Relative Efficiency of Government Spending and Its Determinants: Evidence from OECD and Asian Countries

Eric C. Wang
National Chung Cheng University, Taiwan
and
Eskander Alvi
Western Michigan University, USA

Abstract

The efficiency of government macro-performance is an essential element in pursuing economic development. The major purpose of this paper is to compare the efficiency results of Asian countries with those of OECD countries and to shed some light on LDCs. Two tasks are made in order to proceed with the meaningful comparison. The first is to measure the relative efficiency of government spending of 10 OECD and 7 Asian countries. The second is to investigate the factors that influence government performance when increasing expenditure to promote growth.

To accomplish the first task, the Data Envelopment Analysis (DEA) model will be applied to estimate technical efficiency of government spending (ΔG) in raising GDP (ΔGDP). The inefficiency scores of each country for each year will be recorded for the second task.

The Extreme Bounds Analysis (EBA) approach in association with the truncated Tobit regression will be adopted to carry out the second task. As to testing for factors that could cause inefficiency of government spending, several hypotheses will be examined in the ΔG -ΔGDP nexus. The first is whether private sector's activities (such as consumption, investment, and foreign trade) foster government performance. The second is the government corruption hypothesis. The third hypothesis is about the relationship between monetary expansion and government spending in promoting growth. The fourth hypothesis is about the effect of government size. The fifth hypothesis to be tested is about the effect of government debt. In order to perform the robustness test using EBA, several macro variables will be chosen as exogenous (**Z**) variables.

The results of DEA show that the United States, New Zealand and Germany are the countries having the highest efficiency scores in the OECD sample; and Japan is the one with the highest score in the Asian group. As the OECD case is concerned, EBA method in association with Tobit regression indicates that private sector activities exhibit a robust negative relationship with government inefficiency, which means that increasing the share of private activities in the economy helps reduce the inefficiency of public spending. The Corruption Perception Index (CPI) indicator reveals a not robust effect on government inefficiency in OECD group, which is quite different from the case of 7 East Asian countries. The reason might be due to the fact that OECD countries under study are mostly of less degree of corruption. The EBA results indicate that M3 expansion is a robust positive indicator that remains significant and positive within the range. Government size indicated by the Revenue/GDP ratio is not robust. Although the debt/GDP ratio carries a negatively significant coefficient in the basic models discussed above, it does not come out as a robust variable in the EBA robustness tests.

Keywords: Public expenditure, Efficiency, Data Envelopment Analysis, Extreme Bounds Analysis, OECD and Asian

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1. Introduction

Public expenditure plays an important role in aggregate economy in multiple dimensions. Usually, it is used to produce various public goods and services, to build and upgrade various types of infrastructure, the benefits of which are derived over subsequent years. It is also used by government to adopt various fiscal measures, such as transfer payments, to stimulate economic activities particularly during recessions.

Public economists have long been interested in assessing public/government sector performance and in identifying the determinants that explain the variations, both across countries and over time. Macroeconomists are also interested in such studies because infrastructure is a relevant determinant of long-run income and growth, and cyclical responses surrounding recessions and how government spending helps economies recover is also appealing. Fox (2002) points out the importance of assessing public sector performance in maintaining a prosperous economy and promoting growth. Barro (1990) discusses the potential for long-run growth that is derived from infrastructure investments. In addition, there is a sizeable literature focusing on fiscal expenditure and its aggregate economic effects One of the example is Blanchard and Perotti (2002). It is therefore useful to study the size of the fiscal spending multiplier across countries and identify factors that impede or strengthen their efficacy in affecting aggregate economic activity.

Government spending has taken on a significant role in the recent global recession that started in 2007-08, following the financial crisis in the U.S., even in countries where such spending is usually shunned. As interest rates fell dramatically, engineered by central banks in most countries, there remained little room for typical monetary policy intervention which works by mostly cutting interest rates. Fiscal stimulus therefore became an instrument of choice. For example, the U.S. Congress passed a USD780 billion fiscal stimulus plan mainly for the Federal government to execute infrastructure construction and other recovery programs.[1] Given the state of the global economy and the low interest rates, fiscal expenditure policy is likely to remain active for some time to come. Interesting questions consequently arise. If different governments use up the same amount of incremental expenditure (ΔG), can we expect them to see their GDP (ΔGDP) increase by the same amount? Do governments perform equally well in executing their public expenditure?

There are two major factors that explain differences in performance among countries. According to economic principles, one is the magnitude of the public expenditure multiplier,

[1] See Ward and Beattie, 2009.

which depends on the size of the mpc (marginal propensity to consume), mpi (marginal propensity to invest), mpm (marginal propensity to import), and the marginal tax rate, etc. Different multipliers result in different realizations of ΔGDP. The second factor can be attributed to the macro-management ability of the government, i.e., the efficiency of the government in executing public spending, which in turn depends on a variety of factors.

The purpose of this paper is two-fold. The first is to measure public expenditure among 10 OECD and 7 Asian countries in terms of their relative performance. The second is to investigate the factors that influence government performance when spending is undertaken to promote growth. The group of 10 OECD countries includes Australia, Canada, France, Germany, Italy, Japan, Korea, New Zealand, United Kingdom, and the United States. The research period covers recent years from 1981 to 2008. The 7 Asia countries are Hong Kong, Japan, Korea, Malaysia, Singapore, Thailand and Taiwan with annual data for 1986 – 2007. The time lag between public spending and the change in GDP is also considered.

To accomplish the first task, a Data Envelopment Analysis (DEA) model is applied to estimate the technical efficiency of government spending (ΔG) in raising GDP (ΔGDP). In using this model, the government expenditure multiplier and its components are first considered. The inefficiency scores of each country for each year are then recorded to accomplish the second task. The extreme bounds analysis (EBA) approach in association with the truncated Tobit regression is adopted to carry out the second goal. The robustness of the factors can be confirmed using the EBA method.

As to testing for the factors that may explain the inefficiency in government spending, several hypotheses are examined in the context of the ΔG-ΔGDP linkage. The first concerns whether private sector activities (such as consumption, investment and trade) impact government performance. The second is the government corruption hypothesis. The third hypothesis has to do with the relationship between monetary expansion and the efficacy of public spending in promoting income. The fourth hypothesis has to do with the effect of the government's size on its performance. The last hypothesis is about the effect of government debt on its efficiency in boosting GDP.

The remainder of the paper proceeds as follows. Section 2 briefly describes the theoretical and empirical background in the analysis of public sector efficiency, and Section 3 discusses the hypotheses and related literature. The quantitative models used in this paper are introduced in Section 4. Data for the 10 OECD and 7 Asian countries used in the paper and the empirical results are discussed in Section 5. Section 6 concludes with some policy implications.

2. Background for the Analysis of Fiscal Expenditure

Government fiscal expenditure may be used as an instrument to stimulate the aggregate economy, both in the long run and short run. A sizeable literature, both theoretical and empirical, has been devoted to study how and to what extent public spending, income transfer, taxation and other aspects of fiscal policy affect growth performance since 1930s.

Macroeconomics textbooks, for example, Parkin (2012, pp.692-695), state that from an expenditure perspective GDP can be decomposed into private consumption (C), private investment (I), government fiscal expenditure (G) and net exports (X-M), i.e., GDP = Y = C + I + G + (X-M), and that their variations can be expressed as $\Delta Y = \Delta C + \Delta I + \Delta G + \Delta(X-M)$. Government expenditure (G) includes both government consumption (GC) and government investment (GI) in infrastructure, etc. Furthermore, the government expenditure multiplier can also be written as $m_G = \Delta Y / \Delta G = 1/ [1-(mpc+mpi)(1-t)]$, where mpc is the marginal propensity to consume, mpi is the marginal propensity to invest, and t is the marginal tax rate. In the real economy, m_G varies across countries and over time. Therefore, by keeping other macro variables constant, in the short run the magnitude of ΔY will depend on the size of ΔG and m_G. For example, if (mpc+mpi) is 0.8 and the tax rate is 0.3, the simple model predicts that the government multiplier, m_G, will be 2.2727.[2] Then, in a closed economy, for a 1-million increase in government spending, an increase of 2.2727 million in GDP can in theory be expected.

This paper draws an analogy between the government's macro management and the concept of production. In the short run, m_G is beyond the government's control, since mpc, mpi and t are either determined by the private sector or pre-determined earlier. Government spending policy involves choosing an amount ΔG to reach the target increase in GDP, given the magnitude of m_G. This is similar to the context of short-run production in which the producer chooses the variable inputs to reach a certain level of output given the stock of fixed inputs. Using production terminology, ΔY can be generated from two factors, namely, government spending ΔG and the multiplier, m_G, where private sector ΔC, ΔI, and $\Delta(X-M)$ are exogenously given and/or pre-determined. In the long-run a trade-off between ΔG and m_G is possible, for when m_G is smaller in magnitude, ΔG must be bigger in order to achieve a certain target ΔGDP, and vice versa. This is similar to the long-run substitution between production factors.

The first task of this paper is to apply the DEA method to estimate the technical efficiency of using ΔG and m_G to raise the GDP of the 10 OECD and 7 Asian countries. Yaisawarng (2002) proposes a DEA scheme to assess the efficiency of government divisions and suggests allocating budgets according to their efficiency scores. Within such a scheme setting quantitative efficiency targets for each division become possible. In fact, there has been a line of research that applies DEA to macro management, e.g., to promote GDP. Lovell *et al*. (1995) apply the output-oriented DEA model to measure the performance of

[2] More complex macroeconomic models include the effects of income on imports, interest rates (which further affect consumption and investment), the exchange rate (which further affects imports and exports), and so on. This paper considers these factors in a later section which adopts the EBA approach to hypothesis testing. There we treat these factors as explanatory variables to explain the inefficiency of public spending.

policies based on four macroeconomic variables (real GDP per capita, inflation, employment, and the trade balance) of 19 OECD countries between 1970 and 1990, and make a comparison of 14 European and 5 non-European countries. They argue that "although DEA was originally intended for use in microeconomic environments to measure performance of schools, courts and the like, it is ideally suited to the macroeconomic performance analysis…The units in question are the macroeconomic policy-making entities of nations." (p.508) Leightner (2002) applies the modified version of output-oriented DEA to annual panel data on government spending and GDP from 1983 to 2000 for 24 Asian countries. His purpose is to measure government productivity and to show how productivity has changed over time, especially in the wake of the Asian financial crisis. Rayp and Van De Sijpe (2007) also use the DEA model to measure the efficiency of public expenditure in improving health, education, and governance performance in 52 developing countries. They further apply the non-linear least squares instrumental variables (NLSIV) method to explain the variations in inefficiency.

The DEA model is a popular tool for estimating the DMU's (decision making unit) efficiency. Based on Farrell's (1957) definition of technological efficiency and economic efficiency, the constant-returns-to-scale version of DEA was developed by Charnes, Cooper, and Rhodes (1978) (CCR for short) and was extended to the variable-returns-to-scale version by Banker, Charnes, and Cooper (1984) (BCC for short). Since then, it has been widely applied to various fields of economics and management. Fried *et al.* (1999) applied it to the management of nursing homes. Wang and Huang (2007) applied it to the nation's efficiency in conducting R&D based on a sample of 30 countries.

The second task of this paper is to examine the factors that influence the performance of public expenditure. Since the inefficiency scores estimated using DEA are rankings between 0 and 1, we use the truncated Tobit regression model to examine inefficiency. To confirm the robustness/fragility of the determinants, we apply the extreme bound analysis (EBA) approach. The EBA approach was theoretically developed by Leamer (1983, 1985). It was then applied, among other approaches, by Levine and Renelt (1992) to examine the determinants of cross-country economic growth and by Miller and Upadhyay (2000) to examine the robustness of trade to the determination of productivity growth. Bose *et al.* (2007) used the method to examine the growth effect of disaggregated government expenditures for a panel of 30 developing countries in the 1970s and 1980s. Wang (2010) applied EBA to investigate the determinants of cross-country R&D investment. This paper will conclude by analyzing the inefficiency levels and robustness determinants of government expenditure in 10 OECD and 7 Asian countries along with some policy implications.

3. Hypotheses and Related Literature

Several hypotheses are tested here in relation to the public expenditure-GDP linkage.

Variables chosen to represent the hypotheses are based on economic theory and past empirical studies.

The first argument of concern is how private sector activities affect the government's performance in the effort of raising GDP. The relationship between private economic activities and government efforts in promoting GDP can be either one of substitutes or complements. In the expenditure approach for measuring income discussed in macroeconomics textbooks (e.g., Parkin, 2012, p.492), GDP during a certain period of time can be expressed as $Y = C + I + G + (X-M)$. It follows that the government multiplier can be defined and calculated. In addition to ΔG and the multiplier, m_G, the size of ΔY also depends on private sector activities, i.e., ΔC, ΔI, and $\Delta(X-M)$. The variations in the inefficiency of government spending estimated using DEA can be explained by the variations in the sum of ΔC, ΔI, and $\Delta(X-M)$. This is equivalent to testing the effects of private sector activities on government inefficiency. The ratio of $[\Delta C + \Delta I + \Delta(X-M)]$ to ΔY will be used as an indicator of the private sector activities.

The second hypothesis of interest is the government corruption hypothesis. There are many kinds of corruption behavior, one of the most prominent being the misuse of public resources for private gain (Bardhan, 1997; Treisman, 2000). When public resources are skimmed or misused by public servants and leak out from the normal process, their efficiency in promoting GDP will be compromised. As pointed out by Bardhan (1997), corruption has adverse effects not just on static efficiency but also on investment and growth. Barreto (2000) presents a neoclassical model to identify the level of corruption as well as the effects of corruption on income, consumption and growth. Bose *et al*. (2008) examine the impact of corruption on public infrastructure. They find that corruption adversely affects the provision of public goods when it crosses a threshold. Grigor'ev and Ovchinnikov (2009), in taking Russia's socio-economic development as an example, argue that once corruption becomes an integral part of economic and social institutions, it acts to distort transactions and retard development. The corruption perception index (CPI), compiled and published by Transparency International, is used as an indicator in this paper.

The third argument of interest concerns the relationship between monetary expansion and public spending policies in promoting growth. Although there has been a large literature studying this issue, whether monetary expansion complements fiscal efforts in promoting GDP remains inconclusive. Marini and van der Ploeg (1988) examine monetary and fiscal policy in an optimizing model and find that although an increase in monetary growth leads to a reduction in the real interest rate and boosts capital and total consumption, the results depend on whether the fiscal expansion is tax-financed or bond-financed. Dernburg (1992) also shows that statistical tests of the effectiveness of alternative monetary-fiscal policies may be inconclusive. Faria (2000) argues that fiscal policy decreases the accumulation of capital through an increase in the proportional tax on profits. An inflationary monetary policy has ambiguous effects. With respect to the effects of domestic policies on private consumption, Kandil and Mirzaie (2006) find that fiscal policy has a limited and negative effect on consumption. Monetary growth, by contrast, stimulates an increase in consumption. Recently, Setterfield (2009) explore the macroeconomic consequences of interactions between fiscal and monetary policies in an environment characterized by endogenous money. The interaction effects were found to be mixed. In this paper, growth rates of broad money supply, indicated by M3 for OECD and M2 for Asian, are used as indicators of monetary expansion.[3]

The fourth hypothesis to be tested is the effect of government size. Whereas there is controversy concerning the appropriate size of the government, when measured by its expenditure relative to GDP, there is less disagreement that some public spending is useful. The existing endogenous growth literature, such as Barro (1991), Hansson and Henrekson (1994) and Folster and Henrekson (2001), argue that a large public sector could be a factor impeding growth. However, this has been challenged by others, such as Easterly and Rebelo (1993). Kolluri and Wahab (2007) find little evidence to suggest that government expenditure increases markedly during the period of an economic expansion. In this paper, the ratio of total government revenues to GDP in each country will be used as indicators of government size.[4]

The last hypothesis to be tested here regards the government debt and deficits. Government debt or deficits may affect economic performance through different channels. First, at a theoretical level, much of the literature (e.g. Yellen, 1989; Barro, 1990, among others) has focused on the relationship between private investment and public expenditure mainly because of the crowding out effect of public spending. While other literature (e.g. Aschauer, 1989, among others) has argued that higher public capital, particularly infrastructure capital, is likely to bear a crowding in effect on private investment. Second, other literature with respect to the impact of government debt on macro variable focuses on the relationship between deficit and inflation. Sargent and Wallace (1981) support the proposition that Central Bank will be obliged to monetize the deficit either now or in the later periods. Such monetization results in an increase in the money supply and the rate of inflation. Third, other studies focus on the relationship between budget deficit and the trade deficit, i.e., the twin-deficit relationship. This hypothesis asserts that an increase in budget deficit will cause a similar increase in the current account deficit, although through different channels (Kearney and Monadjemi, 1990). The famous Mundell-Fleming framework argues that an increase in the budget deficit would induce upward pressure on interest rate, causing capital inflows and an appreciation of the exchange rate that will increase the current account

[3] M1 and M3 compiled in OECD dataset--Financial Indicators-- are used to indicate narrow money and broad money, respectively. They appear in index form with year 2005 as 100.

[4] The ratio of government taxes to GDP is also tested in this paper as a proxy for government size. However, it does not perform as good as government revenues/GDP ratio in all aspects, and thus excluded from further tests.

deficit. The Keynesian absorption theory suggests that an increase in the budget deficit would induce domestic absorption, and thus import expansion, causing a current account deficit. The ratio of debt to GDP is used to see whether the higher this ratio is, the weaker the fiscal status of the government will be (Saleh and Harvie, 2005).

4. Quantitative Methods

4.1. Efficiency Estimation: DEA (Data Envelopment Analysis) Method

DEA, a quantitative technique designed to distinguish between efficient and inefficient institutions, is used to identify best practice in the use of resources amongst a group of similar institutions. It measures efficiency in the context of the distance function, which does not require the imposition of behavioral assumptions for decision-making units (DMU) or information on the prices of inputs and/or outputs. This makes DEA particularly useful in assessing the efficiency of organizations that are characterized by a non-profit objective. In these situations, DEA provides a dependable flow of information that identifies variations and provides information for improving efficiency. It is thus used in our paper to explore the technical efficiency of each government. Based on the concept developed by Farrell (1957), technical efficiency (TE) means that an agent cannot produce any more output using existing inputs.[5]

DEA involves the use of a non-parametric programming technique that computes a comparative ratio of outputs to inputs for each DMU, which is reported as the relative efficiency score. It is designed to assist in identifying which set of DMUs may be considered to pursue the best practice. Best practice units are given a rating of one and efficiency scores are assigned to other units by comparing them with the best practice units.

The BCC model (DEA based on variable returns to scale), which is used to compute Farrell's (1957) technical efficiency for unit k, where k=1, …, K, is formulated as the following linear programming (LP) problem:

$$\underset{z,\lambda}{\text{Minimize}}\ \lambda,$$

$$\text{subject to} \quad \begin{aligned} \mathbf{Y}\,\mathbf{z} &\geq \mathbf{y}^k, \\ \mathbf{X}\,\mathbf{z} &\leq \lambda\,\mathbf{x}^k, \\ \mathbf{I}\,\mathbf{z} &= 1, \\ \mathbf{z} &\in R_+^K. \end{aligned} \qquad (1)$$

where $\mathbf{y}^k$ and $\mathbf{x}^k$ are the output and input vectors for DMU k, respectively, $\mathbf{z}$ is a vector of weights, and λ is a scalar value representing a proportional contraction of all inputs, holding input ratios and output levels constant. The LP problem is solved K times, i.e., once for each DMU in the comparison set. The minimum value of λ, that is, the Farrell radial technical

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[5] A DMU may be technically efficient but it may still produce too little or too much output. This distinction is derived from measures of scale efficiency. Scale efficiency is the extent to which a DMU can take advantage of returns to scale by altering its size toward the optimal one.

efficiency measure, provides initial performance evaluations for each DMU, expressed in terms of the optimal values of $\lambda \leq 1$ and the non-negative slacks in the constraints. The optimal value of the above LP formulation (1) measures the relative efficiency under the restriction that a linear combination of efficient units produces the same or more of all outputs and that the reduction in inputs is equi-proportionate. The first constraint in (1) establishes a best practice frontier. The second constraint states the condition of the input-oriented radial efficiency measure. The third regulates the sum of the weights. The fourth is simply a non-negative constraint.[6]

DEA is one of the techniques most commonly used in analyzing the efficiency of non-profit institutions.[7] However, there are some caveats associated with the DEA method. The first problem with DEA is its heavy reliance on the accuracy of the data; there is no allowance for measurement errors. Second, DEA assumes that at least one DMU is technically efficient so that the efficiency frontier can be defined. That is, at least (some observations of) some countries will be given a score of one, while in reality even the best-performing countries may not be operating perfectly efficiently. Obviously this does not rule out the feasibility of achieving greater efficiency than that found on the estimated boundary. Third, it is difficult to include the exogenous variables that could affect the efficiency scores in the DEA model.[8] A common practice with DEA is to derive efficiency scores using only the direct inputs, which are under the control of the DMUs, and then to use information on the non-included inputs to assess their impacts. As to this caveat, we have to rely on other methods to scrutinize the related exogenous factors.

4.2. Determinants of Inefficiency: EBA Method with Tobit Regression

4.2.1. Truncated Tobit Model

The Tobit model is a special regression which maximizes a likelihood function that takes into account the censored nature of the data. The variable is censored because the response cannot take values below (left-censored) or above (right-censored) a certain threshold value.[9] The dependent variable in the Tobit regression used in this paper is censored at both ends as it represents a country's efficiency score in the range of 0 and 1.

We posit that the exogenous factors affecting a country's public spending efficiency

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[6] Of the two major types of DEA models, input-oriented DEA (reducing inputs proportionately without changing output) and output-oriented DEA (expanding output quantities without altering inputs), we use the former. This enables us to obtain input slacks which provide information about how much government spending is wasted when inefficiency appears.

[7] An alternative to the DEA is the stochastic frontier approach (SFA), which can directly provide information about the confidential interval for any estimated efficiency. However, as a non-parametric technique the DEA has some advantages. It does not make assumptions about the functional form of the best frontier, avoids making distributional assumptions about the residuals in the regression analysis and, importantly, works in a multiple output scenario using only information on multiple outputs and inputs to calculate efficiency scores. See Coelli et al. (1998, Chapters 8 & 9) for discussion.

[8] For other options in regard to handling this difficulty, see Fried *et al.* (1999) for references.

[9] Refer to McDonald and Moffitt (1980) and Greene (1981) for a full discussion on the Tobit model.

include both predetermined factors that are out of the government's control and structural variables that are embedded in the government sector institutions.

4.2.2. The Extreme-Bounds-Analysis (EBA) Approach

The main function of the extreme-bounds-analysis (EBA) approach is to provide robustness/sensitivity tests of explanatory variables in an economic regression. The original idea of the EBA approach stemmed from the argument put forward by Cooley and LeRoy (1981, p.825) which stated that economic theory "ordinarily does not generate a complete specification of which variables are to be held constant when statistical tests are performed on the relation between the dependent variable and the independent variables of primary interest."

The core of the EBA method involves varying the subset of control variables included in the regression to find the widest range of coefficient estimates of the variables of interest that standard hypothesis tests do not reject. The specification of the EBA equation in its general form can be written as

$$W = \beta_i \mathbf{I} + \beta_m \mathbf{M} + \beta_z \mathbf{Z} + \mathbf{u} \quad (2)$$

where W represents the inefficiency scores of a country's government spending, **I** is a set of variables always included in the regression, such as private sector activities in GDP, **M** is a vector of variables of primary interest, which includes the corruption index, monetary expansion M3 growth rates, government size, and Debt/GDP ratio as variables, and **Z** is a subset of variables chosen from a pool of macroeconomic variables which are considered to be potentially important explanatory variables in addition to the **M**-variable of primary interest.[10]

In empirical testing, the first step in applying the EBA approach is to choose an **M**-variable vector that contains the focus variables and to run a basic regression that includes only the **I**-variables and the **M**-variables. The second step is then to compute the regression results for all possible linear combinations of up to three **Z**-variables from the pool of variables identified as being potentially important for explaining the variations in government spending inefficiency. Consequently, we restrict the total number of explanatory variables included in any regression to eight or fewer.[11] The third step is to identify the highest and lowest values of the coefficients of the variables of interest, β_m, that cannot be rejected at the 10 percent significance level. The extreme bound is then defined by the group of **Z**-variables that produces the maximum (minimum) value of β_m plus two standard errors. The degree of confidence that one can have in the partial correlation between the W and **M**-variables can be inferred from the extreme bounds on the coefficient $\boldsymbol{\beta_m}$. If $\boldsymbol{\beta_m}$ remains significant and has the same sign within the extreme bounds, the result is referred to as "robust". If the coefficient does not remain significant or if the coefficient changes sign,

[10] For possible econometric problems, such as multi-collinearity, in the specification related to the selection of **Z**-variables, see Leamer (1983, 1985) and Levine and Renelt (1992).

[11] This total is similar to that used by Levine and Renelt (1992).

then one might feel less confident regarding the relationship between the **M** and W variables, because alternations in the conditioning information set change the statistical inferences that one draws regarding the W-**M** relationship. In this case, the result is seen as being "fragile".

This paper intends to apply the EBA technique to examine the robustness of the factors that affect government performance in public spending, such as the level of corruption, government size, debt/GDP ratio and the relationship between monetary expansion and fiscal spending. In applying the EBA approach several subordinate variables are used as **Z**-variables. The major ones considered in the existing literature are: (1) GDP per capita, indicating the degree of development, which is used here to assess if higher income levels lead to better fiscal efficiency (Levine and Renelt, 1992); (2) the secondary school enrollment rate, which is used as a proxy for the education level, to see if higher education implies greater efficiency of government spending (Mankiw *et al.* 1992; Barro, 1991); (3) the unemployment rate, which is used to represent the impact of the business cycle on government spending (Young and Pedregal, 1999); (4) the change in the GDP deflator, which is used to denote the effects of changes in the price level (Neyapti, 2003); (5) the interest rate, which is used to denote the impact of monetary policy on the budget deficit (Cebula, 2003); (6) the industry structure variable indicated by industry cum service share or non-agriculture share; (7) population growth rate; and (8) the saving rate, a proxy for the household debt-income ratio, which is used to denote the country's ability to finance government spending (Evans and Karras, 1996). In addition, two financial variables are included to represent the impacts of financial markets. (1) The private credit to GDP ratio; and (2) the liquid liability to GDP ratio, which is used to denote the effects of financial markets (Polokangas, 1993).

5. Data and Empirical Results

5.1. Data

We use annual data for 10 OECD for the period 1981-2008 and 7 Asian countries for 1986-2007.[12] Data sources are listed in the Appendix.[13]

There are several points worth mentioning here regarding the OECD countries. First, government spending as defined here includes both government consumption (GC) and government investment (GI). Usually, ΔGC may represent attempts by the government to jumpstart the economy during times of recession, which mostly has a short-term impact on the economy. ΔGI in turn may involve public infrastructure construction, etc. over the longer term. Second, the U.S. has the largest average multiplier in the sample period, followed by Japan, Korea, and Australia. Third, New Zealand has the largest

[12] It is noticed that due to the reunion of East and West Germany, most of the government related data are available only from 1991 on. The annual data for Germany used in this study are for the period 1991-2008.

[13] The summary statistics of major variables will be provided upon request.

Δ(C+I+X-M)/ΔGDP ratio on average in the sample period, followed by Korea and Australia. Fourth, Korea has the largest average M3 growth rates, while Japan has the smallest average M3 growth rates. Fifth, interestingly, France has the largest government size measured in terms of Government Revenues/GDP ratio. Finally, Italy has the largest Debt/GDP ratio.[14]

5.2 Estimation of Relative Efficiency Scores

We apply the DEA model to estimate the efficiency of public expenditure ΔG in stimulating ΔGDP, given the expenditure multiplier m_G. Since ΔG has both short-term and long-term effects on ΔGDP, we define ΔGDP_{t+1}, ΔGDP_{t+2}, and ΔGDP_{t+3} as the multiple outputs and ΔG_t and m_{Gt} as inputs in the DEA model to estimate government efficiency.[15] The results of the relative efficiency scores of 10 OECD and 7 Asian countries are summarized in Table 1-(OECD) and Table 1-(Asian).

--- Insert Table 1-(OECD) and Table 1-(Asian) here ---

Several interesting results are worth stating. First, Germany has the highest mean score of government efficiency, followed by the U.S. and New Zealand, while Australia and Italy have the lowest mean scores. This ranking roughly matches that of the number of observations with full efficiency. The U.S. has 5 observations out of 25 are of full efficiency followed by New Zealand has 4 out of 22 and Germany has 3 out of 11. Secondly, France is the only country to have no full efficiency observation. Third, Canada has the lowest efficiency score among all the observations of all countries in the sample which happened in the year 2001. Korea has the second lowest efficiency score which was of the year 2002.[16]

5.3 Preliminary Tobit Regression Estimations

As stated in Section 2, the hypotheses to be tested in this paper include: 1. the relationship between private economic activities and government efforts in promoting GDP; 2. the government corruption hypothesis; 3. the relationship between monetary growth and public expenditure in promoting growth; 4. the government size hypothesis, and 5. the ratio of debt to GDP. The corruption perception index (CPI) published by Transparency International is used to indicate the degree of corruption.[17] Growth rate of broad money, M3, is used for the OECD case to denote monetary expansion; and both M1 and M2 are used for Asian countries. The ratio of government revenues to GDP is used for OECD sample and both taxes and revenues to GDP are used in the Asian case to denote government size. The ratio of debt to GDP is self-explained, but this variable is not available in the Asian countries.

In the Tobit-EBA estimation test, we use Δ(C+I+X-M)/ΔGDP as the **I**-variable, which is the 'always included' variable in EBA jargon and appears in every regression. Note that we remove the contribution of ΔG above since by definition $\Delta GDP = \Delta(C+I+X-M)+\Delta G$. The

[14] Due to space limitations, a summary of the descriptive statistics of the Z-variables will not be presented here. It will, however, be provided by the authors upon request.

[15] The DEA model used in this paper allows only positive values for both the input and output variables. Observations with negative values must therefore be deleted from the analysis.

[16] The efficiency scores for each country are available from the authors upon request.

[17] The CPI ranking ranges from 1 to 10 with 1 being the most corrupt.

remaining portion, considered to be the slack or the degree of inefficiency in DEA jargon, must be correlated with private economic activities, Δ(C+I+X-M). Therefore, the proportion Δ(C+I+X-M)/ΔGDP must be included in the regression when testing the other hypotheses.

In addition, we also examine the effect of recession on government performance. During a recession, there may be significant pessimism on the part of consumers and businesses so that both C and I are depressed. Additionally, both mpc and mpi may register declines due to pessimism, suggesting that both C+ I and the expenditure multiplier may be lower. This "pessimism" problem is well known in macro models. It means that the effect of ΔG on ΔGDP is underestimated in recessions when pessimism is not explicitly included in the model. That is, any ΔG has to additionally overcome the pessimism to produce gains in GDP.

Four basic models using Tobit regressions are estimated first in order to apply the EBA robustness tests. The results are summarized in Tables 2-(OECD) and Table 2-(Asian) when only the **I**- and **M**-variables are included.[18]

--- Insert Table 2-(OECD) and Table 2-(Asian) here ---

Several interesting points are worth mentioning regarding the OECD group. First, it can be seen that all regressions fit pretty well judging by the log-likelihood and AIC statistics. Second, the coefficients of Δ(C+I+X-M)/ΔGDP are both negative and significant, implying that increasing the share of private activities in the economy reduces the inefficiency of government spending. Third, the corruption perception index (CPI) also carries a negative and significant coefficient. This clearly indicates that a country with a higher CPI score performs better in terms of government spending than another with a lower CPI score. Fourth, as far as monetary growth is concerned, the M3 growth rate exhibits a significantly positive relationship with the government inefficiency scores. This means that the faster the broader notion of money supply, M3, grows, the worse the government fiscal spending performance will be. This could possibly result from two related sources. The first is that the higher money growth may generate inflation uncertainty and dampen private sector activities, partly offsetting the increased government spending. The second is that increased government spending may further add to the inflation uncertainty when money growth is already high, thereby reducing its efficiency. Fifth, the indicator of government size (Government Revenues/GDP) is negatively significant. This means the larger the OECD government size, the less inefficiency of its performance; and the size contributes more to its promotion in GDP. Sixth, the debt/GDP ratio also carries a negatively significant coefficient. This could be explained by the fact that the debt/GDP ratio in most sample OECD countries is getting bigger and bigger in recent years, which might cause the government to be more cautious in managing it expenditure.

Table 3s report the results of the Tobit regressions using **I, M** and all **Z**-variables. It is

[18] A recession dummy with a value of 1 is assigned when the fixed investment of the current year is smaller than that of previous year in each country, and with a value of 0, otherwise.

seen that the coefficient of Δ(C+I+X-M)/ΔGDP still remains significantly negative. CPI is significant only at 10% level. Broad money M3 growth rate, the government size proxied by Revenues/GDP ratio and debt/GDP ratio all become insignificant. Among the **Z**-variables used in Table 3, Log of GDP per capita, changes in GDP Deflator, Non-Agriculture share, and Secondary Education are significant at 1 % level with the first one being negative and the latter three being positive. Saving rate is partly significant in three out of four regressions. The variables Interest rate, Unemployment Rate, Population Growth, Private Credit/GDP ratio and Liquid-Liability/GDP ratio are not significant at all.

--- Insert Table 3-(OECD) and Table 3-(Asian) here ---

5.4 Robustness Tests using the EBA Method

The differences and even contradictions in the results of the above regressions in Tables 2 and 3 – both without **Z**-variables and with all **Z**-variables, simply illustrates the fact that economic theory ordinarily does not generate a complete specification of which variables are to be held constant when statistical tests are performed. The robustness analysis proposed in the EBA approach is designed to provide more reliable results regarding the significance of the explanatory variables. This paper uses the discriminatory EBA approach in exploring the robustness of Δ(C+I+X-M)/ΔGDP, as well as the effects of corruption, M3 money growth, government size, and Debt/GDP ratio on the efficiency of government performance. In each regression, as outlined earlier, a combination of three out of ten **Z**-variables are chosen as regressors. A total of 120 forms are tested for each regression in each of OECD and Asian group. The combinations of the **Z**-variables that forge the upper and lower bounds of the **I**-variables and **M**-variables are listed in Table 4-(OECD) and Table 4-(Asian).

--- Insert Table 4-(OECD) and Table 4-(Asian) here ---

It is seen that the **I**-variable Δ(C+I+X-M)/ΔGDP is a robust negative explanatory variable in explaining the inefficiency of public expenditure in promoting GDP. It shows that increasing the share of private activities in the economy helps reduce the inefficiency of public spending. This makes good sense in that there are complementarities between private and public spending in raising GDP. Specifically, any increase in public spending is more effective in raising GDP if the private sector also increases its spending on consumption, investment and net export, otherwise the effects on GDP are likely to be subdued. The CPI indicator reveals a not robust effect on government inefficiency, which is quite different from that on 7 East Asian countries. The reason might be due to the fact that OECD countries under study are mostly of less degree of corruption, which gather around at the high end of CPI and thus have less power in explaining the government inefficiency, while the corruption indices of Asian countries are scattering more from low to high.

As far as the effects of monetary expansion on government performance are concerned, the EBA results indicate that M3 growth rate is a robust positive indicator that remains significant and positive within the range. This implies that the faster the money supply, M3, grows, the worse the government fiscal spending performance will be. Two possible reasons could be proposed. First, higher money growth may generate inflation uncertainty and dampen private sector activities, partly offsetting the increased public spending. Second, increased public expenditure may further add to the inflation uncertainty when money growth is already high, thereby reducing its efficiency.

Government size indicated by the Revenue/GDP ratio is not robust. It changes sign and are insignificant in all tests. This result is different from that of the endogenous growth literature, such as Barro (1991), Hansson and Henrekson (1994) and Folster and Henrekson (2001). It is more in support of the argument made by Easterly and Rebelo (1993).

Although the debt/GDP ratio carries a negatively significant coefficient in the basic models discussed above, it does not come out as a robust variable in the EBA robustness tests when some of the Z-variables are included. This simply illustrates the fact that economic theory ordinarily does not generate a complete specification of which variables are to be held constant or which are to be considered in the model when statistical tests are performed.

Interestingly, in the current global recession which came on the heels of a near collapse of the financial system in the U.S., policy has included government spending both in the form of infrastructure and tax relief. In the U.S. where the recession is often dubbed the “Great Recession” government spending also included lending to banks and financial institutions to shore up their balance sheets so as to make them financially viable. Though somewhat early to confirm, the preliminary results do show that a severe recession may have been averted. It is useful to note, however, that our paper does not address the issue of excessive borrowing and spending by governments, though that obviously is important and often quite pertinent.

6. Concluding Remarks

This paper provides estimates of government spending inefficiency using the DEA method and assesses which factors are significant determinants of such inefficiency using the Tobit regression and the extreme bounds approach. Ten OECD countries with annual data of the period 1981 – 2008 and seven Asia countries with data 1986-2007 are used as samples.

One key finding suggests that government spending inefficiency declines when complemented by an increase in private economic activities, especially an increase in consumption, investment and exports. While there is ample evidence in the literature on public expenditure crowding out private investment, our results suggest that an increase in C+I+NX can help enhance the positive effects of public spending. A second important result is that monetary expansion worsens the government inefficiency in promoting GDP. Finally, the CPI indicator reveals no robust effect on government inefficiency in OECD group, while it is significant in the case of East Asian countries. The reason might be due to the fact that OECD countries under study are mostly of less degree of corruption than the Asian countries.

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Appendix: Variable Definition and Data Sources

For OECD countries

1. ΔGDP: Change in GDP, PPP adjusted US$, billions. Source: World Bank database.
2. ΔG: Change in Government expenditure, PPP adjusted US$, billions. Source: World Bank.
3. C: Private consumption, PPP adjusted US$, billions. Source: World Bank database.
4. I: Fixed investment, PPP adjusted US$, billions. Source: World Bank database.
5. X-M: Net exports of goods & services, PPP adjusted US$, billions. Source: World Bank.
6. Debt: Government debt. Source: OECD.
7. M3 Growth Rate: Growth of broad money M3 in Index with 2005 as 100. Source: OECD.
8. Govt Revenue/GDP: Ratio of Government Revenues to GDP. Source: OECD.
9. Corruption Index: Corruption Perceptions Index. Source: Transparency International, 2010.
10. GDPpc: GDP per capita in PPP. Source: Word Bank database.
11. Saving Rate: Gross savings rate. Source: Word Bank database.
12. Interest Rate: Lending interest rate. Source: Work Bank database.
13. ΔGDP Deflator: Change in GDP deflator with 2000 as 100. Source: Word Bank.
14. Unemployment rate: Unemployment/ total (% of total labor force) Source: Word Bank.
15. Non-Agric Share: Non-agriculture value-added share, %, in GDP measured in constant LCU. Source: Word Bank database.
16. Secondary Education: Secondary enrollment rate in %. Source: Word Bank database.
17. Population Growth: Population growth rate in %. Source: Work Bank database.
18. Liquid-Liability/GDP: Ratio of Liquid Liability to GDP, %. Source: IMF, International Financial Statistics, 35L. (Liquid Liabilities are calculated using IFS numbers and the following method: $\{(0.5)*[(F(t)/P\_e(t))+F(t-1)/P\_e(t-1))]\}/[GDP(t)/P\_a(t)]$,where F is liquid liabilities (line 55l) or Money plus Quasi-Money(lines 35l). If neither liquid liabilities nor money plus quasi-money are available, we use time and savings deposits (line 25). GDP is line 99b,P_e is end-of period CPI (line 64) and P_a is the average annual CPI.
19. Private Credit/GDP: Ratio of Private Credit to GDP. Source: IMF, International Financial Statistics, 22D. (Similar note in 18 applied.)

For Asian Countries:

1. ΔGDP: Change in GDP, PPP adjusted US$, billions. Source: ICSEAD, East Asian Economic Perspectives 2008, The International Centre for the Study of East Asian Development, Japan.
2. ΔG: Change in Government expenditure, PPP adjusted US$, billions. Source: same as in 1.
3. C: Private consumption, PPP adjusted US$, billions. Source: Same as in 1.
4. I: Fixed investment, PPP adjusted US$, billions. Source: Same as in 1.
5. X-M: Net exports of goods & services, PPP adjusted US$, billions. Source: Same as in 1.
6. M1 Growth Rate: Growth rate of narrow money. Source: Asian Development Bank (ADB) dataset.
7. M2 Growth Rate: Growth of broad money. Source: Same as in 6.
8. Govt Revenue/GDP: Ratio of Government Revenues in GDP. Source: Same as in 1.
9. Govt Taxes/GDP: Ratio of Total Taxes in GDP. Source: Same as in 1.
10. Corruption Index: Corruption Perceptions Index. Source: Transparency International, 2009.
11. GDPpc: GDP per capita in PPP. Source: Word Bank database.
12. Saving Rate: Gross savings rate. Source: Word Bank database.
13. Interest Rate: Lending interest rate. Source: Work Bank database.

14. ΔGDP Deflator: Change in GDP deflator. Source: Same as in 1.
15. Unemployment rate: Unemployment/ total (% of total labor force) Source: Work Bank database.
16. Non-Agric Share: Non-agriculture share in GDP. Source: Same as in 1.
17. Secondary Education: Secondary enrollment rate. Source: Same as in 1.
18. Population Growth: Population growth rate in %. Source: Work Bank database.
19. Liquid-Liability/GDP: Ratio of Liquid Liability to GDP. Source: IMF, International Financial Statistics.
20. Private Credit/GDP: Ratio of Private Credit to GDP. Source: Same as in 19.
21. For Taiwan, if data are not listed in ADB, they are drawn from: DGBAS, ROC; Ministry of Finance, ROC; and The Central Bank of China, ROC., etc.

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Table 1-(OECD) Efficiency Scores Estimated by DEA Method

	Mean	St Dev	Maximum	Minimum	# of Efficiency
Australia	0.46332	0.15346	1.000	0.312	1 (25)
Canada	0.61250	0.21530	1.000	0.112	2 (24)
France	0.56468	0.11261	0.789	0.398	0 (22)
Germany	0.75018	0.20893	1.000	0.393	3 (11)
Italy	0.50721	0.15109	1.000	0.356	1 (19)
Japan	0.54162	0.18236	1.000	0.309	2 (21)
Korea	0.54176	0.20754	1.000	0.273	1 (21)
New Zealand	0.72214	0.19275	1.000	0.397	4 (22)
United Kingdom	0.58936	0.17776	1.000	0.413	2 (25)
United States	0.73884	0.18950	1.000	0.347	5 (25)
10 Countries	0.59739	0.19972	1.000	0.112	21 (215)

Note: 1. Estimated using ΔGDP_{t+1}, ΔGDP_{t+2}, and ΔGDP_{t+3} as outputs.
2. Total number of observations is in parenthesis.

Table 2-(OECD) Tobit Regression Results of Basic Models without Z-variables

Tobit Regression	I	II	III	IV
Constant	0.6270	0.6547	0.363	0.5083
	(9.17)***	(8.12)***	(12.75)***	(15.98)***
I-variable				
Δ(C+I+X-M)/ ΔGDP	-0.0962	-0.1181	-0.1265	-0.1014
	(-2.67)***	(-3.19)***	(-3.57)***	(-2.81)***
M-variables				
Corruption	-0.0245	---	---	---
	(-2.86)***			
M3 Growth Rate	---	---	0.0109	---
			(4.79)***	
Gov't Revenues/GDP	---	-0.0052	---	---
		(-2.74)***		
Debt/GDP	---	---	---	-0.0016
				(-3.03)***
Log Likelihood	-1.3759	-1.7097	5.5425	-0.8612
AIC	10.7518	11.4195	-3.0851	9.7225
No. of Observations	215	215	215	215
No. of Iterations	9	9	10	8

Notes: 1. Estimated using SAS 9.1.
2. t-values are in parentheses.
3. ***, **, and * indicate significance at the 1%, 5% and 10% level, respectively.

Table 3-(OECD) Tobit Regression Results of Basic Models with All Z-variables

Tobit Regression	I	II	III	IV
Constant	0.3386	0.0204	0.006	0.2245
	(0.53)	(0.03)	(0.01)	(0.35)
I-variable				
Δ(C+I+X-M)/ ΔGDP	-0.1094	-0.1079	-0.1137	-0.1128
	(-3.58)***	(-3.49)***	(-3.67)***	(-3.67)***
M-variables				
Corruption	-0.0227	---	---	---
	(-1.78)*			
M3 Growth Rate	---	---	0.0021	---
			(0.67)	
Gov't Revenue/GDP	---	0.0027	---	---
		(1.19)		
Debt/GDP	---	---	---	0.0006
				(1.02)
Z-variables				
Ln GDPpc	-0.2775***	-0.3104***	-0.2706***	-0.3083***
Saving Rate	0.0009	0.0079**	0.0052*	0.0058**
Interest Rate	0.0042	0.0036	0.0043	0.0039
Δ GDP Deflator	0.0157***	0.0136***	0.0135***	0.0151***
Unemployment rate	-0.0045	-0.0017	-0.0026	-0.0047
Non-Agric Share	0.024***	0.0266***	0.0248***	0.0254***
Secondary Education	0.005***	0.0047***	0.0045***	0.0051***
Population Growth	-0.0204	-0.0219	-0.0387	-0.0288
Private Credit /GDP	0.0391	0.0811	0.0518	0.0823
Liquid-Liability/GDP	0.074	0.0155	0.0314	-0.0025
Log Likelihood	44.2434	43.3768	42.8947	43.1937
AIC	-60.4867	-58.7536	-57.7894	-58.3874
No. of Observations	215	215	215	215
No. of Iterations	44	46	48	75

Notes: 1. Estimated using SAS 9.1. 2. t-values are in parentheses.
3. ***, **, and * indicate significance at the 1%, 5% and 10% level, respectively.
4. Due to space limit, the t-values of Z-variables will not be presented.

Table 4-(OECD) Sensitivity Results of Tobit Regression using EBA Methodology

	β-coefficient	Standard Error	p-value	Z-variables	Robust/ Fragile
I-variable					
Δ(C+I+X-M)/ ΔGDP					**Robust**
High	-0.0678	0.0353	0.0544	Irate, ChGDPDf, NonAgSh	
Base	-0.0962	0.0361	0.0077	---	
Low	-0.1401	0.0325	<0.0001	LGDPpc, SecEdu, LqLbGDP	
M-variables					
Corruption					**Fragile**
High	0.0104	0.0097	0.2875	LGDPpc, SavR, NonAgSh	
Base	-0.0245	0.0085	0.0043	---	
Low	-0.0436	0.0089	<0.0001	ChGDPDf, SecEdu, LqLbGDP	
M3 Growth Rate					**Robust**
High	0.0153	0.0031	<0.0001	UnempR, NonAgSh, LqLbGDP	
Base	0.0109	0.0023	<0.0001	---	
Low	0.0051	0.0029	0.0766	LGDPpc, ChGDPDf, NonAgSh	
Gov't Revenue/GDP					**Fragile**
High	0.0014	0.0021	0.5030	LGDPpc, SavR, SecEdu	
Base	-0.0052	0.0019	0.0062	---	
Low	-0.0075	0.0018	<0.0001	ChGDPDf, SecEdu, PopGr	
Debt/GDP					**Fragile**
High	0.0005	0.0005	0.3725	LGDPpc, ChGDPDf, SecEdu	
Base	-0.0016	0.0005	0.0025	---	
Low	-0.0021	0.0006	0.0002	PopGr, LqLbGDP, PvCrGDP	

Notes: 1. Estimated using SAS 9.1. A total of 120 equations are estimated for each robust test.
2. The extreme bound is the high (low) value of β-coefficient plus two standard errors.
3. Abbreviations for Z-variables: LGDPpc: log of GDP per capita; SavR: Saving Rate; IRate: Annual Interest Rate; ChGDPDf: Change in GDP Deflator; UnempR: Unemployment Rate; NonAgSh: Non Agricultural Share; SecEdu: Secondary Education Enrollment Rate: PopGr: Population Growth Rate; LqLbGDP: Liquid liability to GDP Ratio; PvCrGDP: Private Credit to GDP Ratio.

Table 1-(Asian) Efficiency Scores Estimated by DEA Method

	Mean	St Dev	Maximum	Minimum	# of Efficiency
Japan	0.659	0.284	1.000	0.268	5 (15)
Singapore	0.582	0.282	1.000	0.257	3 (11)
Taiwan	0.423	0.317	1.000	0.132	3 (16)
Hong Kong	0.555	0.279	1.000	0.090	3 (15)
Malaysia	0.333	0.197	1.000	0.177	1 (15)
Thailand	0.330	0.127	0.543	0.169	0 (12)
Korea	0.601	0.291	1.000	0.227	4 (16)
7 Countries	0.500	0.285	1.000	0.090	19 (100)

Notes: 1. Estimated using ΔGDP_{t+1}, ΔGDP_{t+2}, and ΔGDP_{t+3} as outputs.

2. Number in parentheses are the valid observations for each country estimated in DEA model.

Table 2-(Asian) Tobit Regression Results of Basic Models without Z-variables

Tobit Regression	I	II	III	IV
Constant	1.4234	1.0823	1.0871	0.8455
	(6.48)***	(4.96)***	(4.23)***	(3.50)***
I-variable				
Δ(C+I+X-M)/ ΔGDP	-0.7810	-0.7620	-0.6843	-0.6923
	(-5.25)***	(-5.50)***	(-4.55)***	(-4.96)***
M-variables				
Corruption	-0.0447	-0.0330	-0.0461	-0.0310
	(-2.83)***	(-2.19)**	(-3.08)***	(-2.16)**
M1 Growth Rate	0.0022	---	0.0033	---
	(0.66)		(1.01)	
M2 Growth Rate	---	0.0144	---	0.0146
		(3.64)***		(3.85)***
Govt Revenues/GDP	-0.1853	0.0493	---	---
	(-0.58)	(0.16)		
Govt Taxes/GDP	---	---	0.4937	0.5376
			(1.16)	(1.37)
Log Likelihood	-33.29938	-27.22870	-32.80035	-26.31033
AIC	80.59876	68.45739	79.60069	66.62066
No. of Observations	100	100	100	100
No. of Iterations	14	14	13	14

Notes: 1. Estimated using SAS 9.0. 2. t-values are in parentheses.
3. ***, **, and * indicate significance at the 1%, 5% and 10% level, respectively.

Table 3-(Asian) Tobit Regression Results of Basic Models with All Z-variables

Tobit Regression	I	II	III	IV
Constant	2.1591	2.5738	2.2879	2.5764
	(1.96)**	(2.40)**	(1.93)*	(2.25**)
I-variable				
Δ(C+I+X-M)/ ΔGDP	-0.5799	-0.5404	-0.5803	-0.5328
	(-5.91)***	(-5.63)***	(-5.73)***	(-5.36)***
M-variables				
Corruption	-0.0150	-0.0056	0.0298	0.0109
	(0.47)	(-0.17)	(1.02)	(0.36)
M1 Growth Rate	-0.0001	---	-0.0001	---
	(-0.04)		(-0.02)	
M2 Growth Rate	---	0.0108	---	0.0110
		(2.59)***		(2.60)***
Govt Revenue/GDP	0.6146	0.7403	---	---
	(1.65)*	(2.00)**		
Govt Taxes/GDP	---	---	0.5131	0.7333
			(1.11)	(1.60)
Z-variables				
Ln GDPpc	-0.4363***	-0.5039***	-0.4087**	-0.4750***
Saving Rate	-0.0022	0.0043	0.0040	0.0029
Interest Rate	0.0273*	0.0303**	0.0268*	0.0300**
Δ GDP Deflator	0.0148*	0.0175**	0.0134	0.0164*
Unemployment rate	-0.0335	-0.0485*	-0.0364	-0.0491*
Non-Agric Share	0.0212	0.0211	0.0188	0.0195
Secondary Education	0.0039*	0.0059***	0.0034	0.0052**
Population Growth	0.0644	0.0993*	0.0616	0.0913*
Private Credit / GDP	-0.0404	-0.1061	-0.0560	-0.1216
Liquid-Liability / GDP	0.1107	0.1522*	0.0939	0.1308
Log Likelihood	3.83001	7.15613	3.09437	6.45697
AIC	26.33998	19.68773	27.81126	21.08607
No. of Observations	100	100	100	100
No. of Iterations	97	91	94	87

Notes: 1. Estimated using SAS 9.0. 2. t-values in parentheses. 3. ***, **, and * indicate significance at the 1%, 5% and 10% level, respectively. 4. Due to space limitation, t-values of Z-variables are not presented.

Table 4-(Asian) Sensitivity Results of Tobit Regression using EBA Methodology

	β-coefficient	Standard Error	p-value	Z-variables	Robust/ Fragile
I-variable					
Δ(C+I+X-M)/ ΔGDP					**Robust**
High	-0.4753	0.1152	<.0001	SavR, UnempR, PopGr	
Base	-0.5932	0.1453	<.0001	---	
Low	-0.7299	0.1116	<.0001	I-rate, ChGDPDf, LqLbGDP	
M-variables					
Corruption					**Robust**
High	-0.0342	0.0150	0.0226	SavR, ChGDPDf, UnempR	
Base	-0.0585	0.0147	<.0001	---	
Low	-0.0768	0.0148	<.0001	PopGr, LqLbGDP, PvCrGDP	
M1 Growth Rate					**Fragile**
High	0.0059	0.0028	0.0372	SavR, UnempR, PopGr	
Base	0.0037	0.0035	0.2924	---	
Low	-0.0033	0.0026	0.2105	LGDPpc, NonAgSh, PvCrGDP	
M2 Growth Rate					**Robust**
High	0.0186	0.0037	<.0001	SavR, LqLbGDP, PvCrGDP	
Base	0.0171	0.0036	<.0001	---	
Low	0.0085	0.0039	0.0270	LGDPpc, SavR, PopGr	
Govt Revenue/GDP					**Fragile**
High	0.8179	0.2889	0.0046	Irate, ChGDPDf, LqLbGDP	
Base	-0.5781	0.3216	0.0723	---	
Low	-0.8156	0.3396	0.0163	SavR, PopGr, PvCrGDP	
Govt Taxes/GDP					**Fragile**
High	1.1704	0.3725	0.0017	SavR, Irate, LqLbGDP	
Base	0.6442	0.4635	0.1646	---	
Low	-0.3428	0.3645	0.3471	UnempR, NonAgSh, PopGr	

Notes: 1. Estimated using SAS 9.0. A total of 120 equations are estimated for each robust test.
2. The extreme bound is the high (low) value of β-coefficient plus two standard errors.
3. Abbreviations for Z-variables: LGDPpc: log of GDP per capita; SavR: Saving Rate; IRate: Annual Interest Rate; ChGDPDf: Change in GDP Deflator; UnempR: Unemployment Rate; NonAgSh: Non Agricultural Share; SecEdu: Secondary Education Enrollment Rate: PopGr: Population Growth Rate; LqLbGDP: Liquid liability to GDP Ratio; PvCrGDP: Private Credit to GDP Ratio.