growth in many developed and less-developed countries (Landau, 1983, 1986; Barth et al., 1990).

Ram (1986) found no consistent causal pattern between government expenditures and economic growth based on his study of 63 developed and developing countries. His findings were similar to those of Ahsan et al. (1989), which assessed US data, and those of Conte and Darrat (1988), which analysed OECD countries' data from 1960 to 1984. Similarly, Conte and Darrat (1988) also found no consistent causality between the two variables.

Other studies have looked at the effect of government expenditures on economic growth using different approaches. For example, Cheng and Lai (1997) examined the causality between government expenditure and economic growth along with money supply using South Korean data from1954 to 1994. In their study they found that there is bidirectional causality between government expenditures and economic growth in South Korea.

Ghali (1999) studied the causal relationships between government expenditures and economic growth in ten OECD countries using a quarterly data set which covered the period from 1970:1 to 1994:3. His results supported the Keynesian view.

Al-Faris (2002), examined the nature of the relationship between economic growth and public expenditure in the Gulf Cooperation Council (GCC) using annual data from 1970 to 1997 in the context of Wagner's Law and Keynesian theory. This empirical investigation did not support the hypothesis of public expenditure causing national income as proposed by Keynesian theory.

Wahab (2004) assessed annual government expenditure and GDP time series data from 1950 to 2000 in OECD countries. He found that when the economy grows at or above trend-growth, government expenditure tends to increase, and when economic growth slows and moves to below trend-growth, growth in government expenditure declines more than proportionately with a slowing economy.

Arpaia and Turrini (2008) estimated the long and short-run relations between government expenditure and potential output across EU countries. They used a sample comprising of 15 EU countries over a period of 34 years (1970-2003). Their hypothesis of a common long-term elasticity existing between cyclically-adjusted primary expenditure and potential output close to unity could not be rejected. Despite long-run elasticity decreasing considerably over the decades and being significantly higher than unity in catching-up countries, in fast-ageing countries, in low-debt countries, and in countries with weak numerical rules for the control of government spending.

Wu et al. (2010) re-examined the causal relationship between government expenditure and economic growth in 182 countries from 1950 to 2004. Wu's empirical results strongly supported both Wagner's Law and the hypothesis that government spending is helpful for enhancing economic growth regardless of how variables are measured. When countries were disaggregated by income levels and a degree of corruption, their results confirmed a bi-directional causality between government activities and economic growth.

Dandan (2011) investigated the impact of public expenditures on economic growth using time series data in Jordan from 1990 to 2006. His study found that government expenditure at the aggregate level can have positive impacts on the growth of GDP; this being compatible with Keynesian theory.

Ray and Ray (2012) empirically assessed the connection between government developmental expenditure and economic growth in India using annual data from 1961-62 to 2009-10. In their assessment, the Granger causality test confirmed the absence of any kind of short-run causality between economic growth and developmental expenditures. Their error correction estimates proved that developmental expenditures and GDP growth are mutually causal.

Together, these empirical studies emphasise three distinctive results. First, there is a bidirectional causal relationship between government expenditure and economic growth. Second, economic growth acts as a causal engine in the fluctuation of government expenditure. Third, while causal movement from government expenditures to economic growth is emphasised, the results of such long and short-run relationships is mixed.

3. Methodology and data

3.1. Empirical approaches

Our target is to exploit both time series and cross-sectional (i.e. across countries) data - thus, improving the statistical properties of estimates when the number of observations over time is based on annual data and the size of a taken sample becomes limited. When a smaller sample size is used, this becomes a matter of consideration in the estimation and testing process of stochastic properties in time series data. It may lead to low power stationarity and co-integration tests. To avoid such outcomes, recent literature on non-stationary panel data has concluded that inference on the time series properties of data can be improved upon when applying integration and co-integration tests to a whole panel rather than to each unit separately; see for instance Banerjee (1999), Baltagi and Kao (2000), Phillips and Moon (1999a), and Smith (2000).

In order to avoid spurious regressions when time series data is deployed, the following three steps are considered: i) we check whether or not the series are stationary; ii) we check whether or not a co-integration relationship exists between the series when they are not stationary, iii) when a co-integration relationship exists between series, we use Error Correction Models (ECMs) to analyse the long-term relationship between variables jointly with short-term adjustment towards long-term equilibrium.

3.2. Panel unit root tests

Whether or not all units are stationary with the same autoregressive coefficient across units (the homogeneous alternative hypothesis) remains to be determined. This suggests that in all countries, the relevant variable must congregate towards its average at the same speed (Levin, Lin and Chu (2002) - LLC hereafter - and Breitung (2000)). It is therefore necessary to test the null unit root hypothesis against its homogeneous alternative, stationarity.

An Augmented Dickey-Fuller (ADF) regression of the type below should be performed for tests which allow heterogeneous serial-correlated errors, country-specific fixed effects and country specific deterministic trends.

$$\Delta y_{it} = \delta_i \tau + \emptyset_i y_{it-1} + \sum_{j}^{p_i} \beta_{ij}\, \Delta y_{it-j} + \in_{it} \qquad (1)$$

where y_{it} is GDP in our case, i denotes panel units (countries in our case), t is time, τ is a common trend across countries, p_i is the country specific lag order, and ϵ_{it} are stochastic errors.

Panel unit root tests require two conditions; one condition being cross-sectional data independence. These tests are applied to demeaned data in order to meet this first condition. This means that if countries are equally affected by common factors (i.e. aggregate disturbances common to all), then demeaning the data permits one to eliminate cross-sectional dependence. The second required condition is that data should be free of deterministic trends. This means that if a country encounters specific deterministic trends, a unit root hypothesis test on OLS de-trended should be performed (Phillips and Moon, 1999b). Tests are therefore performed on demeaned and OLS de-trended data.

The null (H_0) and alternative (H_1) hypotheses are set up as follows:

$$H_0: \emptyset_i = 0;\ H_1: \emptyset_i = \emptyset < 0$$

This hypothesis testing will be carried out based on the 5% level of significance. If the probability of the Augmented Dickey-Fuller (ADF) test is smaller than the 5% level of significance, the null hypothesis will be rejected in favour of the alternative hypothesis.

3.3. Panel co-integration tests

The next step involves showing idiosyncratic error terms are independent across units in each panel, i.e., conflicts in one unit do not spread to other units. However, as Banerjee et al. (2004) noted, the existence of co-integration between some units in the panel may still exist and there is the issue of possibly having multiple co-integration vectors.

Residual-based tests of the no co-integration null hypothesis developed by Pedroni (1995, 1997, and 1999) are employed. These tests permit country-specific short-term dynamics and long-term relationships, and are carried out on the residuals of a static regression.

These tests are based on the following regression:

$$e_{it} = \alpha_i + \theta_i y_{it} + u_{it} \quad (2)$$

Where e_{it} is the log of government expenditure, y_{it} is the log of potential GDP in country i and year t, u_{it} is a stochastic residual and α_i is the country specific intercept. The elasticity of expenditure to output, θ_i, is allowed to vary across individual countries. The two variables are co-integrated if the linear combination of I (1) variables is stationary. This implies that deviations of one variable from the path prescribed by the co-integration relationship are transitory (i.e. without memory). A long-term relationship exists between the variable in this case, and temporary deviations can be modelled using an error correction mechanism (ECM).

Two types of tests need to be considered in order to find which one is more powerful. The first type is called the Within Dimension Approach test. This test based on panels including: panel v-statistic, panel p-statistic, panel PP-statistic, and panel ADF-statistic. These statistics pool the autoregressive coefficients across different members for unit root tests on the estimated residuals. The second test is based on the Between-Dimension Approach, which includes group p-statistics, group PP-statistics, and group ADF-statistics. These statistics are based on estimators that simply average the estimated coefficients for each member individually (Lee, 2005; Apergis et al., 2010).

We restrict our analysis to panel ADF and group ADF Pedroni co-integration tests. Our approaches are similar to the one by Pedroni (1997) for the studies of the small sample properties of these tests. In terms of power, Pedroni (1997) showed that panel ADF tests (that obtained pooling along the within dimension) perform better than other tests.

The null hypothesis of no cointegration between the series will be tested against the alternative of they are cointegrated. The null hypothesis will be rejected in favour of the alternative hypothesis if the probability of the ADF test is less than the level of significance of 5%.

3.4. Error Correction Models (ECMs)

The Error Correction Models (ECMs) is found plausible for this analysis. It is a comprehensive method of causality testing when variables are co-integrated. Panel unit-root tests and panel co-integration tests need to be performed before running the ECMs model. We need to make sure whether or not the variables are stationary, and the existence of a long-term relationship between variables is verified using the residual-based Pedroni (1999) method. We follow the model proposed by Granger (1986) and Engle and Granger (1987) for the first time.

The advantage of using an error correction specification is that, on the one hand it allows for testing short-run relationships through lagged, differenced explanatory variables and, on the other hand, for testing long-run relationships through lagged, error correction terms (Verma and Arora, 2010).

A general dynamic specification can be represented by an auto-regressive distributed lag model of order p_i and q_i, ARDL (p_i, q_i):

$$e_{it} = \sum_{j=1}^{p_i} \lambda_{ij}\, e_{it.j} + \sum_{j=0}^{q_i} \delta_{ij}\, y_{it.j} + \mu_i + u_{it} \qquad (3)$$

where μ_i is an unobserved country-specific effect and u_{it} is the error term.

The ARDL (p_i, q_i) can be rewritten in the following error correction model form:

$$\Delta e_{it} = \phi_i \left(e_{it-1} + \frac{\beta_i}{\phi_i} y_{it} \right) + \sum_{j-1}^{p_i-1} \lambda_{ij}^{*}\, \Delta e_{it.j} + \sum_{j=0}^{q_i} \delta_{ij}^{*}\, \Delta y_{it.j} + \mu_i + u_{it} \quad (4)$$

$$where\ \phi_i = -\left[1 - \sum_{j=1}^{p_i} \lambda_{ij} \right];\ \beta_i = \sum_{j=o}^{q_i} \delta_{ij}\ ;\ \lambda_{ij}^{*} = -\sum_{k=j+1}^{p_i} \lambda_{ik}\ ;\ \delta_{ij}^{*} = -\sum_{k=j+1}^{p} \delta_{ik}$$

When the ARDL (p_i, q_i) is stable, means error correcting, the adjustment coefficient ϕ_i should be negative and less than 1 in absolute value. In this case, the long-run relationship is defined by:

$$e_{it} = -\frac{\beta_i'}{\phi_i} y_{it} + \eta_{it}$$

where η_{it} is a stationary process.

In the equilibrium, trend expenditure and potential output are connected to each other, with a long-term elasticity of by

$$\theta_i = -\frac{\beta_i}{\phi_i}$$

The ECM in equation (4) can be estimated in two different ways:

1. Traditional time series models do not take cross-country correlations in the data into account. Dynamic fixed effect models, which control for country fixed effects, impose the same coefficients for all countries. Unless the slope coefficients are identical, pooling produces inconsistent estimates of the parameters value, as shown by Pesaran and Smith (1995). In order to tackle this issue, a Mean Group estimator (MG), consisting of estimating the coefficient of each cross-section and then taking an average of them has been proposed by Pesaran and Smith (1995). The MG estimator, however, does not account for the fact that some of the parameters may be the same across countries; implying that its estimates are likely to be inefficient and strongly affected by the presence of outliers, particularly in small samples.

2. Pesaran, Shin and Smith (1999) have proposed the Pooled Mean Group Estimator (PMG) as an intermediate choice between imposing slope homogeneity and no restrictions. This estimator combines the characteristics of other pooled estimators (the fixed effect estimator in particular) with that of the mean group estimator.

Both short and long-run dynamics are treated differently by the PMG estimator. The short-run dynamics are able to vary across countries; whereas, long-run effects must remain the same. In the event of data having complex, country-specific, short-term dynamics that cannot be captured, imposing the same lag structure on all countries using the PMG estimator is appropriate. Furthermore, since it does not impose any restrictions on short-term coefficients, the PMG provides important information on country-specific speed convergence values which move towards the long-term relationship linking government expenditure and potential output.

3.5. Data

Primary government expenditure is taken into account, rather than exploring the link between economic activity and different government expenditure subcategory definitions. This broad expenditure aggregate is employed for two reasons. Firstly, government deficit and debt, and ultimately the overall sustainability of public finances are effectively determined by overall government expenditure. Secondly, as found in other studies such as those of Kolluri et al.

(2000) and Akitoby et al. (2004), using various government expenditure categories separately via the estimation of dynamic equations does not produce a significantly different relation to economic activity across different types of expenditure.

In this study, business cycle adjustments have not been considered in the data of the two variables, because the benefit of using a structural nature analysis is greater than analysing business cycle rotations. Not considering business cycle adjustments is justifiable so long as sample sizes are big enough.

The bottom line is that government expenditure and potential output are interconnected in such a way that the former reacts to changes in the latter. This makes the public sector subject to change when the size of the economy is modified. Changes in government expenditure are presumed to affect aggregate demand, in turn changing the level of GDP. It is still difficult to distinguish whether government expenditure affects GDP or vice-versa. However, since this relationship is not a direct relationship and it changes through aggregate demand, which is mostly influenced by government expenditures, at least in emerging and developing countries, GDP, therefore, acts as a function of government expenditures (Kneller et al., 1999; Levine and Renelt, 1992; Nijkamp and Poot, 2004).

To investigate the relationship between GDP and government expenditures, we use annual data from 1976 to 2010 for 60 countries. Yearly observations of GDP growth rates, GDP as a total figure and specific country government expenditures were obtained from the online resource of the United Nations. Estimation periods were determined by the availability of adequate data on all variables. Below are the data explanations and sources of each variable:

GDP Growth (Annual %): Annual percentage growth rates of GDP at market prices based on constant local currency came from the EconStats web page, the World DataBank, and OECD StatExtracts.

GDP (current US$): GDP at purchasers' prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for the depreciation of fabricated assets or for the depletion and degradation of natural resources. Data is represented in current U.S. dollars. Dollar figures for GDP are converted from domestic currencies using single year official exchange rates. For a few countries where the official exchange rate does not reflect the rate effectively applied to actual foreign exchange transactions, an alternative conversion factor is used. Data found from the EconStats web page, the World DataBank, and OECD StatExtracts.

GEX (constant price: 2000 US$): General government final consumption expenditure (formerly general government consumption) includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditure on national defence and security, but excludes government military expenditures that are part of government capital formation. Data found from the EconStats web page, the World DataBank, and OECD StatExtracts.

4. Empirical results

Countries have been split into three groups based on their annual growth rates over the aforementioned period. The first group consists of countries having GDP annual growth rates 15 or more than 15 times bigger than 5% from 1976 to 2010. The second group consists of countries having GDP annual growth rates 15 or more than 15 times bigger than 3% for the same period. The last group is comprised of countries having GDP annual growth rates smaller than 3% from 1976 to 2010. These groups are referred to as high, middle and low growth rate countries. As Table 1 shows, group one consists of 19 countries, group two consists of 29 and group three of 12 countries, respectively. Table 1 gives a list of countries in each group, as well as their average growth rates for the period from 1976 to 2010.

Put Table 1 about here

Table 1 shows that China (AGR = 9.597) was the country with the highest average growth rate for 35 years, while Nicaragua (AGR= 1.001) was the country with the lowest average growth rate. Though, while Nicaragua had the lowest average growth rate, it was still included in the second group because it had a GDP annual growth rate which was at least 15 times bigger than 3% for the period from 1976 to 2010.

4.1. Graphical analysis

Prefixes L and Δ are used to indicate whether the data is in natural logarithms or in the first difference form, respectively.

Figures 1 contain six graphs of each group's variable based on a particular form of the natural logarithms (L) data of GDP and GEX. All the graphs are trended and they are not stationary.

Figures 2 show graphs of two variables, ΔLGDP and ΔLGEX, in high, middle and low growth rate countries. Graphs illustrate that first differences of GDP and GEX in all groups are stationary because they cross the zero lines frequently.

4.2. Panel Unit Root Tests

Before implementing the short and long-run relationships between our two panel data sets of Gross Domestic Product (GDP) and Government Expenditures (GEX), Panel Unit-Root Tests were performed to assess whether or not the variables used in this study are stationary. The result of the ADF tests is shown below in Table 2.

Put Table 2 about here

Probabilities of the ADF tests are presented in the brackets. Probabilities less than 0.05 means the null hypothesis of the panel data is not stationary can be rejected in favour of the alternative hypothesis of the panel data is stationary. The first differences of the two variables' panel data (ΔLGDP and ΔLGEX) of all groups are stationary as the probabilities are less than the 5% significance level.

4.3. Panel Co-integration Test

The Unit Root Tests showed that the panel data sets are not stationary and they are I (1). They will be stationary if we take the first differences of the panel data. The question that needs to be addressed now is whether a long-term equilibrium relationship exists amongst the variables (Chang, 2002). The existence of such a long-term relationship between Gross Domestic Product (GDP) and Government Expenditures (GEX) can be verified using residual-based Pedroni (1999) Panel Co-integration Tests. These test results are reported in Table 3.

Put Table 3 about here

We conclude that primary expenditure and potential output are co-integrated on the basis of the overall evidence, and provided that group ADF, which allows for a more general structure of the residual correlation under the null hypothesis, is also the most effective test (Pedroni, 1997). These results are based on the fact that the probabilities of the ADF tests are all less than the 5% level of significance.

We proceed with modelling an error correction mechanism, which allows country-specific and short-term coefficients, having established that government expenditure is co-integrated with potential output.

4.4. Pooled Mean Group ECM estimation

Pooled Mean Group (PMG) estimates require disturbances to be independently distributed across units and over time with zero mean and constant variance. We model cross-sectional dependence assuming the existence of observable common components in the residual, following Pesaran et al. (1999). This is captured by group, aggregate, potential output, which is assumed to have an impact on government expenditures that will differ across countries.

PMG estimates of the ECM are reported in Table 4.

Put Table 4 about here

The empirical evidence for the High Growth Rates Group, the result presented in the part one of the Table 4, shows the coefficient of DLGEX (-1) is positive, 0.089529, and the obtained probability is, 0.0001. The latter result proves that the coefficient of DLGEX (-1) is statistically different from zero as the probability is less than the 5% level of significance. The ECM (-1) coefficient is negative and less than one, -0.013294, and the probability of this coefficient is, 0.0229. Since the probability is less than the 5% level of significance, the ECM (-1) is statistically different from zero.

A negative and less than one error correction coefficient, and being statistically different from zero, imply that any deviation in government expenditure from the value predicted by the long-run relationship with potential output triggers a change in the opposite direction in government expenditure for the high growth rates group. The average value of the error correction coefficient of government expenditure, -0.013, implies an adjustment speed of about less than 1 year.

From these results, it can be concluded that government expenditures have had significant effects on GDP growth rates in the short-run as well as in the long-run in countries experiencing high growth rates (more than 5%) for 15 or more than 15 years.

The results for the Middle Growth Rates Group, presented in the second part of the Table 4, show the coefficient of DLGEX (-1) is positive, 0.019204, and the calculated probability is, 0.2550. The latter result proves that the coefficient of DLGEX (-1) is not statistically different from zero as the probability is not smaller than the 5% level of significance. The ECM (-1) coefficient is negative and less than one, -0.011485, and the probability of this coefficient is 0.0075. Since the probability is less than the 5% level of significance, the ECM (-1) is statistically different from zero.

A negative and less than one error correction coefficient, and being statistically different from zero, imply that any deviation in government expenditure from the value predicted by the long-run relationship with potential output triggers a change in the opposite direction in government expenditure for the middle growth rates group. The average value of the error correction coefficient of government expenditure, -0.011, implies an adjustment speed of about less than 1 year.

From these results, it can be concluded that government expenditures have had significant effects on GDP growth rates in the long-run only, not having any affects in the short-run in countries experiencing middle growth rates (more than 3%) for 15 or more than 15 years.

The results for Low Growth Rates Group, as it is shown in the third part of the Table 4, display the coefficient of DLGEX (-1) is positive, 0.025200, and the calculated probability is, 0.1135. The latter result proves that the coefficient of DLGEX (-1) is not statistically different from zero since the probability is not smaller than the 5% level of significance. The ECM (-1) coefficient is not negative but it is less than one, 0.004643. The probability of this coefficient is 0.1346. Since the probability is not less than the 5% level of significance, the ECM (-1) is not statistically different from zero.

From these results, it can be concluded that government expenditures have not had significant effects on GDP growth rates in the long-run only as well as in the short-run in countries experiencing low growth rates (less than 3%) for 15 or more than 15 years.

These results imply explicitly that without high government expenditures higher than 5%

economic growth rates cannot be achieved in the short-run as well as in the long-run. Furthermore, the results found verify that the low economic growth rate links with low government expenditures. High government expenditures are essential for high economic growth rates.

5. Concluding remarks

An estimation of the long and short-term relations between government expenditure and potential output for high, middle and low growth rate countries around the world has been given throughout this paper. The aim of this study was to determine what causes 5% or more economic growth over time and across countries.

Estimating a dynamic relationship between the two variables turns out to be possible using the Pooled Mean Group (PMG) estimator (Pesaran, Shin, and Smith (1999)). This procedure allows one to combine the accuracy of estimates by pooling data from cross-country dimensions; while, at the same time, limiting the risk of estimate inconsistencies associated with the possible heterogeneity of regression coefficients across countries. The PMG enacts a common long-term elasticity for all countries, while allowing for country-specific short-term elasticities.

Results show that the assumption of a common long-run elasticity is the case for the data of all country groups and is below unity. Group country-specific short-term elasticities imply on average a speed of adjustment of government expenditure to potential output of about 1 year.

This study assumed that government expenditure is the main determinant of high economic growth. Panel co-integration tests revealed that government expenditure and potential output in high growth rate countries are linked by a stable long-term relationship.

For middle growth rate countries, the long-run relationship between government expenditure and potential output was found to be statistically significant; while, the short-run relationship was found to be statistically insignificant.

For low economic growth rate countries neither long-run nor short-run relationship between government expenditure and potential output were found to be statistically significant.

What is found shows explicitly that high economic growth achievement is severely linked to government expenditure. Governments of countries that reached at least 15 times economic growth rates of 5% or more have spent more than countries that have achieved 3-5% economic growth rates, called ‘middle growth rate countries’, and less than 3% economic growth rates, called ‘low growth rate countries’.

As economic growth theories and empirical studies have established, economic growth is linked to many economic factors, such as aggregate demand in the short-run, factors of production in between, and factors like education and government economic policy in the long-run. However, as this study shows, the achievement of higher than 5% economic growth rates is tied to government expenditures.

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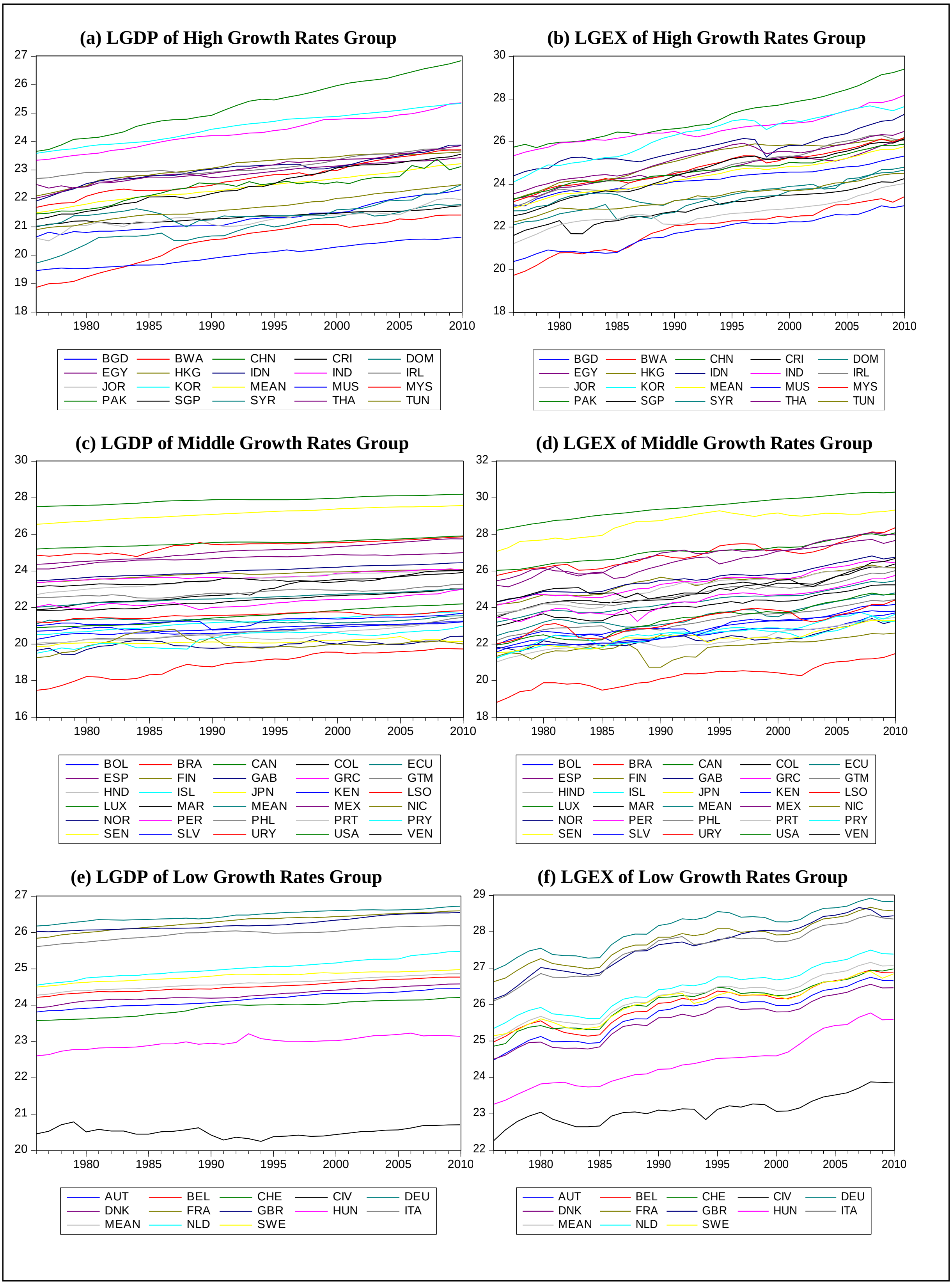
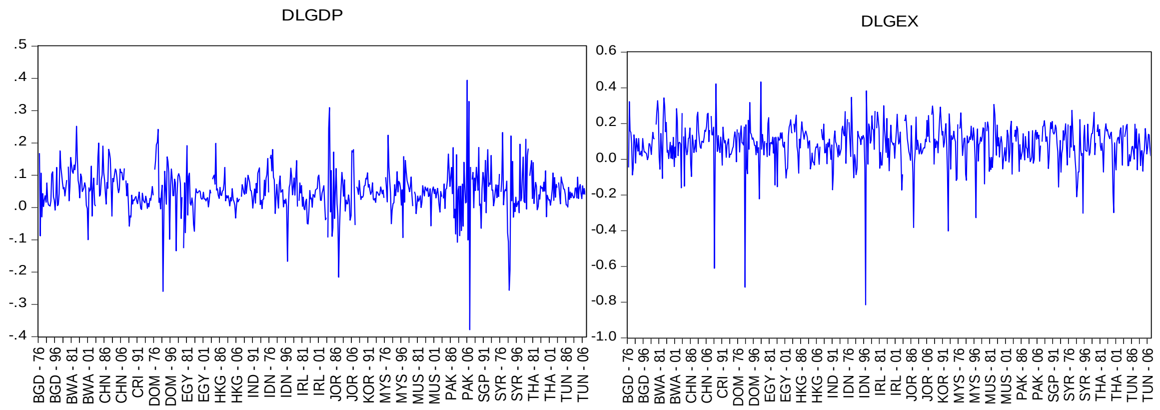
Figures 1: Graphs of LGDP and LGEX with their cross-sectional mean

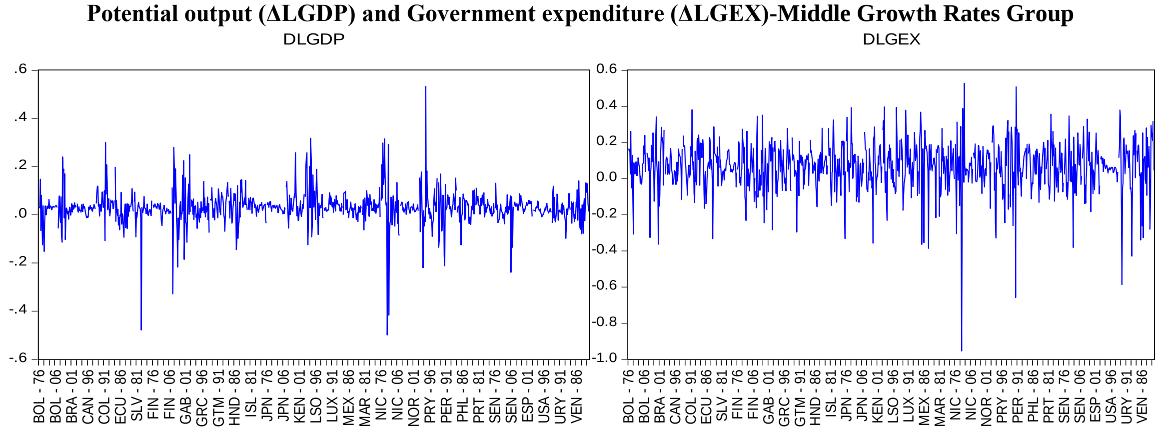


Figures 2: Graphs of ΔLGDP and ΔLGEX

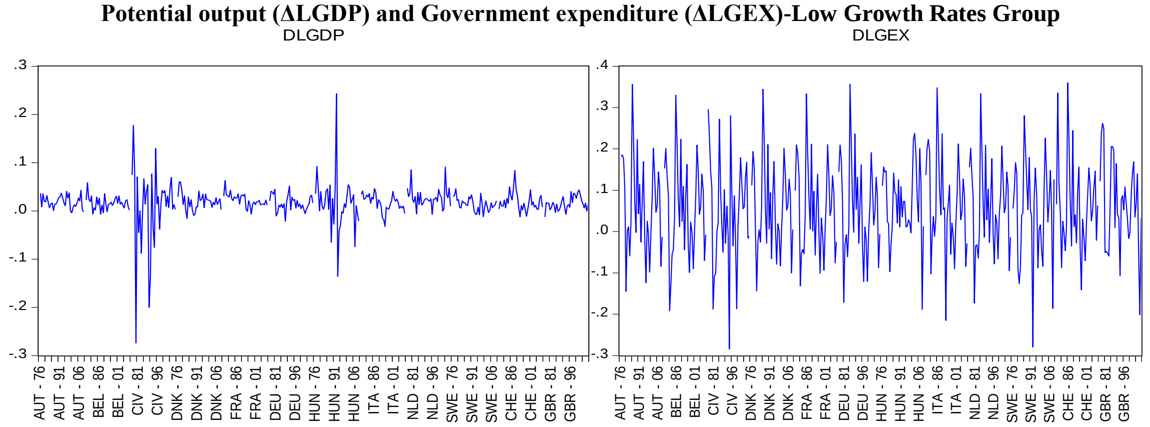
Potential output, (ΔLGDP) and Government expenditure (ΔLGEX)-High Growth Rates Group



Potential output (ΔLGDP) and Government expenditure (ΔLGEX)-Middle Growth Rates Group



Potential output (ΔLGDP) and Government expenditure (ΔLGEX)-Low Growth Rates Group



Note: Graphs of the first differences of GDP and GEX in all groups illustrate that ΔLGDP and ΔLGEX are stationary.

Table 1: List of Countries and Their Average Growth Rates (AGR) for the Period (1976-2010)

1. Group High Growth Rates (n=19, Obs.: 665)		2. Group Middle Growth Rates (n=29, Obs.: 1015)				3. Group Low Growth Rates (n=12, Obs.: 420)	
Bangladesh	4.695	Bolivia	2.526	Luxemburg	4.088	Austria	2.264
Botswana	7.703	Brazil	3.188	Mexico	3.098	Belgium	2.068
China	9.597	Canada	2.723	Morocco	4.050	Cote d'Ivoire	1.864
Costa Rica	4.194	Colombia	3.740	Nicaragua	1.001	Denmark	1.938
Dominican Rep.	4.724	Ecuador	3.205	Norway	2.886	France	2.057
Egypt	5.666	El Salvador	1.842	Paraguay	4.092	Germany	2.009
Hong Kong	5.919	Finland	2.478	Peru	2.984	Hungary	1.663
India	5.839	Gabon	1.804	Philippines	3.573	Italy	1.860
Indonesia	5.719	Greece	2.167	Portugal	2.712	Netherlands	2.347
Ireland	4.501	Guatemala	3.204	Senegal	2.973	Sweden	2.026
Jordan	6.155	Honduras	3.852	Spain	2.526	Switzerland	1.653
Korea	6.458	Iceland	3.095	United States	2.923	United Kingdom	2.171
Malaysia	6.334	Japan	2.541	Uruguay	2.631		
Mauritius	4.443	Kenya	3.785	Venezuela, RB	2.194		
Pakistan	5.146	Lesotho	4.482				
Singapore	7.152						
Syrian Arab Rep.	4.494						
Thailand	5.970						
Tunisia	4.600						

Table 2: Panel unit root tests (ADF - Fisher Chi-square) of GDP and GEX

	Data		Log of Data		First Difference of Log	
	GDP	GEX	LGDP	LGEX	ΔLGDP	ΔLGEX
1. Group (High Growth Rates)	3.099 (1.00)	0.805(1.00)	24.532(0.95)	10.571(1.00)	136.808(0.00)	189.969(0.00)
2. Group (Middle Growth Rates)	19.022 (1.00)	2.784(1.00)	55.511(0.57)	22.533(1.00)	240.254(0.00)	267.040(0.00)
3.Group Low (Growth Rates)	9.727(0.99)	2.096(1.00)	24.425(0.44)	11.125(0.99)	104.209(0.00)	134.592(0.00)

H_0: series has a unit root and it is not stationary, H_1: series has no unit root and it is stationary. Test is based on 5% level of significance. Brackets show probabilities. "L" denotes the natural logarithms of each variable and symbol "Δ" denotes the first differences of each variable

Table 3: Pedroni Residual Cointegration Test Results, LGDP and LGEX, 1976-2010

Pedroni Residual Cointegration Test: Results of High Growth Rates Group

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	3.989360	0.0000	4.061389	0.0000
Panel rho-Statistic	-2.448630	0.0072	-2.620288	0.0044
Panel PP-Statistic	-2.962453	0.0015	-3.123134	0.0009
Panel ADF-Statistic	-3.509044	0.0002	-4.042464	0.0000

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	-1.403248	0.0803
Group PP-Statistic	-2.949927	0.0016
Group ADF-Statistic	-3.821838	0.0001

Pedroni Residual Cointegration Test: Results of Middle Growth Rates Group

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	3.140173	0.0008	3.753035	0.0001
Panel rho-Statistic	-2.296343	0.0108	-2.278427	0.0114
Panel PP-Statistic	-2.324206	0.0101	-2.308320	0.0105
Panel ADF-Statistic	-2.687524	0.0036	-3.022811	0.0013

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	-0.167378	0.4335
Group PP-Statistic	-1.486214	0.0686
Group ADF-Statistic	-3.002463	0.0013

Pedroni Residual Cointegration Test: Results of Low Growth Rates Group

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	2.147297	0.0159	2.476133	0.0066
Panel rho-Statistic	-2.142520	0.0161	-2.210992	0.0135
Panel PP-Statistic	-2.000168	0.0227	-2.098325	0.0179
Panel ADF-Statistic	-2.680274	0.0037	-3.049621	0.0011

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	-0.635184	0.2627
Group PP-Statistic	-1.421347	0.0776
Group ADF-Statistic	-3.183536	0.0007

H_0: No cointegration between the series, H_1: The series are cointegrated. Test is based on 5% level of significance.

Table 4: Estimations of Error Correction Models

Error Correction Models of High Growth Rates Group

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.030219	0.003752	8.054479	0.0000
DLGDP(-1)	0.046662	0.039238	1.189215	0.2348
DLGEX	0.126615	0.022578	5.607943	0.0000
DLGEX(-1)	0.089529	0.022823	3.922756	0.0001
ECM(-1)	-0.013294	0.005829	-2.280720	0.0229

Error Correction Models of Middle Growth Rates Group

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.015867	0.002559	6.200723	0.0000
DLGDP(-1)	0.138025	0.031828	4.336528	0.0000
DLGEX	0.118029	0.016478	7.162716	0.0000
DLGEX(-1)	0.019204	0.016861	1.138958	0.2550
ECM(-1)	-0.011485	0.004285	-2.680569	0.0075

Error Correction Models of Low Growth Rates Group

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.014031	0.002131	6.583929	0.0000
DLGDP(-1)	-0.009468	0.050624	-0.187027	0.8517
DLGEX	0.028926	0.016240	1.781108	0.0757
DLGEX(-1)	0.025200	0.015887	1.586145	0.1135
ECM(-1)	0.004643	0.003097	1.499181	0.1346