Non-parametric analysis of government performance: A case study of SAARC countries

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CERTIFICATE

This is to certify that this thesis entitled: **"Non-parametric Analysis of Government Performance: A Case Study of SAARC Countries"** submitted by Ms. Aisha Tahir is accepted in its present form by the Department of Econometrics and Statistics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree in **Master of Philosophy in Econometrics**.

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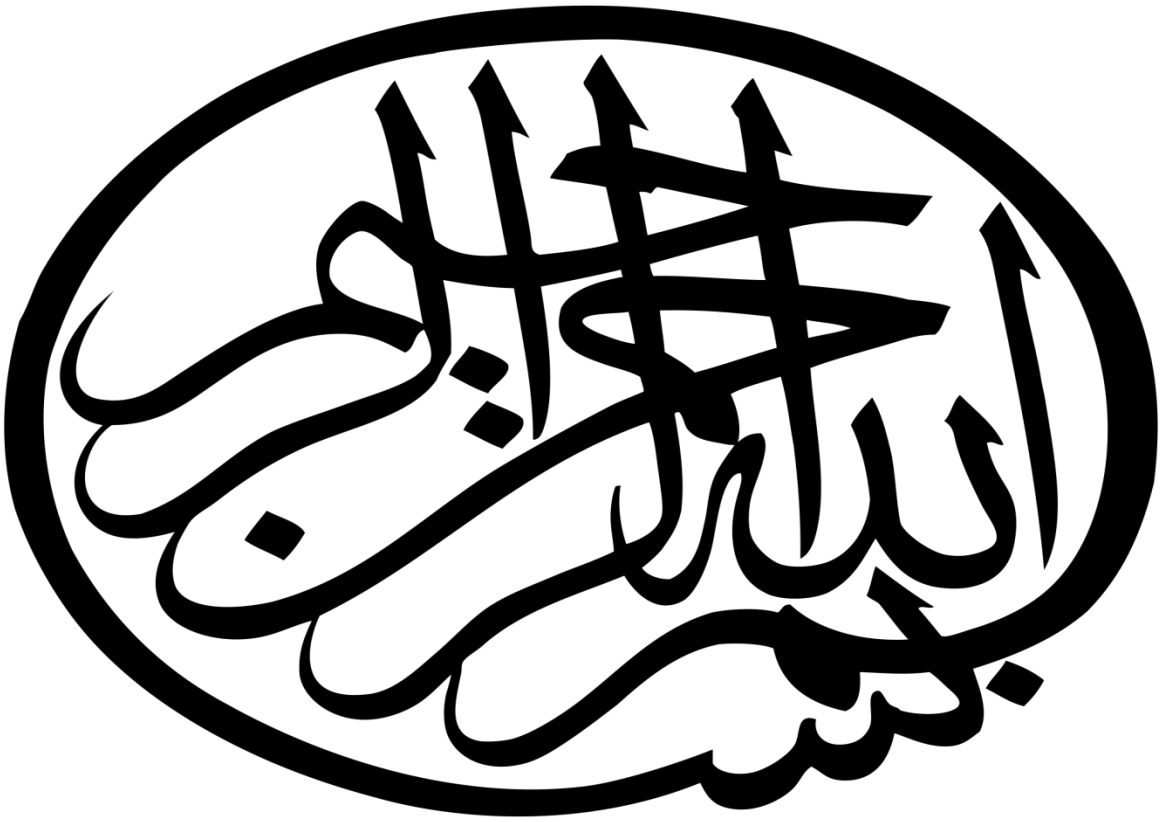
I, Aisha Tahir, Reg no 14/MPHIL-ETS/pide/2013, in the Department of Econometrics & Statistics at PIDE Islamabad do hereby solemnly declare that the thesis entitles, **Non-parametric analysis of government performance: A case study of SAARC countries"** submitted by me in partial fulfillment of the requirement of master of philosophy in the subject of Econometrics is my original work. I solemnly declare that this is my original work and has not been submitted or published earlier and also shall not be submitted in the future. It shall also not be submitted to obtain any degree to any other university or institution.

Aisha Tahir



Abstract

This study focuses on one of the important assumption of DEA, that all DMU is homogenous. The DMUs which are different in the pattern of other DMUs is considered to be the outlier. And this outlier affects the efficiency score as well as determinants. So detection or removal is necessary. Here we used purely nonparametric approach to detect outlier which is introduced by Banker and Gifford (1988), this method screen out all outlets and gives us a more reliable efficiency score. This reliable efficiency score gives us other econometric processing with accuracy or validity and minimized measurement error. This study incorporates the comparison of two standard models of DEA named as CCR and BCC how the difference in results takes place and which model is appropriately regarding this study and helpful to investigate their determinants. This study focuses on the ranking of efficient DMUs as well as sources of these inefficiencies, whether it is inside or outside the system. Along with that this study measures the government public sector investment inefficiencies and their determinants along with that explain the strong theoretical background of government, public sector investment lead growth, theoretical use of macroeconomic Barro model that identifies the concept of inefficiencies in public financing. This study discusses the while the inefficiencies in the government, public financing system is due to political reasons, governmental management flaws or due to some economic causes. This study focuses on SAARC countries because WDI reported negative governmental management index for these countries and this area required a meaningful research.

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List of Acronyms

DEA	Data envelopment analysis
REM	Robust error measurement
VRS	Variable returns to scale
IRS	Increasing returns to scale
CRS	Constant return to scale
DMU	Decision making unit
SAARC	South Asian Association for Regional cooperation
EBA	Extreme bound analysis
CCR	Charnes, Cooper, and Rhodes
BCC	Banker, Charnes, and Cooper

Chapter 1

Introduction

There are many types of research take place which study efficiency and their determinants, by using some non-parametric functions, like data envelopment analysis (DEA) or some other non-parametric linear programming techniques without care of outliers in the system. Because in non-parametric linear programming models we don't have error distribution, (Cherian, 1995) so capturing outliers in non-parametric is considered to be the irrelevant phenomenon. But there are many studies take place which said that linear programming non-parametric techniques are sensitive to outliers like, Kuosmanen, believed that DEA is very penetrating to extreme values. So elimination is required and recommended the robust error measurement. (Kuosmanen T. &., 1999). Otherwise its impact on efficiency score, (P.W, 1995). DEA is a technique which doesn't require an explicit functional relationship. Timmer, was first who examined the technical efficiency score is sensitive to outliers. (Timmer, 1971) In literature, there are numerous methods for identifying outliers in DEA have been defined. Andrews and Pregibon, describe a method which used geometric methods. But the limitation of this method is that it can appropriate when there is one output. (John, 1981) Wilson comes up with innovative forms of the geometric method, but the drawback of this method that frontier analysis is misleading. (wilson, 1993) Cazal et all gives expected minimum input/output method and detect outliers by using the expected frontier estimator, but this method has the limitation of a very large data set (Cazals, 2002). Nam et all gives a new technique by estimating the model by using VRS and then delete

those DMUs which give a very high score, and re-estimate again and again like iterative process until the score is outlier free. But this method is an informal or a crude method applicable only to variable returns to scale (VRS). (Tran, 2010) There are some semi-parametric approaches Simon, introduced stochastic frontier in DEA. (Kwan, 1996) Some used simulation and bootstrapping in DEA in order to examine the distribution of error or to detect outliers. (Simões, 2010) But Banker & Chang, give the method for detecting outliers by using pure non-parametric model. (Banker, 2006) There is a limitation of DEA that all DMUs should be homogenous; the DMU that is differing from the pattern of other DMUs is considering being the outlier. Or affect the efficiency analysis. (Dyson, (2001)) In this study, I used the pure non-parametric model to detect outlier of DMU. We will not able to get accurate determinants if our efficiency score is influenced by outliers. In this study, I focus on efficiency analysis of government, public sector and also estimate their determinants.

In the economic development of a country, public expenditure plays an important role in multiple dimensions, usually in improving infrastructure, the increment in public goods and services. To stimulate economic activities of a country, this public expenditure used by the government to adopt varies fiscal measures such as transfer payments, taxation, and other policy analysis. Traditionally, public expenditure is an element of fiscal policy, which is used to stimulate its growth. (Easterly, 1993) There are many types of research take place which shows the empirical evidence of government, public sector spending led growth. There are lots of previous studies which incorporate the long run relationship between government, public expenditure and economic growth, such as (Demirbas, 1999) and henrekson[i] (1996). But there are certain types of inefficiencies in this process which create hurdles in achieving

such goals. Due to its importance, Public economists have long been interested in public/government sector inefficiency and in investigating the determinants that explain the variations, both across countries and over time. If the different government uses the same rate of government spending in the public sector can we expect that to increase in GDP at the same rate? Do government performance equally improved in achieving the same rate of public expenditure? These are two main factors that explain differences in efficiency among countries. According to economic perspective, one is the public expenditure multiplier magnitude that depends on upon the size of MPC (marginal propensity to consume), MPI (marginal propensity to invest), MPM (marginal propensity to import) and the marginal tax rate etc. The second factor is management ability of government at the macro level. The concern of this study is only to highlight the government management performance in public sector. Measuring multiplier is outside the frame of this study. Measuring inefficiencies are a technical or operational phenomenon, it is sensitive to outliers or extreme values causes' series impact on its determinants. Therefore, detection or removal is necessary. There are two methods of measuring efficiency analysis used in literature one from parametric and other from non-parametric but parametric analysis required that prior production technology is known functional form or specification requirement. So I switch this study to non-parametric approach because different countries follow different production function so it's unable to measure their production technology. So we used here non-parametric DEA approach to measure performance analysis. Previous researches which work on DEA approach and measuring efficiencies and their determinants without care of outliers cause a serious impact on the results. So my study mainly focuses on how outliers impact on determinants and comparison on CCR and BCC standard models. This study is based on SAARC countries

includes PAKISTAN, India, Maldives, Bhutan, Srilanka, Bangladesh, Afghanistan, Nepal. We choose SAARC countries which mostly include developing countries and government inefficiency is a very likely to be the most prominent part (WDI, 2015). Most developing countries rely on tax revenue or government spending on their development projects. (Heller, 1975) At the first stage we measured government inefficiencies by using linear programming techniques on the second stage we find out its determinants using general to specific modeling after detection of an outlier of DMU. General-to-specific demonstrating is a sort of econometric modeler rearranges an at first broad model that sufficiently portrays the experimental confirmation of his or her hypothetical structure. Focal parts of this approach incorporate the hypothesis of diminishment, element particular, and model determination methods, display choice criteria, show correlation, including, PC outomatricks, and exact usage.

1.1 Importance of the study with regard to SAARC

This study is very important in the case of SAARC countries as well as Pakistan. because now a day in Pakistan there is a trend to directly criticize the government, public notice the role of government, how government plays role in country growth and development, policies of the government are effective or not. [1]There have so far been four major political movements in Pakistan that tried to remove an active government. Three of these protesting actions were in contradiction of military regulation and one beleaguered a voted civilian arrangement. However three of the actions (two against martial law and one in

[1] Dawn newspaper :uprisings and downfalls, attempts at ousting Pakistani governments

contradiction of a civilian regime) were really effective in commencing a arrangement of actions that carried the government dejected, the ultimate achievements of these actions were rapidly stained by the resulting appearance of better societal and governmental crisis associated with the ones that the actions had piercing their complaints in contradiction of. The four actions contain the 1968-69 revolution in contradiction of Marched Militant Ayub Khan's military-backed command; the 1977 crusade of opposition parties in contrast to the civilian administration of Zulfikar Ali Bhutto; the 1983 crusade led by the Crusade for the Renovation of Democracy (MRD) in contradiction of the military absolute rule of General Ziaul Haq; and the 2007 complaint crusade controlled by drastic lawyers and assisted by obstruction parties in contradiction of the pro-military system of General Parvez Musharraf. (Lamba, 2016) (PARACHA, 2014) After these movements media highlighted most government activities create awareness, and the public has an eye on government performance and competition between political parties with regard to performance has been increased. Similarly, in the case of SRI-LANKA, there is civil war exist in the country for 26 years, 1983-2009. This war is between Tamil Elam Hindu community in the north of SRI-LANKA, and in Buddhist community who fought for getting a separate state. This war cause continues political or governmental distortion in state and also has after effects which cause governmental performance down. Nepal facing continues governmental changing problem for past few years which cause series economic or development issues in the state. 'Nepal has been the subject of ever-changing political environment and is today probably the worst politically managed country in the whole of South Asia. In the recent months it has been observed that the political life in the country has been disrupted mainly for two regions- the February 1st authoritarian move taken by King Gyanendra and the failure of the political

parties to establish law and order before the royalist takeover" (Political Problems In Nepal) Bangladesh also facing continued political instability," Politically, there have been four successful elections in 1991, 1996, 2001 and 2008. The opposition has won each time, an unmatched record in Asia". (Cookson, 2016) "The Economist Intelligence Unit has predicted that the likelihood of political or governmental performance index according to the report Afghanistan, Pakistan, Bangladesh, Nepal and Sri Lanka are all among the 27 countries rated to have "very high risk" of political and social turmoil. Bhutan and India, both rated to be at "moderate risk". (Tshering Tobgay, 2009). So this area requires a meaning full research. So in this study, we compare government performance of SAARC countries, whether it is inside or outside the system or what are the determinants.

1.2 Background of the study

The history of government spending is very old; Government spending becomes a considerable topic after the global recession in 2007-8, financial crises in U.S where government spending is persistently low. (Robert Rich, 2013) Due to its importance in different fields and strong theoretical background, it becomes a meaningful study. Background of the study based on Keynesian economics where government expenditure has a significant role. Government spending and government spending multiplier are counted to be a fundamental role in country growth.

1.3 Research question and Objective of the study

How DEA capture inefficiencies in SAARC, and how EBA associated with General to specific modeling capture its determinants.

- ✓ To measure efficiency score of public spending by using various non-parametric techniques
- ✓ To find out determinants of these inefficiencies.
- ✓ Investigate the sources of these inefficiencies whether it is due to internal mismanagement or some external forces.
- ✓ A ranking of countries with respect to their efficiency score.
- ✓ To investigate outlier is sensitive to efficiency score or not.

1.4 Significance of the study

The significance of the study is twofold, one from a theoretical point of view of government public spending and the other from an empirical point of view of Econometrics. In Econometrics varies researches took place which explains the importance of outliers on results, but unfortunately in efficiency analysis, especially when we follow the non-parametric method, or when we have no distribution of error than researchers mostly don't care about capturing of extreme values. But in practice outlier may impact the score or determinants. But my work is unique from the econometric point of view that I used the pure non -parametric method to capture outlier of DMU, In order to make efficiency determinants more reliable. In this study, I used the government public sector, which includes health education or infrastructure etc. We know that delivering whereas the kinds of services like education, health, etc. there are two modes to provide such services (i) private source (ii) government source. Various researches prove that government source is a less effective way than the private source in delivering such services. Martin examines the private sector essentially superior to the public sector in the provision of services (Anand, 1993). Although

the government sector gives more compensation than the private sector, Niskanen finds out that officials are maximized in their earning yields, the more resources they grab, improvement in performance take place. (Bender, 1998) We know that the government gives more compensation than why inefficiencies are present in government public sector. The proponent has viewed that government and private sector faces different challenges. But many types of research take place regarding such issue, for example, Scott and Mitchel explain that official's of public and private sector faces the same kind of challenges. (Mitchal, 2002)

1.5 Contribution to the literature

There is small literature exist which incorporate the importance of outliers in efficiency score how it affects the reliability of efficiency estimates, as well as determinants, will not consider being the appropriate representative. My study rejects all previous contributions that measure efficiencies by using non-parametric approach without care of the assumption of homogeneity in DMUs. So this study incorporates government financing inefficiencies or empirically evaluates government management ability in the provision of public goods. Although there is large empirical work are present, which study the long run or short run relationship between government provision of public goods or growth, but very few studies are present which evaluates government performance in the provision of public goods. Such as (Oliver, 2012) and (Glen, 2005) measure government performance. But these studies contribute only in developing countries. Some studies which examine the difference in performance of the organization of economic cooperation and development (OECD) countries and non-OECD countries like (Hsu, 2008) This study is the first time in my

knowledge that measures the government performance of SAARC countries. My study is unique in a sense because of measure inefficiencies, by using CCR and BCC model, find out relative as well as technical inefficiencies. And measure sources of inefficiencies, and represent how DEA sensitive to outliers and reject previous studies that measure inefficiencies determinants without checking of the influence of one of the basic assumption that all DMUs must be homogeneous. So detection or removal of heterogeneous DMU is necessary. Otherwise, determinants are seriously misleading. If one researcher has to use some techniques, they must have to take care of at least a basic assumption of methodological otherwise, result only gives us robust estimator.

1.6 Organization of the study

The first chapter contains an introduction and importance of the study and also describes the objective & contribution of study in literature. The second chapter gives theoretical and empirical literature along literature regarding econometric reasoning, and the third chapter gives theoretical and econometric model used in a study fourth chapter contains results discussion and fifth chapter gives policy implication and a conclusion.

Chapter 2

Theoretical and Empirical review of literature

2.1 introductions

Determinants of government performances have long been tested in industrial or in developing countries. Some studies have shown the difference in government performance of OECD and NON-OECD countries. But according to my knowledge, neither any research has long been taken which separately discuss the government, public financial mismanagement and its determinants in SAARC countries. So the first section of this chapter contains the concept of public sector investment the second section contains macro and micro models of public expenditure, the third section contain theoretical and empirical literature review following chronological method. The fourth section contains the literature review of SAARC countries and in Pakistan and fifth sections contain the literature regarding the econometrics reasoning of the issue.

2.2 Concept of government, public sector investment:

Economist divides government spending into three main components.

(i) Government expenditure on current goods and services, which is called government consumption.

(ii) Government expenditure that creates a future benefit is called government investment.

(iii) Government to transfer payment.

In my study, I take government investment in public goods such as schooling, health, and infrastructure, etc. if the government makes an efficient investment in the public sector than it contributes positively to enhance private sector as well as growth. The impact of public investment depends on upon how the government managed it. But practically due to inefficient allocation of resources, the government failed to get its required output. So in my study, we find out what are the determinants that create these inefficiencies in government management of public goods.

2.3 Models of government, public expenditure:

Bailey (1995) divides the public expenditure models into two parts micro and macro level. A micro model explains the changes in public spending at one segment, whereas macro models explain the long run progression of public spending. (Review Of Theories On Government Expenditure Economics Essay, 2015)

2.3.1 Macro models of public spending:

Wagner model:

Wagner (1883) gives his law of increasing government state activity. The brief interpretation of the law state as a share of government spending in total output expanded at its optimal level. Although he suggests some limit in this expansion. By increasing share of

government create social progress and increase in income. Wagner gives the law that the state should provide the following activities.

- Providing protection and administration
- Assuring stability
- Providing social welfare and economic development of the country.

Musgrave and Rostow development model:

These economists suggest that the increment in the size of government, public expenditure creates a rise in economic growth they give three stages of the development process.

- The stage of early development in which significant spending is mandatory in education or in infrastructure in order to improve the economy. At this stage, private saving is insufficient to finance this essential expenditure. So at this stage government spending must be extraordinary as proportionate to total output.
- The stage of rapid growth in this there is the largest expansion in private saving takes place and government spending fall correspondingly.
- The stage of developing economies in which there is a rise in demand for private goods and also required complementary government public spending.

According to the model requirement of skill labor in high-income economies is made possible through significant investment in research and development areas. (UKESSAYS, 2015)

The displacement model:

Peacock and Wiseman give a model of displacement effect the detail of which is given below.

- Communities not a question to uncommon burdens have equally even ideas about the tax load which they regard as bearable. These ideas govern those of required government spending and hence limit the level to which government spending can raise.
- However, huge scale social instabilities deteriorate these ideas of bearable tax loads. Emergency government spending is acknowledged and so too are the higher amount of taxes required to pay for it. People become used to higher tax burdens and their notions of the bearable tax load are displaced upwards. After the disruption, there is thus enlarged the scope for government spending and this does not decline back to its previous level.
- As long as the taxation restriction being eased by the communal crisis, there is also an inspection effect' of the communal crisis - people detect social wants during the crisis and agree to take greater communal spending.
- In conclusion, the crisis also hints to a rise in the attention of authority in the fingers of the central government and this is also not upturned after the crisis.

Baumol's model:

In Baumol (1967) present modified idea of the unbalanced growth model. It supposes that two sectors economy - a progressive and non-progressive sector. The explanation of progressive' is commonly economic concepts of efficiency, but related to the nature of the good being produced. The progressive sector made that type of product where the demand for labor is derived from the demand for the product themselves. In other contest, labor is only required to produce the products and is not part of the product. Capital can then be replaced for labor without upsetting the value of the goods. Thus, there is substantial scope in progressive businesses for upsurges in labor efficiency.

On the other side, the non-progressive sector produces goods where the labor it becomes the part of commodities which is demanded. In this scenario, labor could not be substituted by capital, without altering the nature of the goods. This means that there is slight scope for upsurges in labor efficiency in this sector.

Next, suppose that salaries in the two sectors rise at a similar level.. It follows that unit cost is same in both sectors. We further undertake that the public sector delivers a high quantity of society's non-progressive goods and use this to check for the comparative growth in public spending.

From here we can take two ways. Firstly, let us suppose that the magnitude of the non-progressive sector is determined by the demand of consumers. As comparative

prices for the goods of that sector increase, we should presume demand for them to decline. However, if the price elasticity of these commodities is low & if the income elasticity for them is high, then demand for them will not decline as income rises and total spending on the goods of the non-progressive sector will expand.

The second way contains assuming that the government determines the public sector provision of commodities and sets out to keep its part of the final output. Wherein two sector increase in salaries at similar rate. But with labor productivity, raising more in the private sector, the government will only be able to attain its goal if there is an ongoing transmission of labor from the private sector to the public sector.

This is all very fascinating, but two difficulties arise. Firstly, why should the public sector encompass non-progressive production than the private sector? Moreover, should administration's struggle to endure the public segment's portion of entire productivity (contributors, 2016) if public sector prices are upset than private sector prices? Using the neo-classical idea of the association between state and community, the answer of these made likely by using the idea of income elasticity and price elasticity of public and private sector commodities. This, in turn, needs us to observe the debate that community subdivision properties are priced inelastic but income elastic.

Environment model:

We talked about the view of a government that is trying to sustain its level of output in real terms. This raises the question of how one calculates the output of numerous government activities. One view is that the political burden on governments is for them to attain output in terms of efficiency - keeping decline the crime rate; decreasing hospital waiting lists; dropping class sizes; reducing infant mortality rate etc... It potency formerly remain that public sector component charges upsurge not because of ineffectiveness, (Kreatif-Tuisyen, 2016) not indeed because of Baumol's disease, but because of deteriorating social situations make it more problematic to sustain levels of performance - for example, the spread of new sicknesses, or increases in statistics of one-parent families, refugee children, and the intake of drugs.

It is also likely to reflect of aims of public sector output more generally and contend that the objective of, for example, `improved education' may be attained equally by different combinations of activities, some of which may derive from the private sector, others from the public sector.

Political model:

This model is famous as “Leviathan model” this model has an argument that there is the difference in the public or private sector, the goods of the public sector are not sold in the market and are free from market competition. So these products

are free from competition and lack of encouragement to work hard to compete in the market.

The objective of the private sector is profit maximization and they increase their output till MR=MC. On the other hand bureau of public sector provide a product free of cost and continue provision of it till MB=0. So they continuously given that product so the unit cost is comparatively higher than the private sector. So there is a difference of unit cost existing in both sectors. Expansion of public sector purely in the people how are directly or indirectly affiliated with.

2.3.2 Micro models of public expenditure

Micro models contain models of the behavior of, bureaucrats, voters, and politicians.

Income distribution model:

According to this view, public expenditure is a political way of redistribution of income. Major programs of public expenditure aims of redistribution of income, from rich to poor, public expenditure program mostly benefited the poor because richer have to pay heavy taxes for it.

Demographic and economic structure model:

This model of public expenditure depends upon transfer payments and age dependency ratio if the number of retired person exceed than the state will face the burden of public expenditure on pensions etc., or amount of pension can exceed along with an increase in inflation similarly in the case of unemployment allowance face by the state.

2.4 Theoretical literature

Adam Smith (1776) promoted much on the "laissez-faire" economy where government and public spending has no rule. According to his opinions, government intervention takes more harm than good to an economy, and that the private sector should carry out most of the actions. But later on, researches prove the importance of government and government spending.

Adolph Wagner (1835-1917) urges the importance of government spending in his commandment of cumulative public action (Karzai) this law has been proven empirically in western Europe at the end of 19th century. Law stated as the beginning of contemporary manufacturing civilization will consequence in growing governmental burden for societal development and amplified grant for societal contemplation by manufacturing. he clarifies that growth of government is increasing function of economic development and industrialization progression, Wagner explains that during industrialization progression real per capita income of nations rises as public expenditure share in total expenditure rises.

Wagner (1893) in his revised edition designed three principal rules for the rise in state expenditure (i) during industrialization progression, public sector activities will replace private sector activities. Functions of state like protective and administrative functions have risen. (ii) it is to be needed that government should provide welfare services like health education , retirement allowance , aid and environmental protection etc. (iii) industrialization progression cause technological change due to which large firms tend to monopolize, Governments have to equalize these effects by providing, social and merit goods, through

budgetary earnings. Wagner suggests that public spending is an endogenous factor, which is determined by the growth of national income. Shortcomings of Wagner law are that, it's a long run phenomenon, longer the time-series, the better the statistical inferences and economic interpretations.

Peacock and Wiseman (1967) proposed that the growth in public expenditure does not arise in the same context that Wagner theorized. Peacock and Wiseman choose the political schemes rather than the organic state where it is believed that government likes to spend money, people dislike rise in taxation and the population voting for ever rise in social services. There may be difference occur in government revenue due to a limitation in taxation and desirable public spending. These differences in large-scale create disturbance and this disturbance cause displacement to shift in government revenue and expenditure to a new level. There will be an upward increase in taxation and initially, citizens will fell displeasure but later on accepted the situation. So the new level of "tax tolerance" accepted by a citizen which seems to be intolerable first. Now the citizen accepts that government will heal up the economy to the new adjustment level. The gap of Peacock and Wiseman views is that nowadays public spending becomes necessity and disturbance have little importance practically. (Review Of Theories On Government Expenditure Economics Essay, 2015)

In (1930) John Maynard Keynes gives the idea of government intervention and gives a framework that effective fiscal policies can stimulate aggregate demand and GDP of a country. Keynesians' acceptance in aggressive government act to imbalance the economy is depending on value judgments and on the acceptance of macroeconomic instabilities significantly decrease economic performance and the government is familiar and capable

enough to improve on the free market. This period is a period of great depression and in order to cure this depression, effective government spending becomes the remedy. At that time effective fiscal policies become world renounced. Keynes considered public expenditure as an exogenous variable that can create economic growth instead of an endogenous phenomenon. Hereby, Keynes suggest the role of the government to be vital as it can vanish depression by growing aggregate demand and thus, interchanging on the economy again by the multiplier effect. It is an instrument that brings stability in the short run. Keynes new approach fulfills previous gaps of short-run analysis. Previous approaches work on long run principal, which is not applicable for short run

In (1931) Dalton explained maximum social advantage theory of government public expenditure. According to this government revenue (taxation) and government, expenditure is two main instruments. Excess of both is not good for economy.it has to be equalizing to get the maximum social benefit.

Dalton condition is designed as welfare in economic growth can be achieved when the marginal utility of expenditure equalize marginal disutility of taxation MSB=MSS.

A C. Pigou (1932) divided economics welfare into two segments, namely, the (i) production and (ii) distribution. The Pigou rate of tax is used to affect negative externalities, and taxes are used as a subsidy for positive externalities. Pigou designed maximum satisfaction point at which rate of marginal benefit equal to marginal satisfaction.

R. A. Musgrave (1933) takes little amendment in theory of maximum social advantages; he proposed a condition where maximum social benefits, can be attained on net social benefit equal to zero.

Howard R. Bowen (1943) urge that social goods not available in a similar amount to all voters. Since all community members have to enjoy social goods so there is a need for equal contribution for the provision of these public goods. But different community members have different capacity to enjoy these public goods. Each community member has a dissimilar valuation for social good. So they expected to pay differently for the provision of public goods. But hereby government wants that volume of payment that equalize the marginal cost of supplying such good equal to the marginal utility the community members enjoy after using these public goods. So the differences in community members and government cause a disturbance which so-called inefficiencies.

Solow (1956) proposed his study which is based on standard neoclassical production function. Solow found the components of GDP growth is technical progression. If there is Significantly increased in labor supply or capital accumulation cause GDP expansion. So government effective investment on the provision of skilled labor and capital accumulation creates GDP expansion. However revised version shows other factors of GDP expansion such as availability of natural resources and human capital. It is found that share of human capital income is more in the industrialized state. He suggests that output increased due to change in method of production and input remain unchanged.

Romer (1986) gives an endogenous growth model which full filled the gaps of heterogeneity of Solow work. He explained that change in method of production for GDP growth is taking place through research and development (R&D). He also promotes government funding for research and development such as education expenditure etc. (contributors, Endogenous growth theory, 2016)

Sergio Rebelo & Locus (1991) suggest that investment in human capital has a spillover impact on the economy that causes to increase in GDP by reducing decreasing return to capital accumulations.

Grossman and Hellman (1992) incorporate market imperfections in the process of GDP growth and in research and development. (Review Of Theories On Government Expenditure Economics Essay, 2015)

2.5 Empirical literature review:

Government plays a significant role in country welfare through the channel of public spending, but this spending should be productive. Since according to Wagner law productive public spending tends to rise in economic growth. So different studies have been taking place in order to prove such phenomenon.

Richard and Meltzer (1981) & Tabellini and Persson (1990) explained the public choice to sort the government distribute the social profits. They suggest the growth of government in the 18th and 19th century which enlarged the number of low-income voters who drive for further redistributive expenditures. In their model, they explained how

government boarded on satisfying the median voters which make a relationship between economic growth and public spending if the position of the conclusive voter shifts towards the lower end. When incomes of skilled labor rise, redistribution is needed. (Review Of Theories On Government Expenditure Economics Essay, 2015)

Daniel Landau (1983) found a negative correlation between real per capita GDP growth rate and government consumption expenditure share in GDP. He used a sample of 96 countries for the period of 1961-76.

Beck (1985) proposed his study in which he separated price effect from total government spending and examines government expenditure in real terms in the US. He proved that nominal government spending might be misleading to represent economic growth.

Ram (1986) found that there is positive relation exists between country economic performance and size of government spending. He used cross-sectional data to investigate that phenomenon.

Ram (1987) in another study reported that cross-sectional study does not support the granger causality of a positive relation between government provision of public goods and growth while time series analysis supports the positive relationship. Ram (1986) investigates that size of government and economic performances have a positive relationship. In another paper of time series, he found that multiple results for 63 countries.

Saunders (1988) determines the elements of the size of government expenditure growth in OECD countries. 20 years sample of 1960-80 has been taken for the analysis. The study revealed that public expenditure growth is a function of political and social collaborations.

Barro (1989) found that positive relation exists between government expenditure in human capital and GDP growth per capita and negative relation present in political instability, price distortion and GDP per capita. Barro (1990) proposed in another paper that government expenditure directly upsets the private production function.

Henrekson (1993) found that there is no long-run association among Administration expenses and GDP. (Srinivasan, 2014) The study based on Sweden by using time series analysis. Sample size has been taken from the period of 1861-1990. The technique used by him is two stages Engel granger test, he also points out the validation of previous work, that before testing causality between public spending and economic growth once should be sure that both series must be stationary otherwise it would be the spurious relationship.

Hondroyiannis and Papapetrou (1995) found a long run relationship in government expenditure and economic growth, in Greece. The methodology used by him is Johansson cointegration analysis.

Lin (1995) present hi study in Mexico from the period 1950-80 and found a mixed evidence of a relationship between government spending on public goods and GDP.

Bohl (1996) tested the existence of Wagner law by using post world war data in G-7 countries. It is found that there is no evidence of granger causality exists. Except for UK and Canada, the order of integration in other countries is one.

Payne and Ewing (1996) used ECM to test Wagner law random sampling of 22 countries. Results suggest that Pakistan, Philippine, Malaysia, Colombia and Australia have a positive relationship between government expenditure and GDP. A bi-directional relationship exists between US, Sweden, Switzerland Peru, and India. Granger causality not present in Finland, chili, Greece, japan and Italy.

James and Bradley (1996) extend the Henrickson's study by using error-correction models to observe the Granger-Causality b/w government spending and economic growth. Finding suggests that 6 positive relationships exist between the two variables from the group of 22 countries. Remaining countries contain one uni- directional relation and one bi-directional relation in causality.

Demirbas (1999) found the existence of Wagner law, by using time series data for the period of 1950 to 1996, his study specifically based on turkey. And findings suggest that there is significantly long run relationship between turkey GNP and public expenditure.

(Hughes, Nold & Edwards M.E, 2000) measures government efficiency through local level municipalities in their paper "Leviathan & Lilliputian: Data envelopment analysis of government efficiency". The main purpose of this paper is to find out whether local government performs well, if not then what causes inefficiency in local government

performance. They explain the property value maximization order, DEA explains that political jurisdiction is efficient or not.. By using Tobit regression analysis they determine which factors causes inefficiency. Results suggest that the main cause of inefficiency is the size of jurisdiction and production inefficiency and government waste is a minor problem.

Van de Sijpe, Nicolas; Rayp, Glenn (2005) measure government performance by computing and amplification state Inefficiency in the Emerging States, the main purpose of this paper is to measure government expenditure inefficiencies in low or middle-income countries and identify its determinants. The author used data from 52 developing countries due to availability constraints. The methodology used by him DAE for measure inefficiency scores and general to a specific approach to finding out its determinants. We find that government inefficiency is determined mainly by Governance and political variables, like regulation of law and political steadiness. In addition, structural country variables (in part reflecting past policies and past inefficiency) such as a huge share of young people in the total population, high adult illiteracy, and low private health expenditure make it more problematic for governments to produce outputs for a given amount of public expenditure. Governments should, therefore, focus on solidification regulation of law and maintain political steadiness to reduce inefficiency. When adjusting for these variables, political constraints, limiting the ability of politicians to follow their chosen course of action, obstruct government efficiency. (Glenn, 2005)

Oliveira de F.G, (2012) examined the experimental factors of management effectiveness A study based on Unbiased Gauges The main objective of this paper is to find out quantifiable measures of government efficiency and testing determinants of each quality.

Sample size includes 208 countries the author used moving average and simple regression technique with solving endogeneity issues. The key findings of the paper are income is positively related to government efficiency with the positive and significant coefficient of income per capita in all regressions and income per capita found to be most robust or consistent estimator of government efficiency. He also verifies that general expenditure has a positive or significant role in government efficiency urban population has a positive role in government performance, while age structure has no consistent role in government performance or agriculture oriented societies have a less efficient government. (Oliver, Aid and government fiscal behaviour, what does the evidence say, 2012)

Wang C.E & Alvi .E, (2012) examined the comparative Effectiveness of Rule expenditure and Its determinants: suggestion from OECD and Asian countries. The main objective of this paper is to find out the relative efficiency of government in 10 OECD countries and 7 Asian countries and the second objective of this paper is to find out the factors that influence government performance. The methodology used by this paper is DEA & EBA non-parametric approach; they used annual data for 10 OECD for the period 1981-2008 and 7 Asian countries for 1986-2007. The key finding suggests that government spending inefficiency declined when to increase in private sector activities. The second finding of this paper is that monetary expansion degrades the government inefficiency in encouraging GDP. Finally, the CPI indicator exposes no robust effect on government inefficiency in OECD set; while it is significant in the case of Asian countries. The reason behind the fact that OECD countries have less degree of corruption than the Asian countries. (Alvi, 2012)

Hsu, Maxwell, et all, (2015) describe in the difference of efficiency in OECD and Non-OECD Country by using Data Envelopment Analysis Approach. The main objective of this paper is to compare the efficiency in between developed countries (OECD COUNTRIES) and less developed countries (NON-OECD countries). They used three input variable government efficiency, business efficiency and infrastructure advancement and one output variable that is economic performance. Data used by them is from 2004 World Competitiveness Yearbook (WCY). WCY explain that there are 60 economies which have the ability to maintain global competition which is proven by 323 criteria, the author used the index of four variable and methodology used by them is DEA. Results show that there is a significant difference between OECD (Developed countries) and NON-OECD (LDs) with regard to efficiency score scale. Findings suggest that some less developed countries although has not very advanced infrastructure but they operate in a relatively efficient manner such as brazil, Argentina, Indonesia. Argentina and Indonesia ranked number one in efficiency score of less developed countries. (DEA, 2012)

A. Inzelt, (2015) explain in this paper he measured the change in efficiency of hungry by using an organized mathematical formula. He used time series data for the period of 1960-1974 of series of GDP which is transformed into the stationary process and free from stock fluctuation but only explain short term equilibrium. Results show that Hungarian economy produced more than a double in 1974 than in 1960.with the 16 % rise in gain full occupied population. (Inzelt, measuring the changes of efficiency in national economy, 1975)

Frost, Raymond & Thomas B.H, (2015) explain the Investigation of Administrative efficiency in developed countries The main purpose of this paper is to describe the

comparative analysis of general government efficiency measuring by government expenditure per employ in a year on the basis of which difference in productivity take place. They used annual cross-sectional data of govt. expenditure of service sector employees and countries; due to the problem of small sample size (only 20 industrial countries involved) they used quasi-step regression procedure. Results of the paper suggest that country size as measured by population very little effect in government expenditure per employee. GDP is found to be the most significant estimator affecting government expenditure per employ and govt efficiency. (Frost, 2000)

2.6 Literature in the context of SAARC countries public spending

Pradhan, Prakash (2007) found causality between government public expenditure and economic growth in SAARC countries. Panel data from the period of 1970 to 2005 have been taken. Methodology used by him granger causality test. Finding suggest that unidirectional causality found between India, Nepal, and Bhutan, but there is no evidence found of reverse causality in that countries, on the other hand, bidirectional causality found in Maldives and Bangladesh. And no causality found in Srilanka and Pakistan. This study also found that there is the difference in the specification in different SAARC countries. (Pradhan, 2007)

Hussnain (2010) examined that government used different sources in the collection of funds in the provision of public goods. So sources of public spending matters, different source effect differently in public expenditure sector. He also investigates that because

SAARC is mostly developing countries, they required public expenditure that improves skills of labor in the agriculture sector, because mostly agriculture sector has a major role in GDP.

Rudhra (2011) found the long run and short run relation exist in government spending and economic growth except for Pakistan and Srilanka. (Rudra, 2011)

Zaman et al. (2011) suggest that public expenditure on education is helpful in reduction of poverty. (Zaman, 2011)

Rudra et al. (2012) in other study examine the granger causality in government expenditure export and in GDP in SAARC countries. They used panel data from period 1960 to 2010. The result suggests that unidirectional causality exists between government public spending and in economic growth in Bangladesh and Maldives or reverse causality exist in Bhutan and Pakistan. In those countries exports cause government expenditure to rise. (R.P, 2011)

Hassan et al. (2014) found a long run relationship exist between government public health expenditure and economic growth in SAARC countries. He used two outputs of health sector infant mortality rate and life expectancy rate. The time period has been taken from 1995 to 2010. Results also suggest that government expenditure on health sector has a significant impact on growth. (Hassan, 2014)

2.7 Literature in context of Pakistan about government performance:

Ali (2007) represent its working paper ranking local government performance in Pakistan through Scorecards the aim of this report is to measure the functioning of local

government and shows their weakness and give the recommendation to overcome this. Report check the local government performance the criteria given by Local Government Ordinance 2001 The report will also explain local Government Bodies and what steps can be taken to further develop their structure. Sample selected from 19 districts of Pakistan. The sample size is 19 districts which are chosen to be representative. Findings suggest that on average SANGHAR is the highest score while KALAT is the lowest score with regard to performance. Finding also suggests that there is a lack of transparency in local government bodies.

Qureshi (2008) explain the systematic relationship between public expenditure human development and economic growth. He used simulation to check that pattern or dynamic framework. Findings suggest that even though with increasing public expenditure in education or in health sector improve demographic structure or human development indicators but don't have a role in improving economic growth. Results suggest that HD and the demographic situation has robust linkages with public expenditure but feeble linkages with economic development.

Amjad et al. (2011) study causes of stagflation his one of the implications that government mismanagement and structural weakness in the system tend to raise stagflation in the country.

Tariq Mahmoud and Sial (2011) suggest that government should increase its development expenditure or reduce its current expenditure.

Jawaid (2011) found that government fiscal policy is less effective than monetary policy in case of Pakistan. He used government spending GE as a proxy of fiscal policy, he also found that long run relationship exists between economic growth government spending.

Ammad .S, et al. (2012) measures importance of government spending by using fiscal responsiveness, persistence and discretion A Case Study of Pakistan in this paper they decompose government expenditure and revenue in three parts, responsiveness, persistence, and discretion. They used time series data from period 1972 to 2010 and used 2SLS. A result shows that government spending is more significantly responsive than government revenue in increasing output (real GDP) in the context of Pakistan.

Madni (2013) classified government expenditure into two parts productive and non-productive government expenditure. Productive government spending is those which have a significant or neutral impact on growth while nonproductive government expenditure is those which have a negative effect on economic growth. They used time of 1979 to 2012 by using ARDL approach or cointegration analysis.

PILDAT report (2014) measure government performance of Pakistan in his report named as Civic Attitude on Excellence of Authority in Pakistan. The purpose of this report is to measure the quality of government by using different governance indicators. Survey is conducted in 3065 cities of all rural or urban areas of Pakistan. Survey has a cross section of young old middle income and education or languages. Error margin is taken as +3.5% with 95% confidence interval. The result shows negative sign regarding the quality of government. It's a government policy agenda that steps are to taken to improve government quality, the,

however, the result shows that federal government affords don't have a significant impact on improving quality.Results show that 26 out of 30 governance indicator shows negative sign. The federal government received negative net performance rating (NPR). (PILDAT, 2014)

2.8 Kinds of literature regarding econometric reasoning:

Every econometrics approach has certain limitations or assumptions, and results are sensitive to those limitations, in order to get more reliable result researcher has to care about the most appropriate assumptions. As per concern to DEA efficiency score it will be biased to statistical noise or outliers. And 2nd most important limitation is that DEA influenced by sample size not gives a reliable score in small sample size. Here we concern the 1st limitation of statistical noise or outliers; it will affect the homogeneity of DMUs. DMU that is not equal in size and shape is considering being the outlier or affecting the homogeneity condition of DEA. Charnes et al (1978) explain that DEA is a standard non-parametric method to measure the efficiency of multiple input and output of homogeneous DMUs. Seiford & thrall (1990) explain that demerits of DEA are not helpful for further conventional econometrics. The controversial aim of conventional econometrics is to detect outliers and influence and divergent observations detail discussion are found in Hodge & Austin (2004) and Pregibon & Andrews (1977).

Grosskopf & Valdmanis (1987) are first who introduced the limitation of DEA is sensitive to outliers. Wilson (1993) proved a methodology to detect outliers but later on it will verify that it is unable to detect inefficient DMU outlier. Wilson & Dusansky (1995) comes up with revised version of methodology to detect outliers. After that Simor (1996) come up with the

parametric method of stochastic frontier analysis to detect outliers. Wilson & simar (2000) explain a general method that used bootstrapping in DEA to detect outlier. Ruggiero & Ondrich (2002) explain that computing standard deviation is not appropriate to detect outliers and used a revised version that used jackknifing to identify outliers. Johnson & Chen (2006) introduced a model that explains the consequence of outliers on frontier analysis. Johnson and McGinnis (2008) used a Wilson method to detect outlier inefficient and inefficient decision-making unit. Tran et al (2010) introduced a new method to detect outliers which are based on two scalar measure. Kuosmanen and Johnson (2010) introduced axiom to detect outliers. The above methodology has the certain limitation that they are not valid in multiple input/output cases. Or some used semiparametric techniques in which detection of outlier can be possible but the frontier analysis is meaningless even when we don't know about production technology or functional form. In this study, I used the pure non-parametric technique to detect outlier because the functional form or production technology unknown and our concern to make a frontier analysis. There are many studies take place which gives different measurement techniques to count homogeneity condition in DEA details are given below. Andres Hassan (2013) suggest his work on homogeneity condition by using correlation matrix, the result shows that when there is a positive correlation between inputs than DMUs is significantly more homogeneous. Haas & murphy (2003) explain homogeneity condition mean that DMUs are involved in the identical procedure. All DMUs operates in similar condition. Soteriou & Zenios (1999) deals with non-homogeneity by allocating branches to homogeneous sets by place class and magnitude. They then compare efficiency within the sets and also compare the efficiency outside the group. Murphy (2003) describe that there are two methods to deal with non-homogeneity either to delete that or adjust that.

In small sample size, it's better to adopt adjustment method, so he compares adjusted CCR model with unadjusted CCR model, they don't found any significance difference in both. He follows to stage regression in DEA for adjustment to homogeneity. Nunnikhoven & fizzle (1992) and sexton (1994) gives a methodology to tackle with homogeneity, according to them at first stage calculate ordinary DEA score and in second stage regress, these score to possible determinants to homogeneity. Molinero et al (2008) explain that in practice outliers are seldom present when we are dealing with some institutions like bank branches some are large or some are small or medium branches, he gives a solution to categorizing them and calculate separate efficiency score for each classification. At the 2nd stage we used Henry methodology of general to specific model to find out the appropriate determinants, there is literature exist regarding the pros and cons of this model. Few studies have researched how well *GETS* displaying does. Nonetheless, Hoover and Perez (1999) offer vital proof in a noteworthy Monte Carlo, rethinking the Lovell (1983) tests. They put 20 full-scale factors in databank; produce one (y) as a component of 0–5 others; relapse y on every one of the 20 or more all slacks thereof, then let their calculation rearrange that GUM till it finds a consistent (encompassing) irreducible result. They check up to 10 distinct ways, testing for mis-specification, gather the outcomes from every, then select one decision from the rest of by taking after numerous ways, the calculation is ensured against chance false courses, and conveys an undominated compatible model. In any case, Hendry and Krolzig (1999b) enhance their calculation in a few critical regards and this area now portrays these. Commentators of general-to-specific strategies have indicated various potential troubles, including the issues of 'absence of ID', 'estimation without hypothesis', 'information mining', pre-test inclinations', 'overlooking determination impacts', 'rehashed testing', and the potential

'way reliance' of any choice: see entomb alia, Faust and Whiteman (1997), Koopmans (1947), Lovell (1983), Judge and Bock (1978), Leamer (1978), Hendry, Leamer and Poirier (1990), and Pagan (1987). The accompanying examination drawson Hendry (2000a). Koopmans' investigate followed up the before assaulting by Keynes (1939, 1940) on Tinbergen (1940a, 1940b), and set the scene for questioning all econometric examinations that neglected to begin from prespecified models. Lovell's investigation of attempting to choose a little connection (zero to five regressors) covered up in a substantial database (40 factors) found a low achievement rate, subsequently proposing that pursuit methodology had high expenses, and supporting an unfavorable perspective of information based model determination. The third feedback concerned applying essentialness tests to choose factors, contending that the subsequent "estimator" was one-sided as a rule by being a weighted normal of zero (when the variable was rejected) and an impartial coefficient (on consideration). The fourth concerned predispositions in reported coefficient standard mistakes from regarding the chose demonstrate as though there was no instability in the decision. The following contended that the likelihood of holding factors that ought not to enter a relationship would be high on the grounds that a large number of tests on insignificant factors must convey some "huge" results. The 6th recommended that how a model was chosen influenced its 'believability': at its outrageous, we discover the claim in Leamer (1983) that 'the mapping is the message', accentuating the choice procedure over the properties of the last decision. Notwithstanding this flood of feedback, numerous financial analysts came to question the estimation of observational proof, even to the degree of alluding to it as a 'logical dream' (Summers, 1991).The upshot of these assaults on experimental research was that all econometric studies needed to begin from pre-determined models (or imagine they did). Summers (1991)

neglected to notice this was the wellspring of his guaranteed 'logical dream': econometric confirmation had gotten to be hypothesis subordinate, with little esteem included, and a solid inclination to be disposed of when designs in principle changed. Much exact proof just relies on upon low-level hypotheses which are a piece of the foundation learning base – not subject to examination in the present investigation – so an information based way to deal with contemplating the economy is doable. Since hypothesis reliance has at any rate the same number of downsides as test reliance, information demonstrating methods are fundamental: see Hendry (1995a). Undoubtedly, these reactions are refutable, as we now appear.

Chapter 3

Theoretical and conceptual model

Barro (1990) proposes a simple endogenous growth model with the government. In the Barro model, public spending goes for public investment (school, infrastructure, sanitation etc.). Open reserves, which are subsidized over income duties, equilibrium secluded reserves. Meanwhile, communal investments promotion the efficiency of secluded investments; higher taxes can be associated with an increase or decrease in overall growth. (van de Sijpe & Rayp, 2004) Barro suggests a growth model in which public expenditure is productive.it is easy to explain that if government investment increases in infrastructure it will ultimately help to increase the private production profitability. Let G be total services, then g = G/N is the quantity assigned to each of n producers. This concept is not similar to the concept of public goods which have a rivalry or excludable property. This means infrastructure (phone lines. Roads, factories) which is a link with government investment also stimulate private profitability. In any happening, it allows us to mark production function. (van de Sijpe & Rayp, Measuring and Explaining Measuring and Explaining , 2005)

$$Y=Ak^{1-\alpha} g^{\alpha} \qquad (i)$$

Barrio endogenous growth model uses Cobb, Douglas production function and assumes that labor is constant because the population is assumed to be fixed so we do not

include labor input into the model only capital affected by government investment. The model assumes that constant returns to scale in labor "L" and physical capital "k". (Siena, 1992)

Notice that "y "is subject to decreasing returns to k, but not to" k and g". The individual producer takes "g "as fixed (i.e., independent of his decision about k).

The government has to track a balanced budget; hence $T = g/y$. Since "g" uses one unit of the single output good, efficiency requires g* such that $\frac{\partial y}{\partial g*}$ = 1. Now if g is set efficiently, then from (¡) it follows that g/y =α. This follows because:

$$\frac{\Delta y}{\Delta g} \alpha A k^{1-\alpha} g^{\alpha-1}$$

So

$$1 = \alpha y g^{-1} \rightarrow \frac{g}{y} = \alpha \qquad (¡¡)$$

It's only happened when there is one to one relationship between government revenue collection process and government productive spending. But this is not necessarily one to one relation exists. Inefficiency in a transformation process caused by varying misallocation such as waste of resources, crowding out of private investment, low quality of public services. (Filmier at all. 1997). So we incorporate the efficiency parameter" ð" (0≤ ð ≤ 1) into the

model. We assume that" 1-ð "of revenue waste away fail to transform into productive government spending.

$$\boldsymbol{g = ðR = ðTY} \qquad \textbf{(¡¡¡)}$$

If g = g* or there is no inefficiency in government spending than MPK is determined from equation (¡).

$$\frac{\boldsymbol{\Delta y}}{\boldsymbol{\Delta k}} = \boldsymbol{(1-\alpha)A^{\frac{1}{1--\alpha}}(g/y)^{\frac{\alpha}{1}-\alpha}}$$

$$\boldsymbol{= (1-\alpha)A^{\frac{1}{1--\alpha}}\alpha^{\frac{\alpha}{1}-\alpha}} \qquad \textbf{(¡v)}$$

Thus, Government moves the MPK through two channels: i) rise in "g" raises the MPK to a point; ii) taxes always decrease the private return of capital. The private return to investment is what is left after taxes: Profit maximization condition in competitive economy equivalents the interest rate to the after-tax marginal product of capital. The setting, as in Barro and Sala-i-Martin (1995)

$$\boldsymbol{r = (1-T)\frac{\partial y}{\partial k} = (1-T)[(1-\alpha)A^{\frac{1}{1--\alpha}}(g/y)^{\frac{\alpha}{1}-\alpha}]} \qquad \textbf{(v)}$$

Dynamic optimization of household lifetime utility, subject to a dynamic budget

The constraint of the form "*a = w + Ra – c" in* every period (w is the wage income, *are* the interest rate and *an* attitude for capital, which is expected to be nothing in the early and preceding stages: *a*0 = *at* = 0), yields the well-known result. (Aristovnik, 2012)

$$\boldsymbol{\gamma = \frac{c}{c} = \frac{1}{\alpha}(r - \rho)} \qquad \textbf{(v¡)}$$

So if $g \neq g^*$ There is inefficiency in the government spending process, then it has followed. Substituting (¡) in (¡¡¡) yields an expression in '*g'* which can be inserted in (5) to solve for the interest rate.

$$\boldsymbol{\gamma = (1/\sigma)\,[\alpha\, A1/\alpha\, (L\,\tau)\,(1-\alpha)/\alpha\,(1-\tau)\,\delta\,(1-\alpha)/\alpha - \rho].} \qquad \textbf{(vi¡)}$$

High inefficiency (a low δ) problems, growth, suggesting that failure to take the inefficiency into account in growth regressions can lead to a downward bias in the productive spending coefficient, precisely as ignoring distortionary taxation (represented in (v¡) by the factor *(*1−τ)*)* does. It is straightforward to get that the relationship between government inefficiency and economic growth also holds in the case of lump-sum taxes; i.e. when (¡¡¡) may be written as:

$$\boldsymbol{g = \eth R}$$

And τ vanishes from (VI). Hence, government inefficiency is harmonizing to distortionary taxation to explain the weak link between productive spending and growth. The supplementary inefficient administrations are, the more the progressive stimulus of industrious spending is diminished and, therefore, the more growth rates are declining. These also prove that the determinants of government inefficiency are vital for policy purposes. (Sijpe, 2007)

3.2 Endogenous theories of R&D government expenditure

The formal endogenous growth theory also depends on upon government, public sector expenditure which can enhance human development or R&D in technology. Mostly in less developing countries the concept of HD is more acceptable than R&D.

Because R&D to improve technology require high budgeting in that area, so the channel of HD is easier than R&D, especially in the case of less developed countries like SAARC countries. So the main focus of my study is that how government, public expenditure can improve HD. This is described by the figure given below.

Formal endogenous growth theory

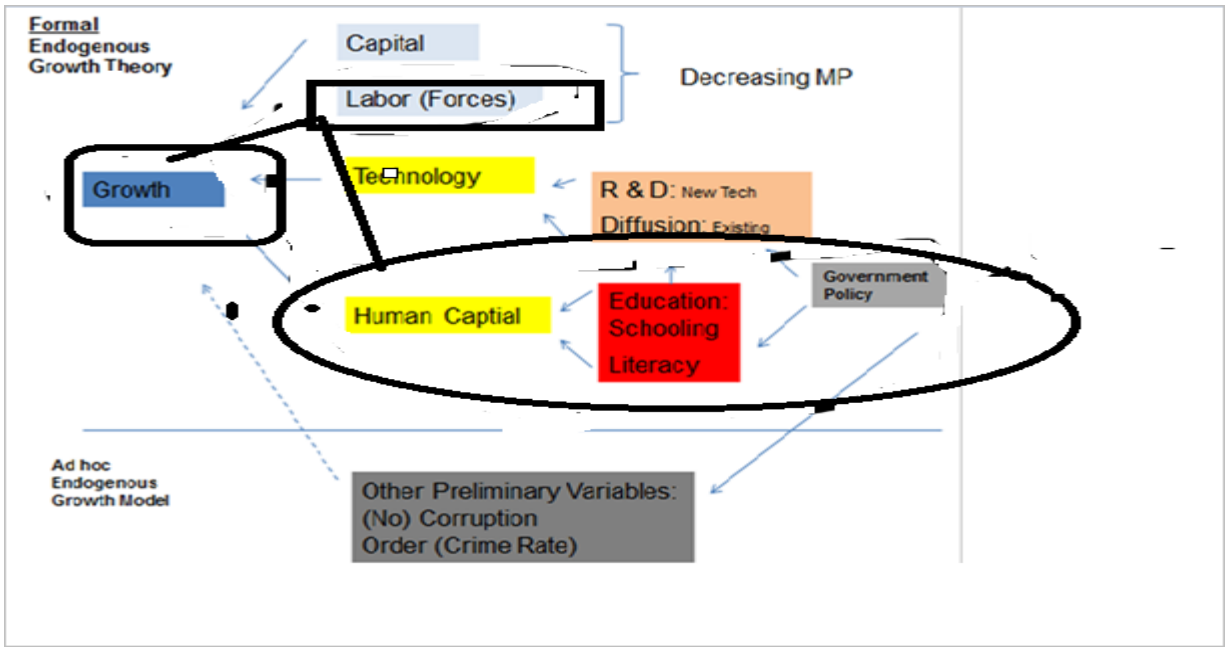

Figure 1 Formal endogenous growth model

The above figure shows the formal endogenous theory area marked by black shows the HD part of this theory. The theory involves two channels, one from capital intensive associated with R&D and second labor intensive associated with human development. So in my study, I only used labor intensive linked to human development. So government spending on education and health sector increase the human capital of the state which helpful to sustain MP at its initial level ultimately growth takes place. In short, government funding for health or education sector create human capital, which is helpful to make an MP at its initial level ultimately improves on production take place by using labor-intensive technology.

Chapter 4

Data and methodology

Introduction

This chapter includes methodological framework data variable sample size or model description. Section 4.1and 4.2 include a detailed description of variable and required a transformation that we used in this study, section 4.2 also shows the comparative analysis of transformation which we found in the literature. Section 4.3 gives model identification criteria of DEA that is helpful in the "*GETs" in* the selection of best bound in our study. Section 4.4 gives details of general to specific modeling and section 4.5 gives details about the DEA model that we used in our study.

4.1 Data

In my study, I used panel data from the period of 1990-2014 of SAARC countries. Data of varies political or governance sector is taken from the project of WDB named as "Kaufmann, Kraay, and Mastruzzi". Or health or education sector output is taken from WDI and [2]Afghanistan public survey report. We made DMU of one input and four outputs, in which two has been taken from the health sector and remaining two has been taken from education sector due to non-availability of data in infrastructure we are bound to take only two public sectors. The data is in 5-year average form and give five values of each SAARC country. And made 40 DMU of the whole panel. Detail of data is given in below.

[2] Islamic Republic of Afghanistan: 2007 Article IV Consultation and Third review pp 38
book Afghanistan After the Drawdown center for preventive action reports.

Decision-making unit

Decision-making unit	
INPUT	**OUTPUTS**
Central government, public expenditure per capita based on purchasing power parity, 1990-1994 average	**Health** Infant mortality (per 1,000 live births), 1990-1994 average Immunization against measles (% of children under 12 months), 1990-1994 average **Education** Youth illiteracy rate (% of people ages 15-24), 1990-1994 average Secondary school enrolment (% gross), 1990-1994 average **Government effectiveness** Government effectiveness index,

Table 1 Decision making unit

4.2 Transformation of data

First, two variables (health & education) are taken from WDI from the period 1990-2014. and governance indicator is taken from the project of the World Bank. "Kaufmann, Kraay and Mastruzzi". These variable required transformations. Transformation is necessary to confirm ISO- tonicity property. According to this property, *"an increase in any input should result in some output increase and not a decrease in any output"* (Sijpe, Measuring and explaining government efficiency in developing countries, 2007)

4.2.1 Reciprocal transformation.

Health and education need reciprocal transformation. There is another type of transformation by subtracting observation from 1000, but here we cannot use it because of the reason, suppose country “A” and “B” has a child mortality of 50 and 10, respectively. Since child mortality is not good in B, country A could do 5 times better. Taking reciprocals give 0.02 for A and 0.01 for B as *good* output. Again, we find that A could do 5 times better if only it was as efficient as B in reducing child mortality. Subtracting observations from 1,000 gives 950 for A and 990 for B, leaving almost no room for A to expand its output.

4.2.2 0 to 1 interval transformation

Government effectiveness required scale based measure in 0 to 1 ratio. Government effectiveness roughly situated between -2.5 and 2.5. Since an engine displacement does not alter the efficient frontier, Bowlin (1998) advocates addition the similar positive quantity to the standards of the variable disturbed for all DMUs in a direction to resolve the non-positivity problematic. However, in a BCC output orientated model and train dislocation of outputs does disturb the ineffectiveness scores of those DMUs not on the efficient frontier (Lovell and Pastor, 1995). For that reason, we scheme the explanations for administration effectiveness on a [0, 1] -interval, instead of addition a random number to them. For inadequacy, each measurement is signified by one output.

4.3 Model identification criteria of DEA approach

My aim is to calculate inefficiency score, but first, it is essential to identify numerous means of variation in the basic DEA model, leading to a selection of different types of models of implementation

Orientation	Output maximization	Input minimization
Formulation	Primal form	dual form
Return to scale	CRS	VRS
Discretionary	Control variable	Non-control variables
Model	Additive model	Multiplicative model

Table 2 Model identification criteria

- Orientation gives the source for concentrating on minimizing input or on maximizing output. It depends on upon our objectivity, our objective is minimized of expense we used input-oriented model or maximization of productivity we used output-oriented model. In this study, input government expenditure is fixed or exogenously determined through revenue collection so my objective is to increase performance at fixed input, so we used output-oriented model.
- The result of the formulation is same in both cases so the choice of formulation depends on upon ease of interpretation. If the number of DMUs is large as compared to the number of input and output variables than the Dual form is considered being

more efficient in computation. In this case number of DMUs is 40 consisting of 8 SAARC countries or input/output total variables are 4 so dual models are my selected model.

- Return to scale criteria depends upon our hypothetical condition if it follows the constant return to scale (CRS) or variable return to scale (VRS). In this study, we choose a VRS model because SAARC countries are not considered to be core developed countries its include usually less developed countries which not have the ability to work at full capacity, economy has uncertainty and variable return to scale. So we run the BCC model which used to estimate performance when there is a variable return to scale.
- In identifying "input and output" variable process one should include that variable which is relevant to study. For example, output level not only determined through input used to produce that output, but also some other variable included in the black box.

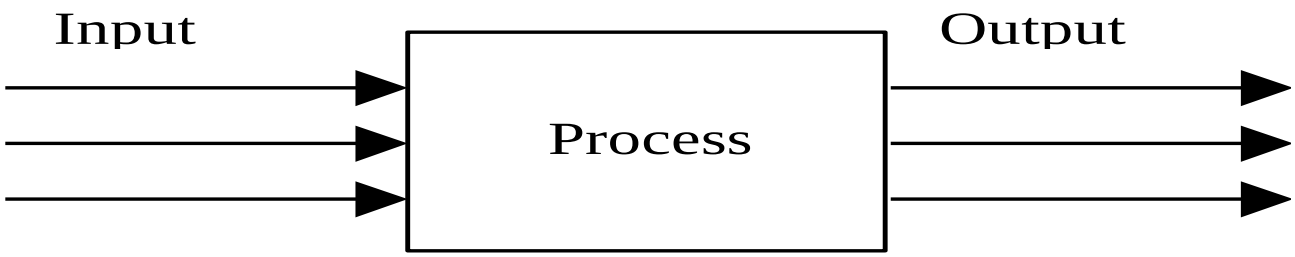

Figure 2 Production process

In black box process, there are lots of variable includes. Some variable can easily be controllable by organization, but some are uncontrollable like market forces, externalities etc. or some are controllable, so it is the obligation of investigator to inspect their input-output outline keep "containable procedure" or "uncontainable procedure' ours data generating process is controllable because all operation is in government policy effective. (Chun Xiang (Cynthia) Lina, 2009)

- Additive model required in which input or output solve simultaneously. In this process, we used multiplicative model.

4.4 Generals to a specific method to find out determinant

After getting inefficiency score, we used them to find out their determinants by using G to S model. The general to specific approach is adopted because a comprehensive theory for the explanation of inefficiency is absent. General to specific avoids the worst excesses of data mining, where researchers attempt several different combinations of candidate variables for a given data set, in search of 'the best regression'. Another name of this method is "deductive method" reverse is "inductive method" which we called specific to general. This methodology is based upon David Hendry approach of model selection criteria. This method is used when DGP is unknown and we don't have theoretical or prior information. David Hendry (2009) emphasizes:

This insinuation is not a trajectory for tedious modeling of data in the nonappearance of pecuniary analysis, but as an alternative of this proposes expressing more common original models that insert the obtainable economic theory as an exceptional case, constant with our information of the organized context, historic record, and the data assets. ... Applied

Econometrics cannot be directed without an economic theoretic structure to guide its endeavors and assistance understand its conclusions. However, since the economic theory is not comprehensive, precise, and unchallengeable, and never will be, one also cannot defend an insistence on originating empirical models from theory alone.

Hendry gives five qualities of a good model:

I. The model should be data admissible
II. The model should be consistent with the theory
III. Model should expect out of sample validity
IV. The model should have the property of data coherency error should be white noise all information in a model.
V. The model should explain that the previous model has the property of encompassing models.

The model selection begins with a general unrestricted model (GUM), which nests restricted models and, restrictions allowed to be tested.

$$y = xB + z\emptyset + \varepsilon$$

GUM moves towards its specific stage reduction start by using t-test and f-test GUM reached to its specific model after deletion of the irrelevant variable. If rival models are nominated, encompassing tests or information criteria (AIC, BIC) can be used to choose a final model. This is the discovery stage. After this decrement, we move to a specific model.

$$y = xB + \epsilon$$

General to specific process

Figure 3 General to specific process

4.4.1 Stages of general to specific modeling

- Stage 1: First, confirm that the GUM does not effect from any diagnostic problems. Observe the residues in the general model to guarantee that they have satisfactory properties. (That is, the test for heteroskedasticity, non-normality, incorrect functional form, etc.). (DOCSLIDE)
- Stage 2: Test the restrictions indirect by the specific model in contradiction of the general model – either by test of exclusion or by other tests of linear restriction
- Stage 3: If the restricted model is acknowledged, test its residuals to confirm that this more specific model is still acceptable on diagnostic grounds.

4.4.2 Functional form of "*GETs*"

The functional form of *GETs* modeling is just similar to regression by using exploratory data analysis EDA we just select a functional form of the model. The functional form of "*GETs*" is given below. There are different kinds of the model such as Lin-log models, double log models or simple exponential models.

A functional form	Equation (one X only)	The meaning of β_1
Linear	$Y_i = \alpha_0 + \alpha_1 x_1 + \alpha_2 x_2 + \varepsilon$	Slope of y with respect to X
Semi-log (Ln x)	$Y_i = \alpha_0 + \alpha_1 x_1 + \alpha_2 \ln x_2 + \varepsilon$	The unit change in y related to the 1 percent change in x
Double-log	$\ln Y_i = \alpha_0 + \alpha_1 x_1 + \alpha_2 \ln x_2 + \varepsilon$	Elasticity of y with respect to x
Semi-log (Ln y)	$\ln Y_i = \alpha_0 + \alpha_1 x_1 + \alpha_2 x_2 + \varepsilon$	Percent change in y due to unit change in x
Polynomial	$Y_i = \alpha_0 + \alpha_1 x_1 + \alpha_2 x 1^2 + \varepsilon$	Roughly the slope of y with respect to x for small x
Inverse	$Y_i = \alpha_0 + \alpha_1 \frac{1}{x1} + \varepsilon$	Roughly inverse the slope of y with respect to x for small x

Table 3 Functional form of G to S

From the above table, we just select log-log model, because our dependent and independent variables are in percentage form so it's appropriate to select log-log model for our study.

$$logineff_{BCC} = \alpha + \sum_{i=1}^{n} XiBi, j + \mu j$$

In our study, the dependent variable is inefficiencies which are taken from the BCC variable return to scale models. In order to calculate the inefficiency score here, we used The BCC (Banker-Charnes-Cooper) 1984 model because of its close accordance with our Barro government spending model, where the optimistic effects of government spending diminishing as the ratio of government spending increases. And independent variable is divided into three categories, 1) governance, quality variable 2) political policy variable and 3) economic policy variable. Although there are some demographic or structural variable or some infrastructure variable alter the inefficiency score but due to non-availability of data we have to limit our research among three sectors.

Variables of General to specific modeling

Governance quality variables	Economic policy variable	Political variable
Rule of law	***Exports % of GDP***	***Political rights***
Control of corruption	***FDI % of GDP***	***Civil liberties***
Regulatory quality	***MONEY GROWTH % OF GDP***	***Political globalizations***

Voice and accountability	***LIQUID LIABILITIES % OF GDP***	***Political stability***

Table 4 Variables of G to S model

4.4.3 Monte Carlo evaluation in small sample size.

Dealing with SAARC countries we have a small sample size in order to evaluate our *GETS* that the model should be correctly specified we have Monte Carlo simulation. Since model choice with indicative testing has escaped hypothetical investigation, we concentrate on demonstrating systems by reenactment. The Monte Carlo tests demonstrate that PcGets recoups the DGP particular from a general model with size and power near starting from the DGP itself, so demonstrate choice can be moderately non-distortionary notwithstanding when the instrument is obscure. The Monte Carlo recreation investigation of Hoover and Perez (1999) considered the Lovell database, which exemplifies a huge number of relations between factors as in genuine economies, and is of the scale and intricacy that can happen in large scale econometrics: the rerun of those analyses utilizing PcGets is talked about as a part of Hendry and Krolzig (1999). The assessment of Monte Carlo explores dependably includes estimation issues: see Hendry (1984). A major issue here is that with some positive likelihood, the GUM – and "reality" – will get dismiss on analytic tests. Tests are developed to have non-zero ostensible size under their invalid, so now and again reality will be rejected: and the all the more regularly, the more tests that are utilized. Three conceivable techniques present themselves: one rejects that information test, and arbitrarily re-draws; one changes the significance level of the "culpable" test, or one indicates a more broad GUM which is consistent. We consider these options thus. Hoover and Perez (1999) utilize a '2-critical test

dismissals' model to dispose of a specimen and redraw, which presumably somewhat supports the execution of Gets. In our Monte Carlo with PcGets, the issue is "fathomed" by endogenously changing the importance levels of tests that reject the GUM.

4.5 Data envelopment analysis

This approach is non-parametric technique based on mathematical calculations deals with an efficiency score of DMU, and divided into three standard approaches to efficiency analysis. CCR BCC and super efficiency model of DEA. Now we have to deal with how we used these three approaches to incorporate efficiency analysis in our study.

4.5.1 CCR model

This model stands for charnes, cooper, Rhodes, (CCR) model.In 1978, in the European journal of operational research (EJOR) introduce this model, and the model is used to compare the relative efficiency of DMU in multiple input or output case this model gives information which of the DMU works on an optimal level. The DMU works on optimal level gives values of 0. 1, this DMU considers being the efficient DMU. This works on efficient frontiers. The input, output mechanism is fully utilized in these DMUs. A simplified form of this model for DMU_o can be described as let (x_1 ,x_2…….x_n)are inputs and (Y_1,y_2……..y_n) are output than all DMU are ranked relative to the most efficient decision-making unit. So the CCR model gives relative efficiency DMUs from most efficient DMU. Model for DMU_o is given below.

$$\max \circ = \frac{\sum \mu_r \ \gamma_{rj}}{\sum_i v \, x_{ijo}}$$

$$\text{Subject to} = \frac{\sum_r u_r y_{rj}}{\sum_i v_i x_{ij}} \leq 1 \text{ for each unit of j}$$

$$u_r, v_I, \geq 0$$

The clarification of "U_r" and "V_i" is that they are weights involved to the outputs Y_{rj} and inputs X_{ij} and are selected to maximize the efficiency score h0 for DMUo. (Milan M. Marti}1, 2009) (Harold O. Fried, 2008)

4.5.2 BCC model

CCR model enables to give details regarding the return to the scale of DMUs. There is no positive or negative economies exist in CCR model, this means small country able to operate as efficiently as a large country. The BCC model gives information regarding the technical efficiency of DMUs. There are three kinds of technology exist in the economy (1) increasing the return to scale (2) decreasing returns to scale and (3) constant return to scale. In order to calculate the inefficiency score here, we used The BCC (Banker-Charnes-Cooper) 1984 model because of its close accordance with our Barro government spending model, where the optimistic effects of government spending diminishing as the ratio of government spending increases. The BCC model production possibility set *PB* is defined by:

$$PB = \{(a;, y) \mid a; > X, A, y < y A, e A = l, A > o\},$$

Where X = (x $_j$) $\epsilon R^{m\times n}$ And y= (y, j) $\epsilon R^{s\times n}$ In a given data set, where $\lambda \epsilon R^{n}$ And "e "is a row vector with all elements equal to 1.

4.5.3 Theoretical description of CCR and BCC model

Here we explain the BCC output-oriented model. The figure below exhibits 4 DMUs, named as A, B, C or D, each with one "input" and one "output". (Pascoe, Kirkley, Gréboval, & Morrison-Paul, 2003) The frontiers of the BCC model contains the bold lines joining *A, B,* and *C.* A dotted line shows CCR model which is help full to measure scale efficiencies. The production possibility set consists of the area of the frontier which joined the observed or possible actions with an excess of input and shortfall in output compared with the frontiers. In A, B and C connecting lines makes BCC efficient frontier. In diagram B is a BCC and CCR combine efficient point because there is a constant return to scale, these two measures give the same result in constant returns to scale but a different result in a variable return to scale. In this study, because SAARC countries are not considered developed core countries, it usually doesn't have CRS but different researches took place to show VRC in developing countries because developing countries don't work at full capacity and there is uncertainty in their economic condition. Usually, the CCR-efficiency does not surpass BCC-efficiency. But B is an equivalent point of both models. The BCC and CCR models diverge with each other only because of convexity condition and its other constraint. $\varepsilon^{n}_{j=1,\lambda j=1,\lambda j\geq 0}$. The BCC theoretical model graph is shown below.

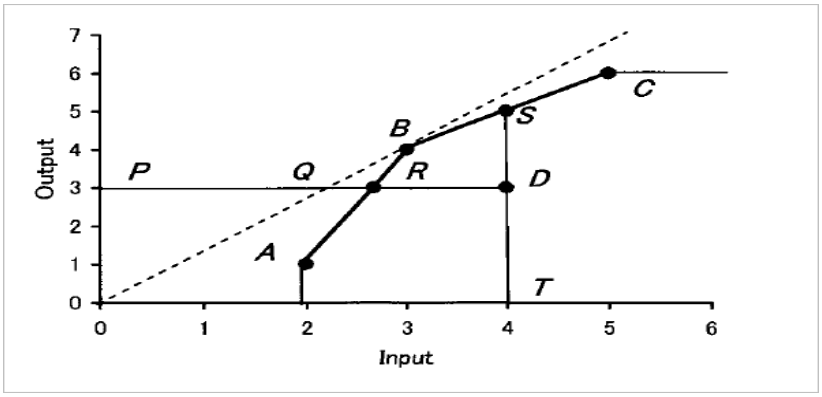

Figure 4 Graphical representation of BCC and CCR

Source :(William. In all, DEA, 2007, p. 90)

The BCC-efficiency of "*D"* is evaluated by reading values from the graph. PD

$$\frac{PR}{PD} = \frac{2.666}{4} = 0.667$$

In the output-oriented BCC model, we recite from the vertical axis of the graph to find "*D "*evaluated by:

$$\frac{ST}{DT} = \frac{5}{3} = 1.6667$$

This required that attainment of efficiency would augment the D's output from its observed value of 1.66 x 3 = 5 units.

4.5.4 BCC-output oriented dual model empirical description.

The main idea behind computing output-oriented processes, one could also try to calculate how much output amounts can be proportionally enlarged without varying the input quantities used. Because government expenditure is our inputs and it depends on upon revenue collection constraint. So in order to measure how much output can be increased by using given and fixed amount of input we used an output oriented BCC, VRS model. This model used when we have only quantitative data available.

$$\text{Maximize} \quad \sum_{r=1}^{s} u_r y_{rk} + \sigma$$

$$\text{subject to} \quad -\sum_{i=1}^{m} v_i x_{ij} + \sum_{r=1}^{s} u_r y_{rj} + \sigma \leq 0$$

$$\sum_{i=1}^{m} v_i x_{ik} = 1$$

$$v_i \geq 0, u_r \geq 0 \text{ and } \sigma : \textit{unrestricted}$$

Notations

Y= vector of output

X= vector of input

U= weight attached to the output

V= weight attached to the input

I= input quantities

r= output quantities

k= DMUs quantities

α=scalar quantity

n= DMUs

4.5.5 Super efficiency model:

The super efficiency model allows for effective ranking of efficient DMUs. The CCR model gives relative efficiency while BCC model gives technical efficiency these two models only gives result regarding efficient DMUs but not helpful to make an effective ranking of efficient decision-making unit. Super efficiency model, is also helpful in detection of an outlier in DMUs.

$$\max \quad \sum_{k=1}^{s} v_k y_{kp}$$

$$s.t \quad \sum_{j=1}^{m} u_j x_{jp} = 1$$

$$\sum_{k=1}^{s} v_k y_{ki} - \sum_{j=1}^{m} u_j x_{ji} \leq 0, \quad \forall i \neq p$$

$$v_k, u_j \geq 0 \quad \forall k, j$$

The DMU being evaluated is removed from the constraint set thereby allowing its efficiency score to exceed a value of 1.00

4.5.6 Super efficiency model detection of outliers:

Detection of outliers

There are many methods to detect outliers, some are given. Decency and Wilson (1995) developed a procedure to detect outlier's n-tipple L.P. Shimmer (2000) bootstrapping model to detect outliers. Kourosh and Arash (2013) give KAM methods to detect outliers in DEA. There are many Bayesian techniques to detect outliers. But here in this study, we used super efficiency model, to detect or removed outliers. BG suggests that only those. Observations. with super-efficiency points upper than a pre-selected display should be eradicated. If an efficient, observation is a non-homogeneous consider to be the outlier, that has been adulterated with noise, then it is more probable to have an output (or input) level much greater (smaller) than that of other observations with similar input (or output) levels. Therefore, such outliers are more likely to have a super-efficient score much greater than one. This is the motivation underlying the BG procedure for outlier identification. (Zheng, 2015)

Chapter 5

Empirical results and discussion

This chapter includes the detail explanations of empirical results. Section 5.1 gives the relative efficiency score for the decision-making unit. Section 5.2 gives technical efficiency score and gives quantitative values of all DMUs operation scales, this section also provides the operational scale evidence for all decision-making units. Section 5.3 provides the comparative analysis CCR and BCC models which of DMUs include in both models, section 5.4 gives the descriptive analysis of three standard measures. Section 5.5 includes the determinants of inefficiencies by using EBA associated with the general to specific modeling.

5.1 Relative efficiency analyses

The model gives the relative efficiency of all decision-making unit to more efficient decision-making unit. The result shows that DMUs names as F11 of work in optimal level in the period of 1990. This DMU represents the performance of Bhutan public spending in the period of 1990 is relatively best to another decision-making unit. Similarly, SRILANKA in a period of 2010-14 operates at its optimal level as compared to other countries.

At that time, according to WDI Maldives government, public expenditure on health sector is [3]7.07% of GDP and in the education sector, 6.78% is greater than all other SAARC countries, but it is operating 20% less than SRILANKA and Bhutan if we see score card. This also shows that there is a misallocation of resources in Maldives. So it can be concluded that

[3] WDI statistics

we cannot get high performance due to increase in expenditure. Details of the model score are given below.

Relative efficiencies:

Date	DMU	Countries	Score	DMU	Countries	Score
1990-94	f1	AFG1	97.50%	f6	BGD1	87.97%
1995-99	f2	AFG2	94.44%	f7	BGD2	88.12%
2000-04	f3	AFG3	95.41%	f8	BGD3	87.11%
2005-09	f4	AFG4	95.54%	f9	BGD4	87.12%
2010-14	f5	AFG5	97.17%	f10	BGD5	86.49%
1990-94	f11	BTN1	100.00%	f16	IND1	92.33%
1995-99	f12	BTN2	99.12%	f17	IND2	91.97%
2000-04	f13	BTN3	99.44%	f18	IND3	91.69%
2005-09	f14	BTN4	97.16%	f19	IND4	89.77%
2010-14	f15	BTN5	96.33%	f20	IND5	89.69%
1990-94	f21	SLK1	92.55%	f26	MDV1	88.17%
1995-99	f22	SLK2	94.75%	f27	MDV2	87.67%
2000-04	f23	SLK3	91.81%	f28	MDV3	87.13%
2005-09	f24	SLK4	98.66%	f29	MDV4	88.50%
2010-14	f25	SLK5	100.00%	f30	MDV5	88.62%
1990-94	f31	NPL1	97.68%	f36	PK1	93.09%
1995-99	f32	NPL2	92.94%	f37	PK2	93.20%
2000-04	f33	NPL3	88.50%	f38	PK3	92.66%
2005-09	f34	NPL4	88.49%	f39	PK4	94.23%
2010-14	f35	NPL5	88.50%	f40	PK5	93.42%

Table 5 Relative efficiencies

5.2 Scale efficiency analysis:

The BCC model has the ability to measure returns to scale all countries work on different returns to scale, gives the technological aspects of countries. Results

show that in most of the countries public sector is operating at increasing returns to scale. it is because of most of SAARC countries are less developed countries work on below full capacity. The result shows that neither the country operates at decreasing returns to scale. Results also indicate that sources are not a root cause of theses inefficiencies. Because most of the countries have IRS every increment in input gives a positive increase in output. This also shows that there are other factors which are not present in internal management that determines theses inefficiencies. Results show that Bangladesh, India, Nepal, and Pakistan and Maldives works with the IRS in their total time span. On the other hand Afghanistan, Bhutan shows variation in result in different time or in different DMUs. Similarly, Srilanka shows CRS in their whole time span.

Technical efficiencies:

Date	DMU	Countries	SE	Technology	DMU	Countries	SE	Technology
1990-94	f1	AFG1	0	CRS	f6	BGD1	0.25	IRS
1995-99	f2	AFG2	0.32	IRS	f7	BGD2	0.3	IRS
2000-04	f3	AFG3	0.16	IRS	f8	BGD3	0.33	IRS
2005-09	f4	AFG4	0.36	IRS	f9	BGD4	0.34	IRS
2010-14	f5	AFG5	0.38	IRS	f10	BGD5	0.33	IRS

Date	DMU	Countries	SE	Technology	DMU	Countries	SE	Technology
1990-94	f11	BTN1	0	CRS	f16	IND1	0.12	IRS
1995-99	f12	BTN2	0	CRS	f17	IND2	0.15	IRS
2000-04	f13	BTN3	0	CRS	f18	IND3	0.15	IRS
2005-		BTN4	0.07	IRS		IND4	0.18	IRS

09	f14				f19			
2010-14	f15	BTN5	0.06	IRS	f20	IND5	0.22	IRS

Date	DMU	Countries	SE	Technology	DMU	Countries	SE	Technology
1990-94	**f21**	**SLK1**	0	CRS	**f26**	**MDV1**	0.29	IRS
1995-99	**f22**	**SLK2**	0	CRS	**f27**	**MDV2**	0.32	IRS
2000-04	**f23**	**SLK3**	0.03	DRS	**f28**	**MDV3**	0.33	IRS
2005-09	**f24**	**SLK4**	0	CRS	**f29**	**MDV4**	0.35	IRS
2010-14	**f25**	**SLK5**	0	CRS	**f30**	**MDV5**	0.37	IRS

Date	DMU	Countries	SE	Technology	DMU	Countries	SE	Technology
1990-94	f31	NPL1	0.24	IRS	f36	PK1	0.1	IRS
1995-99	f32	NPL2	0.29	IRS	f37	PK2	0.14	IRS
2000-04	f33	NPL3	0.3	IRS	f38	PK3	0.19	IRS
2005-09	f34	NPL4	0.32	IRS	f39	PK4	0.21	IRS
20010-14	f35	NPL5	0.37	IRS	f40	PK5	0.2	IRS

Table 6 Technical efficiencies

5.3 CCR OR BCC efficiency comparative analysis

Comparative analysis shows that the DMU are considered to be the most efficient in both approaches. According to theoretical models in figure no 6 there are some DMUs which are both efficient in CCR and BCC model. These DMUs consider being the common factor in both modelings, although the number of efficient decision-making units increases with the BCC model because of convexity condition. If we make the EBA of efficiency score BCC line is just above the CCR model. Or there some points where BCC points are just tangent

CCR model indicating that some of the DMUs are commonly efficient in both models. The result indicates that DMUs f11 and f25 consider being the common DMUs in both models.

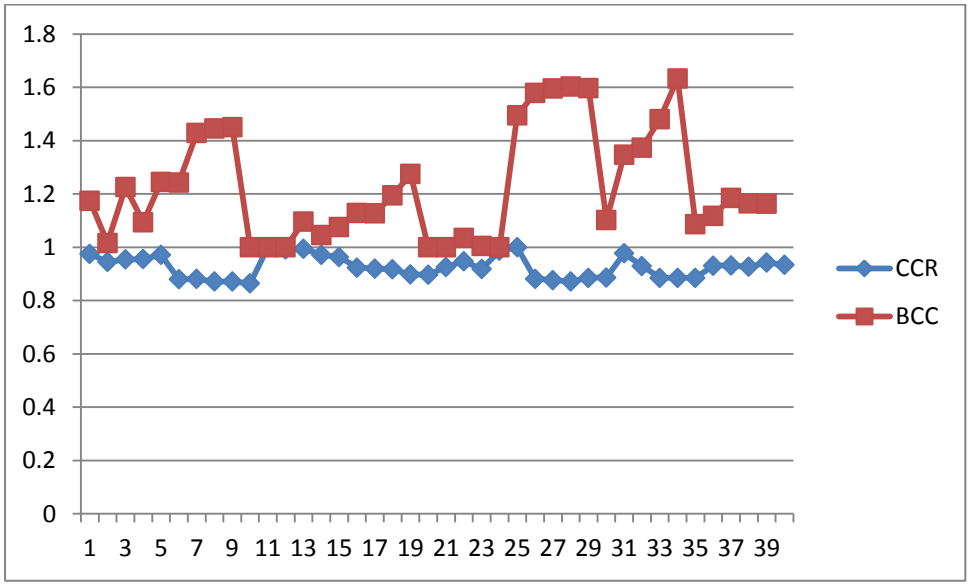

Figure 5 CCR and BCC comparison

Comparative analyses of CCR & BCC results

Date	DMU	Countries	CCR	BCC	DMU	Countries	CCR	BCC
1990-94	f1	AFG1	0.975	1	f6	BGD1	0.8797	1.2447
1995-99	f2	AFG2	0.9444	1.1748	f7	BGD2	0.8812	1.2432
2000-04	f3	AFG3	0.9541	1.0162	f8	BGD3	0.8711	1.4286
2005-09	f4	AFG4	0.9554	1.2254	f9	BGD4	0.8712	1.4455
2010-14	f5	AFG5	0.9717	1.0941	f10	BGD5	0.8649	1.451

Date	DMU	Countries	CCR	BCC	DMU	Countries	CCR	BCC
1990-94	f11	BTN1	1	1	f16	IND1	0.9233	1.0758
1995-99	f12	BTN2	0.9912	1	f17	IND2	0.9197	1.1288
2000-04	f13	BTN3	0.9944	1	f18	IND3	0.9169	1.1272
2005-09	f14	BTN4	0.9716	1.0968	f19	IND4	0.8977	1.1946
2010-14	f15	BTN5	0.9633	1.0452	f20	IND5	0.8969	1.2746

Date	DMU	Countries	CCR	BCC	DMU	Countries	CCR	BCC
1990-94	f21	SLK1	0.9255	1	f26	MDV1	0.8817	1.495
1995-99	f22	SLK2	0.9475	1	f27	MDV2	0.8767	1.5787
2000-04	f23	SLK3	0.9181	1.0353	f28	MDV3	0.8713	1.5954
2005-09	f24	SLK4	0.9866	1.0048	f29	MDV4	0.885	1.6027

2010-14	f25	SLK5	1	1	f30	MDV5	0.8862	1.5969
Date	DMU	Countries	CCR	BCC	DMU	Countries	CCR	BCC
1990-94	f31	NPL1	0.9768	1.1017	f36	PK1	0.9309	1.0867
1995-99	f32	NPL2	0.9294	1.3469	f37	PK2	0.932	1.1184
2000-04	f33	NPL3	0.885	1.3733	f38	PK3	0.9266	1.1855
2005-09	f34	NPL4	0.8849	1.4811	f39	PK4	0.9423	1.1642
2010-14	f35	NPL5	0.885	1.6334	f40	PK5	0.9342	1.1637

Table 7 Comparative analysis of CCR and BCC

Descriptive statistics of three approaches

RE		*TE*		*SE*	
Mean	0.926235	Mean	1.226415	Mean	0.19425
Standard Error	0.006621	Standard Error	0.033136	Standard Error	0.02124
Median	0.92605	Median	1.1642	Median	0.205
Mode	0.885	Mode	1	Mode	0
Standard Deviation	0.041877	Standard Deviation	0.206894	Standard Deviation	0.134334
Sample Variance	0.001754	Sample Variance	0.042805	Sample Variance	0.018046
Kurtosis	-1.18173	Kurtosis	-0.87195	Kurtosis	-1.41739
Skewness	0.233774	Skewness	0.680683	Skewness	-0.25
Range	0.1351	Range	0.6334	Range	0.38
Minimum	0.8649	Minimum	1	Minimum	0
Maximum	1	Maximum	1.6334	Maximum	0.38
Sum	37.0494	Sum	47.8302	Sum	7.77
Count	40	Count	40	Count	40

Table 8 Descriptive statistics

5.4 Super efficiency model

Effective ranking of efficient DMUs made possible through this model, this model made a ranking of countries which are operating the inefficient frontier line. This model also indicates outlier of DMUs, because of the efficiencies mostly relative efficiencies are sensitive to extreme DMUs. So detection or removal may change the efficiency scores. The result shows that DMU f25 is an outlier in all DMU, it affects the efficiency score especially relative efficiency score. Bhutan in a period of 1995-99 ranked as first in all DMUs, details of other are given below in the table. An outlier can also affect the determinants of inefficiency so detection or removal is necessary. In order to get the best regression.

Ranking of DMUs:

Ranking of efficient DMU.

Ranking	DMU	Countries	Time	Score
1	f12	BTN2	1995-99	0.9945
2	f21	SLK1	1990-94	0.9728
3	f13	BTN3	2000-04	0.9559
4	f22	SLK2	1995-99	0.9118
5	f11	BTN1	1990-94	0.7678
6	f1	AFK1	1990-94	0.6525

Table 9 Ranking of DMUs

Super efficiency is a model which is also helpful in effective ranking DMUs that are operating on the efficient frontier. The result in the above table shows that DMU named f12, Bhutan in the period 1995-99 operating at the most optimal point of the efficient frontier. Similarly, Srilanka in the period 1990-94 operates at number 2^{nd} of the efficient frontier by getting 0.9728 scores. Results of the remaining are given above.

Detection of outlier:

Date	DMU	Countries	Score	DMU	Countries	Score
1990-94	f1	AFG1	65.25%	f6	BGD1	124.47%
1995-99	f2	AFG2	117.48%	f7	BGD2	124.32%
2000-04	f3	AFG3	101.62%	f8	BGD3	142.86%
2005-09	f4	AFG4	122.54%	f9	BGD4	144.55%
2010-14	f5	AFG5	109.41%	f10	BGD5	145.10%
1990-94	f11	BTN1	76.78%	f16	IND1	107.58%
1995-99	f12	BTN2	99.45%	f17	IND2	112.88%
2000-04	f13	BTN3	95.59%	f18	IND3	112.72%
2005-09	f14	BTN4	109.68%	f19	IND4	119.46%
2010-14	f15	BTN5	104.52%	f20	IND5	127.46%
1990-94	f21	SLK1	97.28%	f26	MDV1	149.50%
1995-99	f22	SLK2	91.18%	f27	MDV2	157.87%
2000-04	f23	SLK3	103.53%	f28	MDV3	159.54%
2005-09	f24	SLK4	100.48%	f29	MDV4	160.27%
2010-14	f25	SLK5	Big	f30	MDV5	159.69%
1990-94	f31	NPL1	110.17%	f36	PK1	108.67%
1995-99	f32	NPL2	134.69%	f37	PK2	111.84%
2000-04	f33	NPL3	137.33%	f38	PK3	118.55%
2005-09	f34	NPL4	148.11%	f39	PK4	116.42%
2010-14	f35	NPL5	163.34%	f40	PK5	116.37%

Table 10 Detection of outlier

5.4.2 Result of detection of outliers

The result shows that TE score is insensitive to outliers, return to scale remains the same, but as we notice the relative efficiency score in CCR model the difference is significant. Some of the DMUs which are becomes efficient after removal of outliers, like f11 and f13 DMUs. Similarly, the impact of an outlier in BCC is also shown the significant change now DMU number f24 become efficient and DMU f25 become inefficient after

removal of outliers. Similarly, as outlier effect efficiency score it will considerably affect the determinants of this efficiency so detection or removal is necessary.

Change in results after removal of outliers

Before	After	Before	After	Before	After	
BCC	BCCo	CCR	CCRo	SE	SEO	TE
1	1	0.975	0.9927	0	0	CRS
1.1748	1.171	0.9444	0.9608	0.32	0.32	IRS
1.0162	1.0134	0.9541	0.9652	0.16	0.16	IRS
1.2254	1.2143	0.9554	0.9603	0.36	0.36	IRS
1.0941	1.0833	0.9717	0.9737	0.38	0.38	IRS
1.2447	1.2434	0.8797	0.8809	0.25	0.25	IRS
1.2432	1.2405	0.8812	0.8813	0.3	0.3	IRS
1.4286	1.4259	0.8711	0.8728	0.33	0.33	IRS
1.4455	1.4384	0.8712	0.8731	0.34	0.34	IRS
1.451	1.4471	0.8649	0.869	0.33	0.33	IRS
1	1	1	1	0	0	CRS
1	1	0.9912	0.9954	0	0	CRS
1	1	0.9944	1	0	0	CRS
1.0968	1.0955	0.9716	0.9781	0.07	0.07	IRS
1.0452	1.0435	0.9633	0.9731	0.06	0.06	IRS
1.0758	1.0758	0.9233	0.9395	0.12	0.12	IRS
1.1288	1.1288	0.9197	0.9338	0.15	0.15	IRS
1.1272	1.1272	0.9169	0.9309	0.15	0.15	IRS
1.1946	1.1946	0.8977	0.9094	0.18	0.18	IRS
1.2746	1.2746	0.8969	0.9054	0.22	0.22	IRS
1	1	0.9255	0.9358	0	0	CRS
1	1	0.9475	0.9603	0	0	CRS
1.0353	1.0319	0.9181	0.9255	0.03	0.03	IRS
1.0048	1	0.9866	1	0	0	CRS
1	1.95	1	0.8848	0	0.29	IRS
1.495	1.787	0.8817	0.8817	0.29	0.32	IRS
1.5787	1.954	0.8767	0.8764	0.32	0.33	IRS
1.5954	1.001	0.8713	0.8886	0.33	0.35	IRS
1.6027	1.923	0.885	0.8908	0.35	0.37	IRS
1.5969	1.105	0.8862	0.981	0.37	0.24	IRS
1.1017	1.3469	0.9768	0.9347	0.24	0.29	IRS
1.3469	1.733	0.9294	0.8915	0.29	0.3	IRS

1.3733	1.811	0.885	0.8916	0.3	0.32	IRS
1.4811	1.334	0.8849	0.8923	0.32	0.37	IRS
1.6334	1.867	0.885	0.9382	0.37	0.1	IRS
1.0867	1.184	0.9309	0.9407	0.1	0.14	IRS
1.1184	1.855	0.932	0.9348	0.14	0.19	IRS
1.1855	1.642	0.9266	0.9538	0.19	0.21	IRS
1.1642	1.637	0.9423	0.9466	0.21	0.2	IRS
1.1637		0.9342		0.2		

Table 11 Change in results after removal of outliers

5.5 Generals to specific modeling

Determinants of inefficiencies can incorporate due to this method; it helps us to find out factors other than internal management which cause inefficiencies. We just run general to specific variable reduction model at 1% significance level. The result shows that economic or political indicators determine inefficiencies. We include 12 variables in general to specific modeling. The first model is called GUM "generalized unrestricted model". The process includes a variable reduction by using T-test and joint distribution by using an F - test, after a variable reduction process includes encompassing between rivalry models, encompassing select most appropriate model between the rivalry models. After estimating the results. The validity of most appropriate model has been tested or has been evaluated by using Monte Carlo simulation. The best model includes four variables in which two economic variables, one political or governance, quality variable cause inefficiencies in the country. So we can say that economic policy, governance, quality and political system must be strengthened to overcome these inefficiencies. Specifically selected model statistics are given below in the table; detail general to specific process is given in the appendix.

General to specific estimation results					
	Coefficient	**Std.Error**	**t-value**	**t-prob**	**Part.R^2**
Lexp	-0.108254	0.04796	-2.26	0.0304	0.1270
Lliab	-0.284620	0.05610	-5.07	0.0000	0.4237
lRQ	-0.114565	0.05199	-2.20	0.0342	0.1218
PG	0.282458	0.04461	6.33	0.0000	0.5339
Sigma	0.0536762	RSS	0.100839709		
Log-likelihood	60.8382				
No. of observations	39	no. of parameters	4		
Mean (INEFF)	0.0829015	se (INEFF)	0.0706679		
AR 1-2 test:	F (2,33)	=	1.3694 [0.2683]		
ARCH 1-1 test:	F (1,37)	=	6.5470 [0.0147] *		
Normality test:	Chi^2 (2)	=	0.68570 [0.7097]		
Hetero test:	F (8,30)	=	1.7698 [0.1229]		
Hetero-X test:	F (14,24)	=	1.6865 [0.1260]		

```
RESET23 test:     F (2,33)   =  0.84285 [0.4395]
```

Table 12 Specific model

Graphical representation

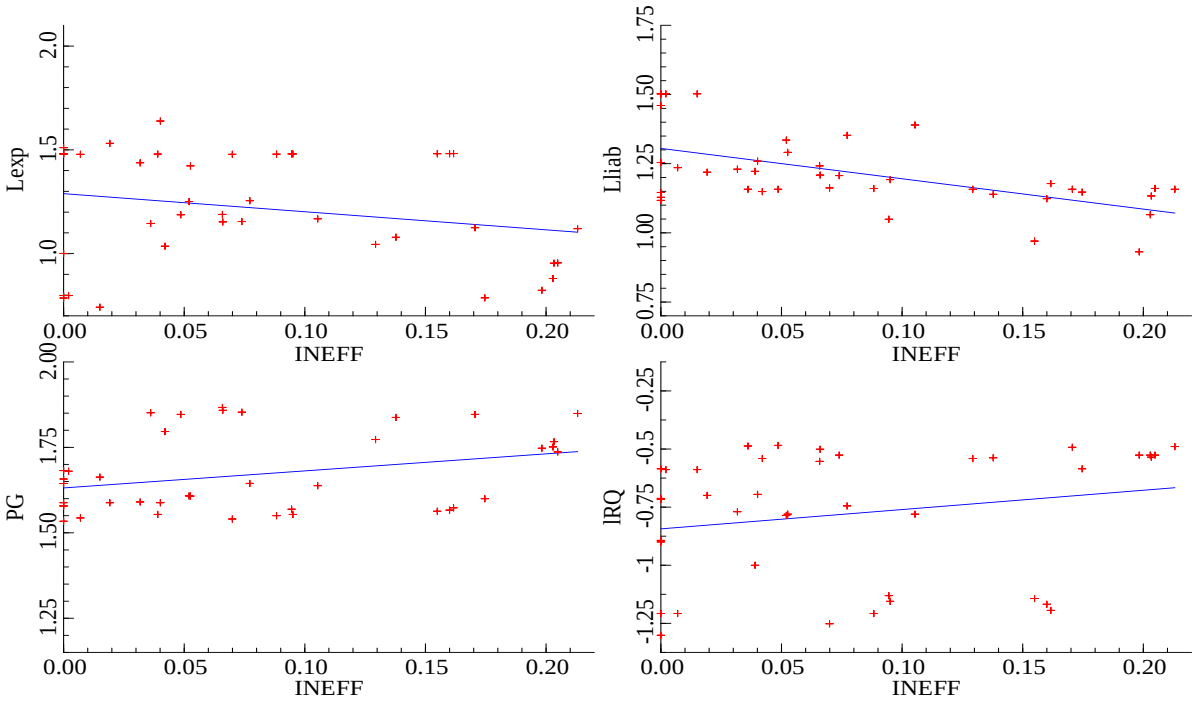

Figure 6 General to specific model

Results show that 1 percent increase in exports causes 10 percent decline in inefficiencies. Similarly, 1 percent increase in liabilities creates 28 percent reduction in inefficiencies of SAARC countries. 1 percent improvement in regulatory quality creates 11 percent reduction in inefficiencies. Political globalization effect inefficacies positively. A 1 percent increase in political globalization creates 28 percent increase in inefficiencies. It is so because the increase in political globalization may increase the influence of other states in

home country politics. Under globalization, political affairs can take place above the countries through political assimilation schemes such as the “European Union” and through intergovernmental establishments such as the IMF, the “World Bank, and the World Trade Organization”. Political action can also exceed national borders through global actions and NGOs. Civil society groups turn globally by establishing alliances with governments in other countries, using global communications systems, and lobbying worldwide organizations and other actors openly, instead of occupied through their national governments. But it some reduces countries sovereignty if a poor country relies on IMF or ITO etc. they have to face some rules or treaties which will be helpful in world development but creates a problem for internal aspects of the state. so increasing political globalization creates inefficiencies in SAARC countries. Because SAARC countries are mostly weak or less developed are not able to face external pressure.

Graphical analysis:

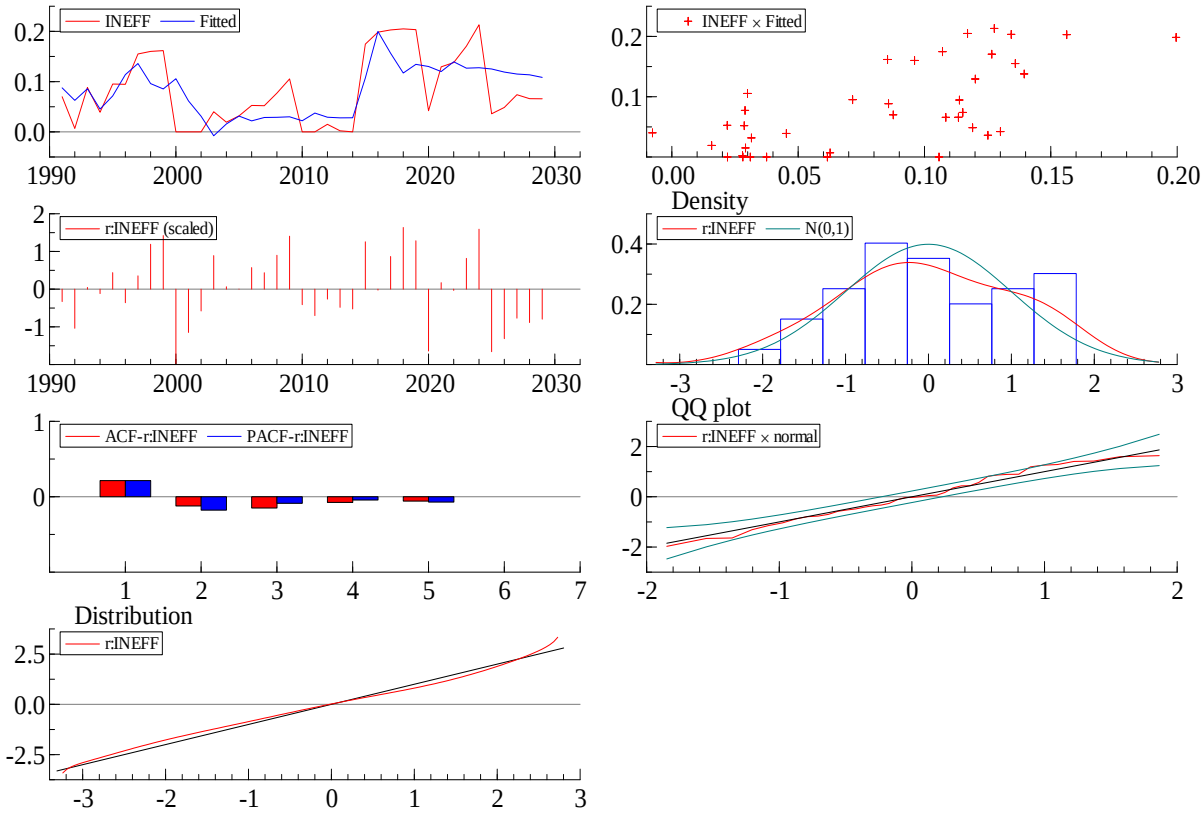

Figure 7 Graphical analysis of inefficiencies

Chapter 6

Conclusion and implications

Literature found a strong theoretical or empirical linkage between economic growth and government public investment. But the incorporation of inefficiencies in the government financial system is missing phenomenon for SAARC countries. Along with that WDI reported the bad situation of the government. In order to find out the flaws in the government, public investment system this study will help. Data used in this study is taken from 5-year policy plan of government of public investment in SAARC countries from the period 1990-2014. Each country contains 5 values and makes 40 DMUs of input and output. Input contains government, public expenditure and output is taken from education or health sector and government effectiveness. First, we calculate relative efficiencies among DMUs. Results suggest that Bhutan in the period 1990-94 or Srilanka in the period 2010-14 shows relative better performance than other countries. WDI reported that government public investment in Maldives in that time is higher than other countries, but they fail to get completed result, so we conclude that high government spending doesn't lead to a high-efficiency score.

Secondly, we have to find out the sources of these inefficiencies, whether the internal management system generates these inefficiencies or some external forces, like political government or economic system generates this inefficiency score. So result gives the technical efficiency that most of the DMUs are operating at increasing returns to scale, or some are constant returns to scale. This means that every new unit gives us a positive result.

So the result suggests that the internal management system of government, public expenditure is not poor. Marginal productivity by investing new unit is positive there are some external forces which determine these inefficiencies.

Now we have to find out the determinants of inefficiencies in SAARC countries before that in order to get an accurate result, we have to get rid of an outlier of DMU. So we adopt a purely nonparametric approach to detect outlier of DMUs. Although there are some Bayesian or semi-parametric techniques which incorporate distribution of errors in DEA, but here we follow purely nonparametric methods to detect outlier of DMU. We just run super efficiency model which gives a ranking of efficient DMUs. Along with that, it detects outlier when the score is very far from 1. The result, suggesting that DMU f25 is an outlier in DMU. So we remove that DMU and recalculate the efficiency score there is clear difference found in the result before and after removal of an outlier. So efficiency score is sensitive to outliers. After removal we just find out determinants of these inefficiencies. In order to get best bounds of this inefficiency we just run general to specific variable reduction model. In general form, we have 12 variables, which include economic policy variables government quality variable and political variables. At specific form the best bound have been selected between 4 variables. This best bound by the inefficiency process passed through encompassing and test of validity. So result suggests the best model of inefficiencies. Inefficiency determines through exports, liabilities regulatory quality and political globalizations.

Empirical findings lead to following implications:

- In order to improve efficiency scores or reduction of inefficiency is made possible if the inefficient DMU unit follows policies which are operating in efficient DMU. Like if Bhutan and Srilanka are considered to be more efficient than Pakistan have to critically analysis of their government financial policies.
- The size of government spending is not found to be helpful in reduction of inefficiencies.
- The internal management system is in good form, so external forces determine the inefficiencies.
- Inefficiencies influenced by economic policy variables, government quality, and political system. So government critically analyses these sectors in order to get best results of government public investment.
- The government can get best results of their public sector investment if economic policy appropriately made. Similarly, if government quality improves, states should adopt those policies which improve governance, quality of state like made accountability units' media free environment etc.
- The political system mainly political globalization reduces country sovereignty because globalization made open economy and all internal systems affected by external forces, so in the case of less developed states like SAARC countries, political globalizations creates problems because these less developed states not in conditions to follow many international treaties.

- There is heterogeneity found in DMUs, it is one of the important assumptions to run the DEA that all DMU is homogeneous, otherwise, it impacts on results and determinants so have to care about that important assumption of DEA.

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Appendix

Estimated CCR model

DMU	countries	date	Score	gov exp {I}{V}	SE {O}{V}	YL {O}{V}	imm {O}{V}	inf mor {O}{V}	gov eff {O}{V}	Benchmarks	{F} gov exp {I}	{S} SE {O}	{S} YL {O}	{S} imm {O}	{S} inf mor {O}	{S} gov eff {O}
f1	AFK1	1990-94	97.50%	0.17	0	0.12	0.02	0	0	11 (0.65) 25 (3.30)	84.99%	0.03	0	0	0.2	1.7
f2	AFK2	1995-99	94.44%	0.2	0	0.12	0.02	0	0	11 (0.53) 25 (2.01)	72.22%	0.01	0	0	0.12	1.11
f3	AFK3	2000-04	95.41%	0.17	0.04	0	0.08	0	0	11 (0.55) 25 (1.98)	72.48%	0	0.01	0	0.11	0.97
f4	AFK4	2005-09	95.54%	0.17	0	0.11	0.02	0	0	11 (0.73) 25 (0.77)	73.26%	0.04	0	0	0.04	0.56
f5	AFK5	2010-14	97.17%	0.17	0	0.12	0.02	0	0	11 (0.95) 25 (0.25)	83.02%	0.07	0	0	0.01	0.49
f6	BGD1	1990-94	87.97%	0.17	0	0.04	0.01	0	0	11 (0.82) 25 (0.50)	27.80%	0.03	0	0	0.03	0.36
f7	BGD2	1995-99	88.12%	0.17	0	0.05	0	0	0	11 (0.96) 25 (0.03)	28.70%	0.04	0	0	0	0.23
f8	BGD3	2000-04	87.11%	0.17	0	0.03	0	0	0	11 (0.51) 25 (0.57)	22.69%	0.03	0	0	0.03	0.21
f9	BGD4	2005-09	87.12%	0.17	0	0.03	0	0	0	11 (0.46) 25 (0.61)	22.71%	0.03	0	0	0.03	0.21
f10	BGD5	2010-14	86.49%	0.17	0	0.03	0	0	0	11 (0.18) 25 (1.05)	18.92%	0.01	0	0	0.05	0.23
f11	BTN1	1990-94	100.00%	0.55	0.39	0.1	0.06	0	0	36						
f12	BTN2	1995-99	99.12%	0.17	0	0.14	0	0	0.02	11 (0.72) 25 (0.39)	94.74%	0	0	0	0.02	0
f13	BTN3	2000-04	99.44%	0.17	0	0.14	0	0	0.02	11 (0.47) 25 (0.70)	96.63%	0.02	0	0	0.03	0
f14	BTN4	2005-09	97.16%	0.17	0	0.12	0	0	0.02	11 (0.37) 25	82.96%	0.02	0	0	0.03	0

											(0.72)						
f15	BTN5	2010-14	96.33%	0.17	0	0.11	0	0	0.02	11 (0.28) 25 (0.95)	77.97%	0.02	0	0	0.04	0
f16	IND1	1990-94	92.33%	0.17	0.02	0	0.07	0	0	11 (0.06) 25 (1.75)	53.95%	0	0	0	0.1	0.3
f17	IND2	1995-99	91.97%	0.17	0	0.07	0.01	0	0	11 (0.12) 25 (1.50)	51.84%	0.01	0	0	0.08	0.23
f18	IND3	2000-04	91.69%	0.17	0.01	0	0.07	0	0	11 (0.02) 25 (1.67)	50.13%	0	0	0	0.09	0.25
f19	IND4	2005-09	89.77%	0.17	0	0.05	0.01	0	0	11 (0.05) 25 (1.32)	38.61%	0	0	0	0.07	0.11
f20	IND5	2010-14	89.69%	0.17	0	0.05	0.01	0	0	11 (0.16) 25 (0.97)	38.14%	0.01	0	0	0.04	0.05
f21	SLK1	1990-94	92.55%	0.17	0	0	0	0	0.09	25 (1.57)	55.30%	0	0	0	0.07	0
f22	SLK2	1995-99	94.75%	0.17	0	0	0	0	0.11	25 (1.56)	68.51%	0	0	0	0.07	0
f23	SLK3	2000-04	91.81%	0.17	0.02	0	0	0	0.07	11 (0.03) 25 (1.16)	50.85%	0	0	0	0.03	0
f24	SLK4	2005-09	98.66%	0.17	0.03	0	0	0	0.13	11 (0.02) 25 (1.04)	91.95%	0	0	0	0.01	0
f25	SLK5	2010-14	100.00%	0.63	0.04	0.11	0.13	0.34	0.01	38						
f26	MDV1	1990-94	88.17%	0.17	0.02	0	0.03	0	0	11 (0.34) 25 (0.58)	29.02%	0	0.01	0	0.03	0.06
f27	MDV2	1995-99	87.67%	0.17	0.01	0	0.03	0	0	11 (0.12) 25 (0.86)	26.05%	0	0	0	0.04	0.07
f28	MDV3	2000-04	87.13%	0.17	0.01	0	0.03	0	0	11 (0.06) 25 (0.94)	22.76%	0	0	0	0.04	0.07
f29	MDV4	2005-09	88.50%	0.17	0.02	0	0.03	0	0	11 (0.29) 25 (0.61)	30.99%	0	0	0	0.02	0.12
f30	MDV5	2010-14	88.62%	0.17	0.02	0	0.04	0	0	11 (0.22) 25 (0.70)	31.75%	0	0	0	0.02	0.14
	NPL	19	97.	0.17	0	0.1	0.02	0	0	11	86.10	0.05	0	0	0.03	0.37

f31	1	90-94	68%			3				(0.82) 25 (0.56) 11	%						
f32	NPL2	1995-99	92.94%	0.17	0	0.08	0.01	0	0	(0.52) 25 (0.74) 11	57.64%	0.03	0	0	0.04	0.25	
f33	NPL3	2000-04	88.50%	0.17	0.01	0	0.04	0	0	(0.11) 25 (1.22) 11	30.98%	0	0	0	0.07	0.2	
f34	NPL4	2005-09	88.49%	0.17	0.01	0	0.04	0	0	(0.08) 25 (1.10) 11	30.94%	0	0	0	0.06	0.15	
f35	NPL5	2010-14	88.50%	0.17	0.01	0	0.04	0	0	(0.04) 25 (1.08) 11	31.00%	0	0	0	0.05	0.16	
f36	PK1	1990-94	93.09%	0.17	0.03	0	0.06	0	0	(0.51) 25 (1.20) 11	58.54%	0	0.01	0	0.07	0.37	
f37	PK2	1995-99	93.20%	0.17	0.03	0	0.07	0	0	(0.41) 25 (1.35) 11	59.18%	0	0.01	0	0.08	0.39	
f38	PK3	2000-04	92.66%	0.17	0.03	0	0.06	0	0	(0.34) 25 (1.11) 11	55.98%	0	0	0	0.06	0.24	
f39	PK4	2005-09	94.23%	0.17	0.03	0	0.08	0	0	(0.22) 25 (1.18) 11	65.36%	0	0	0	0.06	0.18	
f40	PK5	2010-14	93.42%	0.17	0.02	0	0.08	0	0	(0.14) 25 (1.36)	60.51%	0	0	0	0.07	0.21	

Estimated BCC model:

DMU	Score	gov exp {I}{V}	SE {O}{V}	YL {O}{V}	imm {O}{V}	inf mor {O}{V}	gov eff {O}{V}	Benchmarks	{S} gov exp {I}	{S} SE {O}	{S} YL {O}	{S} imm {O}	{S} inf mor {O}	{S} gov eff {O}
f1	100.00%	1	0	0	1	0	0	29						
f2	117.48%	1	0.6	0	0.24	0.16	0	1 (0.66) 11 (0.28) 25 (0.06)	0	0	0	0	0	0.19
f3	101.62%	1	0.64	0	0.21	0.15	0	1 (0.50) 11 (0.45) 25 (0.05)	0.01	0	0.01	0	0	0.13
f4	122.54%	1	0	0.95	0	0.05	0	1 (0.37) 11 (0.50) 25 (0.13)	0	0.03	0	0	0	0.14

	109													
	.41			0.9				1 (0.26) 11						0.2
f5	%	1	0	4	0	0.06	0	(0.61) 25 (0.13)	0	0.05	0	0	0	3
	124													
	.47			0.6				1 (0.31) 11						
f6	%	1	0	1	0	0.09	0.3	(0.66) 25 (0.03)	0.14	0.02	0	0	0	0
	124													
	.32			0.5				1 (0.27) 11						
f7	%	1	0	9	0	0.1	0.31	(0.66) 25 (0.07)	0.12	0.03	0	0	0	0
	142							1 (0.18) 11						
	.86			0.2				(0.60) 22 (0.08)						
f8	%	1	0	5	0.21	0.12	0.42	25 (0.13)	0.13	0.04	0	0	0	0
	144							1 (0.19) 11						
	.55			0.2				(0.54) 22 (0.03)						
f9	%	1	0	4	0.21	0.15	0.4	25 (0.24)	0.12	0.03	0	0	0	0
	145							1 (0.25) 11						
f1	.10							(0.09) 22 (0.47)						
0	%	1	0	0.2	0.22	0.19	0.39	25 (0.19)	0.12	0.01	0	0	0	0
	100													
f1	.00													
1	%	1	1	0	0	0	0	29						
	100													
f1	.00													
2	%	1	0	0	0.32	0	0.68	2						
	100													
f1	.00			0.1										
3	%	1	0	3	0	0	0.87	4						
	109							11 (0.16) 13						
f1	.68			0.1				(0.64) 22 (0.13)						
4	%	1	0	8	0	0.05	0.76	25 (0.08)	0	0.01	0	0	0	0
	104							11 (0.31) 13						
f1	.52			0.1				(0.24) 22 (0.34)						
5	%	1	0	7	0	0.06	0.77	25 (0.11)	0	0.03	0	0	0	0
	107													
f1	.58							1 (0.25) 11						
6	%	1	0	0	0.49	0	0.51	(0.13) 21 (0.63)	0	0.01	0	0	0.01	0
	112													
f1	.88							1 (0.22) 11						
7	%	1	0	0	0.46	0	0.54	(0.08) 21 (0.70)	0	0.01	0	0	0.01	0
	112													
f1	.72							1 (0.22) 11				0.0		
8	%	1	0	0	0.47	0	0.53	(0.18) 21 (0.60)	0	0.02	1	0	0	0
	119													
f1	.46							1 (0.15) 21						
9	%	1	0	0	0.39	0	0.61	(0.85)	0.01	0	0	0	0	0
	127							1 (0.12) 11						
f2	.46							(0.11) 21 (0.19)						
0	%	1	0	0.1	0.24	0.11	0.55	22 (0.58)	0.02	0.01	0	0	0	0
	100													
f2	.00													
1	%	1	0	0	0.22	0	0.78	15						
	100													
f2	.00													
2	%	1	0	0	0	0.05	0.95	14						
	103													
f2	.53							11 (0.03) 22						
3	%	1	0.05	0	0	0.38	0.57	(0.40) 25 (0.57)	0.02	0	0	0	0	0
	100													
f2	.48							11 (0.02) 22						
4	%	1	0.04	0	0	0.46	0.49	(0.12) 25 (0.86)	0	0	0	0	0	0
	100													
f2	.00													
5	%	1	0.02	0.9	0	0.07	0	16						

f26	1990-94	1	0.01	0	0.37	0	0.63	1 (0.09) 11 (0.48) 21 (0.43)	0.05	0	0.01	0	0	0
f27	1990-94	1	0.01	0	0.38	0	0.62	1 (0.13) 11 (0.16) 21 (0.71)	0.03	0	0.01	0	0	0
f28	1990-94	1	0.02	0	0.35	0.08	0.55	1 (0.14) 11 (0.05) 21 (0.69) 22 (0.12)	0.04	0	0	0	0	0
f29	1990-94	1	0.08	0	0.32	0.17	0.42	1 (0.14) 11 (0.42) 22 (0.21) 25 (0.23)	0.04	0	0.01	0	0	0
f30	1990-94	1	0.07	0	0.32	0.23	0.39	1 (0.15) 11 (0.32) 22 (0.12) 25 (0.41)	0.04	0	0.01	0	0	0
f31	1990-94	1	0	0.67	0.33	0	0	1 (0.18) 11 (0.79) 25 (0.03)	0	0.05	0	0	0	0.1
f32	1990-94	1	0	0.03	0.44	0	0.53	1 (0.22) 11 (0.55) 21 (0.23)	0.01	0.03	0	0	0	0
f33	1990-94	1	0.01	0	0.44	0	0.55	1 (0.22) 11 (0.10) 21 (0.68)	0.03	0	0	0	0.01	0
f34	1990-94	1	0	0	0.42	0	0.57	1 (0.19) 11 (0.08) 21 (0.73)	0.02	0	0.01	0	0	0
f35	1990-94	1	0	0	0.42	0.11	0.47	1 (0.24) 21 (0.10) 22 (0.66)	0.02	0	0.01	0	0	0
f36	1990-94	1	0.01	0	0.49	0	0.5	1 (0.26) 11 (0.50) 21 (0.24)	0.02	0	0.01	0	0	0
f37	1990-94	1	0.01	0	0.5	0	0.49	1 (0.29) 11 (0.39) 21 (0.32)	0.01	0	0.01	0	0	0
f38	1990-94	1	0.01	0	0.44	0	0.55	1 (0.20) 11 (0.36) 21 (0.44)	0	0	0.01	0	0	0
f39	1990-94	1	0	0	0.53	0.03	0.44	1 (0.14) 12 (0.47) 13 (0.38) 22 (0.01)	0	0.01	0.01	0	0	0
f40	1990-94	1	0	0	0.55	0.03	0.42	1 (0.17) 12 (0.55) 13 (0.18) 22 (0.10)	0	0.02	0.01	0	0	0

Estimated technical efficiencies score

DMU	date	Score	gov exp {I}{V}	SE {O}{V}	YL {O}{V}	imm {O}{V}	inf mor {O}{V}	gov eff {O}{V}	Benchmarks	{S} gov exp {I}	{S} SE {O}	{S} YL {O}	{S} imm {O}	{S} inf mor {O}	{S} gov eff {O}
f1	1990-94	0	0.23	0.27	0.56	1.46	0.08	0	17						

	1995-99	0.32	0	0.06	0.04	0.56	0.05	0	1 (0.49) 11 (0.45) 22 (0.07)	0.01	0.01	0	0	0	0.3
f2	2000-04	0.16	0	0.11	0.03	0.57	0.08	0.14	1 (0.49) 11 (0.44) 22 (0.04) 25 (0.03)	0.01	0	0.01	0	0	0.15
f3	2005-09	0.36	0	0.03	0.03	0.36	0.07	0.17	1 (0.16) 11 (0.64) 22 (0.20)	0.01	0.04	0	0	0	0.33
f4	2010-14	0.38	0	0.02	0.68	0.02	0.18	0.16	1 (0.13) 11 (0.77) 25 (0.10)	0.01	0.06	0	0	0	0.32
f5	1990-94	0.25	0	0.05	0.03	0.34	0.01	0.32	1 (0.09) 11 (0.91)	0.16	0.04	0	0	0	0.21
f6	1995-99	0.33	0	0.04	0.03	0.01	0.02	0.33	11 (0.94) 22 (0.06)	0.14	0.04	0	0	0	0.25
f7	2000-04	0.33	0	0.02	0.02	0.01	0.03	0.32	11 (0.83) 22 (0.17)	0.14	0.05	0.01	0	0	0.27
f8	2005-09	0.34	0	0.02	0.02	0.01	0.03	0.3	11 (0.67) 22 (0.33)	0.13	0.04	0	0	0	0.3
f9	2010-14	0.33	0	0.02	0.02	0.26	0.1	0.29	1 (0.03) 11 (0.44) 22 (0.54)	0.14	0.03	0	0	0	0.3
f10	1990-94	0	0.16	0.62	0.32	0.21	0.07	0.84	33						
f11	1995-99	0	1.18	0.1	0.03	1.77	0.05	2.44	0						
f12	2000-04	0	0.86	0.05	0.08	0.6	0.02	1.09	0						
f13	2005-09	0.07	0.31	0.02	0.02	0.01	0.02	0.5	11 (0.41) 22 (0.29) 25 (0.30)	0	0.03	0	0	0.01	0.04
f14	2010-14	0.06	0.33	0.01	0.02	0.01	0.02	0.54	11 (0.39) 22 (0.42) 25 (0.19)	0	0.03	0	0	0.01	0.02
f15	1990-94	0.12	0	0.02	0.02	0.37	0.05	0.44	1 (0.16) 11 (0.78) 22 (0.06)	0.01	0.05	0.01	0	0	0.05
f16	1995-99	0.15	0	0.02	0.02	0.34	0.06	0.43	1 (0.11) 11 (0.76) 22 (0.13)	0.02	0.05	0.01	0	0	0.09
f17	2000-04	0.15	0	0.02	0.02	0.34	0.07	0.43	1 (0.13) 11 (0.66) 22 (0.21)	0.01	0.05	0.01	0	0	0.09
f18	2005-09	0.18	0	0.02	0.02	0.28	0.08	0.45	1 (0.03) 11 (0.65) 22 (0.32)	0.03	0.05	0.01	0	0	0.13
f19	2010-14	0.22	0	0.01	0.02	0.01	0.04	0.43	11 (0.54) 22 (0.46)	0.03	0.04	0.01	0	0	0.17
f20	1990-94	0	0.06	0.02	0.07	0.63	0.23	2.7	0						
f21	1995-99	0	0.11	0.05	0.08	0.2	0.41	1.83	26						

f23	2000-04	0.03	0	0.04	0.01	0.01	0.32	0.48	11 (0.02) 22 (0.47) 25 (0.51)	0.02	0	0	0	0	0.03
f24	2005-09	0	0.19	0.01	0.01	0.01	0.06	0.43	11 (0.02) 22 (0.12) 25 (0.85)	0	0	0	0	0	0
f25	2010-14	0	0.05	0.05	0.1	0.16	1.17	0.53	6						
f26	1990-94	0.29	0	0.04	0.01	0.01	0.01	0.37	11 (1.00)	0.06	0.05	0.02	0	0	0.21
f27	1995-99	0.32	0	0.02	0.01	0.01	0.02	0.34	11 (0.93) 22 (0.07)	0.05	0.06	0.02	0	0	0.24
f28	2000-04	0.33	0	0.02	0.01	0.01	0.03	0.34	11 (0.80) 22 (0.20)	0.06	0.06	0.02	0	0	0.25
f29	2005-09	0.35	0	0.03	0.01	0.01	0.03	0.29	11 (0.64) 22 (0.36)	0.05	0.03	0.01	0	0	0.3
f30	2010-14	0.37	0	0.03	0.01	0.01	0.05	0.27	11 (0.39) 22 (0.61)	0.04	0.02	0.01	0	0	0.34
f31	1990-94	0.24	0	0.03	0.03	0.35	0.01	0.33	1 (0.11) 11 (0.89)	0	0.06	0	0	0	0.18
f32	1995-99	0.29	0	0.02	0.02	0.3	0.01	0.34	1 (0.02) 11 (0.98)	0.02	0.06	0.01	0	0	0.22
f33	2000-04	0.3	0	0.02	0.01	0.01	0.02	0.35	11 (0.99) 22 (0.01)	0.06	0.06	0.01	0	0	0.22
f34	2005-09	0.32	0	0.02	0.01	0.01	0.02	0.34	11 (0.88) 22 (0.12)	0.04	0.06	0.02	0	0	0.24
f35	2010-14	0.37	0	0.02	0.01	0.01	0.03	0.29	11 (0.73) 22 (0.27)	0.03	0.05	0.01	0	0	0.3
f36	1990-94	0.1	0	0.06	0.02	0.39	0.01	0.41	1 (0.18) 11 (0.82)	0.03	0.02	0.01	0	0	0.07
f37	1995-99	0.14	0	0.05	0.02	0.39	0.01	0.38	1 (0.18) 11 (0.82)	0.02	0.03	0.02	0	0	0.09
f38	2000-04	0.19	0	0.04	0.02	0.32	0.05	0.41	1 (0.07) 11 (0.92) 22 (0.01)	0.02	0.04	0.01	0	0	0.13
f39	2005-09	0.21	0	0.03	0.02	0.3	0.05	0.42	1 (0.04) 11 (0.91) 22 (0.05)	0	0.05	0.01	0	0	0.14
f40	2010-14	0.2	0	0.03	0.01	0.32	0.06	0.41	1 (0.07) 11 (0.83) 22 (0.10)	0	0.05	0.02	0	0	0.13

i

Estimated super efficiency model

DMU	countries	date	Score	gov exp {I}{V}	SE {O}{V}	YL {O}{V}	im {O}{V}	inf mor {O}{V}	gov eff {O}{V}	Benchmarks	{S} gov exp {I}	{S} SE {O}	{S} YL {O}	{S} im {O}	{S} inf mor {O}	{S} gov eff {O}
f1	AFK1	1990-94	65.25%	0	0	0	1	0	0	29						
f2	AFK2	1995-99	117.48%	0	0.6	0	0.24	0.16	0	1 (0.66) 11 (0.28) 25 (0.06)	0	0	0	0	0	0.19
f3	AFK3	2000-04	101.62%	0	0.64	0	0.21	0.15	0	1 (0.50) 11 (0.45) 25 (0.05)	0.01	0	0.01	0	0	0.13
f4	AFK4	2005-09	112.54%	0.86	0	0.95	0	0.05	0	1 (0.37) 11 (0.50) 25 (0.13)	0	0.03	0	0	0	0.14
f5	AFK5	2010-14	109.41%	0.75	0	0.94	0	0.06	0	1 (0.26) 11 (0.61) 25 (0.13)	0	0.05	0	0	0	0.23
f6	BGD1	1990-94	104.47%	0	0	0.61	0	0.09	0.3	1 (0.31) 11 (0.66) 25 (0.03)	0.14	0.02	0	0	0	0
f7	BGD2	1995-99	104.32%	0	0	0.59	0	0.1	0.31	1 (0.27) 11 (0.66) 25 (0.07)	0.12	0.03	0	0	0	0
f8	BGD3	2000-04	102.86%	0	0	0.25	0.21	0.12	0.42	1 (0.18) 11 (0.60) 22 (0.08) 25 (0.13)	0.13	0.04	0	0	0	0
f9	BGD4	2005-09	104.55%	0	0	0.24	0.21	0.15	0.4	1 (0.19) 11 (0.54) 22 (0.03) 25 (0.24)	0.12	0.03	0	0	0	0
f10	BGD5	2010-14	105.10%	0	0	0.2	0.22	0.19	0.39	1 (0.25) 11 (0.09) 22 (0.47) 25 (0.19)	0.12	0.01	0	0	0	0
f11	BTN1	1990-94	76.78%	0.05	1	0	0	0	0	29						
f12	BTN2	1995-99	99.45%	0.24	0	0	0.32	0	0.68	2						
f13	BTN3	2000-04	95.59%	0.54	0	0.13	0	0	0.87	4						

		2005-09	10 9.6%	0.38	0	0.18	0	0.05	0.76	11 (0.16) 13 (0.64) 22 (0.13) 25 (0.08)	0	0.01	0	0	0	0
f15	BTN5	2010-14	10 4.5%	0.38	0	0.17	0	0.06	0.77	11 (0.31) 13 (0.24) 22 (0.34) 25 (0.11)	0	0.03	0	0	0	0
f16	IND1	1990-94	10 7.5%	0.07	0	0	0.49	0	0.51	1 (0.25) 11 (0.13) 21 (0.63)	0	0.01	0	0	0.01	0
f17	IND2	1995-99	11 2.8%	0.08	0	0	0.46	0	0.54	1 (0.22) 11 (0.08) 21 (0.70)	0	0.01	0	0	0.01	0
f18	IND3	2000-04	11 2.7%	0.08	0	0	0.47	0	0.53	1 (0.22) 11 (0.18) 21 (0.60)	0	0.02	0.01	0	0	0
f19	IND4	2005-09	11 9.4%	0	0	0	0.39	0	0.61	1 (0.15) 21 (0.85)	0.01	0	0	0	0	0
f20	IND5	2010-14	12 7.4%	0	0	0.1	0.24	0.11	0.55	1 (0.12) 11 (0.11) 21 (0.19) 22 (0.58)	0.02	0.01	0	0	0	0
f21	SLK1	1990-94	97.28 %	0	0	0	0.22	0	0.78	15						
f22	SLK2	1995-99	91.18 %	0.33	0	0	0	0.05	0.95	14						
f23	SLK3	2000-04	10 3.5%	0	0.05	0	0	0.38	0.57	11 (0.03) 22 (0.40) 25 (0.57)	0.02	0	0	0	0	0
f24	SLK4	2005-09	10 0.4%	0	0.04	0	0	0.46	0.49	11 (0.02) 22 (0.12) 25 (0.86)	0	0	0	0	0	0
f25	SLK5	2010-14	big	4.15E+09	0.02	0.9	0	0.07	0	16						
f26	MDV1	1990-94	14 9.5%	0	0.01	0	0.37	0	0.63	1 (0.09) 11 (0.48) 21 (0.43)	0.05	0	0.01	0	0	0
f27	MDV2	1995-99	15 7.8%	0	0.01	0	0.38	0	0.62	1 (0.13) 11 (0.16) 21 (0.71)	0.03	0	0.01	0	0	0
f28	MDV3	2000-04	15 9.5%	0	0.02	0	0.35	0.08	0.55	1 (0.14) 11 (0.05) 21 (0.69) 22 (0.12)	0.04	0	0	0	0	0

		2005-2014	16.2%	0	0.08	0	0.32	0.17	0.42	1 (0.14) 11 (0.42) 22 (0.21) 25 (0.23)	0.04	0	0.01	0	0	0
f29	MDV4																	
		2010-2014	15.9%	0	0.07	0	0.32	0.23	0.39	1 (0.15) 11 (0.32) 22 (0.12) 25 (0.41)	0.04	0	0.01	0	0	0
f30	MDV5																	
		1990-1994	11.1%	1	0	0.67	0.33	0	0	1 (0.18) 11 (0.79) 25 (0.03)	0	0.05	0	0	0	0.1
f31	NPL1																	
		1995-1999	13.9%	0	0	0.03	0.44	0	0.53	1 (0.22) 11 (0.55) 21 (0.23)	0.01	0.03	0	0	0	0
f32	NPL2																	
		2000-2004	13.3%	0	0.01	0	0.44	0	0.55	1 (0.22) 11 (0.10) 21 (0.68)	0.03	0	0	0	0.01	0
f33	NPL3																	
		2005-2009	14.1%	0	0	0	0.42	0	0.57	1 (0.19) 11 (0.08) 21 (0.73)	0.02	0	0.01	0	0	0
f34	NPL4																	
		2010-2014	16.3%	0	0	0	0.42	0.11	0.47	1 (0.24) 21 (0.10) 22 (0.66)	0.02	0	0.01	0	0	0
f35	NPL5																	
		1990-1994	10.7%	0	0.01	0	0.49	0	0.5	1 (0.26) 11 (0.50) 21 (0.24)	0.02	0	0.01	0	0	0
f36	PK1																	
		1995-1999	11.8%	0	0.01	0	0.51	0	0.49	1 (0.29) 11 (0.39) 21 (0.32)	0.01	0	0.01	0	0	0
f37	PK2																	
		2000-2004	11.5%	0	0.01	0	0.45	0	0.55	1 (0.20) 11 (0.36) 21 (0.44)	0	0	0.01	0	0	0
f38	PK3																	
		2005-2009	11.4%	0.31	0	0	0.47	0.03	0.44	1 (0.14) 12 (0.47) 13 (0.38) 22 (0.01)	0	0.01	0.01	0	0	0
f39	PK4																	
		2010-2014	11.3%	0.33	0	0	0.5	0.03	0.42	1 (0.17) 12 (0.55) 13 (0.18) 22 (0.10)	0	0.02	0.01	0	0	0
f40	PK5																	

CCR after removal of outliers

DMU	Score	gov exp {I}{V}	SE {O}{V}	YL {O}{V}	imm {O}{V}	inf mor {O}{V}	gov eff {O}{V}	Benchmarks	{F} gov exp {I}	{S} SE {O}	{S} YL {O}	{S} imm {O}	{S} inf mor {O}	{S} gov eff {O}

f1	99.27 %	0.17	0	0.08	0.08	0	0	13 (1.38) 24 (2.41)	95.63 %	0.01	0	0	0.14	1.79
f2	96.08 %	0.2	0	0.08	0.08	0	0	11 (0.15) 13 (0.80) 24 (1.49)	80.41 %	0	0	0	0.08	1.17
f3	96.52 %	0.17	0.03	0	0.1	0	0	11 (0.48) 24 (2.06)	79.11 %	0	0.01	0	0.11	1.02
f4	96.03 %	0.17	0	0.09	0.04	0	0	11 (0.04) 13 (1.35)	76.19 %	0.01	0	0	0.01	0.6
f5	97.37 %	0.17	0	0.1	0.04	0	0	11 (0.77) 13 (0.35) 24 (0.05)	84.22 %	0.06	0	0	0	0.5
f6	88.09 %	0.17	0	0.03	0.01	0	0	11 (0.36) 13 (0.88)	28.55 %	0.01	0	0	0.01	0.38
f7	88.13 %	0.17	0	0.05	0	0	0	11 (0.95) 24 (0.03)	28.77 %	0.04	0	0	0	0.23
f8	87.28 %	0.17	0	0.02	0.02	0	0	13 (0.98) 24 (0.02)	23.66 %	0.01	0	0	0	0.23
f9	87.31 %	0.17	0	0.02	0.02	0	0	13 (0.90) 24 (0.10)	23.88 %	0.01	0	0	0	0.24
f10	86.90 %	0.17	0	0.02	0.02	0	0	13 (0.39) 24 (0.79)	21.40 %	0	0	0	0.03	0.26
f11	100.00 %	0.57	0.37	0.1	0.06	0.01	0.03	22						
f12	99.54 %	0.17	0.01	0.09	0	0	0.06	11 (0.68) 13 (0.14) 24 (0.25)	97.26 %	0	0	0	0.01	0
f13	100.00 %	0.67	0.01	0.39	0.11	0	0.16	17						
f14	97.81 %	0.17	0	0.08	0	0	0.07	13 (0.82) 24 (0.12)	86.86 %	0.01	0	0	0	0
f15	97.31 %	0.17	0	0.07	0	0	0.07	13 (0.67) 24 (0.41)	83.89 %	0.01	0	0	0.01	0
f16	93.95 %	0.17	0	0.05	0.06	0	0	13 (0.18) 24 (1.58)	63.69 %	0	0	0	0.08	0.34
f17	93.38 %	0.17	0	0.05	0.05	0	0	13 (0.29) 24 (1.28)	60.30 %	0	0	0	0.06	0.27
f18	93.09 %	0.17	0	0	0.1	0	0	24 (1.68)	58.54 %	0	0	0	0.08	0.29
f19	90.94 %	0.17	0	0.04	0.04	0	0	13 (0.15) 24 (1.19)	45.63 %	0	0	0	0.05	0.14
f20	90.54 %	0.17	0	0.04	0.04	0	0	13 (0.35) 24 (0.74)	43.25 %	0.01	0	0	0.03	0.08

f21	93.58 %	0.17	0	0	0	0	0.1	24 (1.47)	61.51 %	0.01	0	0	0.06	0
f22	96.03 %	0.17	0	0	0	0	0.13	24 (1.46)	76.20 %	0	0	0	0.05	0
f23	92.55 %	0.17	0.01	0	0	0	0.08	11 (0.00) 24 (1.11)	55.28 %	0	0	0	0.02	0
f24	100.00 %	0.61	0.03	0.09	0.11	0.36	0.01	33						
f25	88.48 %	0.17	0.01	0	0.04	0	0	11 (0.32) 24 (0.60)	30.85 %	0	0.01	0	0.03	0.07
f26	88.17 %	0.17	0.01	0	0.04	0	0	11 (0.09) 24 (0.90)	29.05 %	0	0	0	0.04	0.09
f27	87.64 %	0.17	0.01	0	0.04	0	0	11 (0.02) 24 (0.98)	25.82 %	0	0	0	0.04	0.09
f28	88.86 %	0.17	0.01	0	0.04	0	0	11 (0.27) 24 (0.63)	33.19 %	0	0	0	0.02	0.14
f29	89.08 %	0.17	0.01	0	0.04	0	0	11 (0.20) 24 (0.72)	34.48 %	0	0	0	0.02	0.16
f30	98.10 %	0.17	0	0.1	0.04	0	0	11 (0.31) 13 (0.99)	88.62 %	0.03	0	0	0.01	0.39
f31	93.47 %	0.17	0	0.06	0.05	0	0	13 (1.01) 24 (0.16)	60.79 %	0.01	0	0	0.01	0.28
f32	89.15 %	0.17	0.01	0	0.05	0	0	11 (0.07) 24 (1.27)	34.89 %	0	0	0	0.06	0.23
f33	89.16 %	0.17	0.01	0	0.05	0	0	11 (0.05) 24 (1.14)	34.95 %	0	0	0	0.05	0.18
f34	89.23 %	0.17	0.01	0	0.05	0	0	11 (0.00) 24 (1.13)	35.41 %	0	0	0	0.05	0.19
f35	93.82 %	0.17	0.03	0	0.08	0	0	11 (0.47) 24 (1.25)	62.95 %	0	0	0	0.06	0.4
f36	94.07 %	0.17	0.03	0	0.08	0	0	11 (0.36) 24 (1.40)	64.42 %	0	0.01	0	0.07	0.42
f37	93.48 %	0.17	0.02	0	0.08	0	0	11 (0.30) 24 (1.16)	60.90 %	0	0	0	0.06	0.27
f38	95.38 %	0.17	0.02	0	0.1	0	0	11 (0.18) 24 (1.23)	72.30 %	0	0	0	0.06	0.21
f39	94.66 %	0.17	0.02	0	0.09	0	0	11 (0.09) 24 (1.41)	67.98 %	0	0	0	0.07	0.25

BCC after removal of outliers

DMU	Score	gov exp {I}{V}	SE {O}{V}	YL {O}{V}	imm {O}{V}	inf mor {O}{V}	gov eff {O}{V}	Benchmarks	{S} gov exp {I}	{S} SE {O}	{S} YL {O}	{S} imm {O}	{S} inf mor {O}	{S} gov eff {O}
f1	100.00%	1	0	0	1	0	0	30						
f2	117.10%	1	0.59	0	0.24	0.17	0	1 (0.66) 11 (0.28) 24 (0.06)	0	0	0	0	0	0.19
f3	101.34%	1	0.63	0	0.2	0.16	0	1 (0.50) 11 (0.45) 24 (0.05)	0.01	0	0.01	0	0	0.14
f4	121.43%	1	0	0.93	0	0.07	0	1 (0.37) 11 (0.49) 24 (0.14)	0	0.03	0	0	0	0.14
f5	108.33%	1	0	0.92	0	0.08	0	1 (0.26) 11 (0.60) 24 (0.14)	0	0.05	0	0	0	0.23
f6	124.34%	1	0	0.61	0	0.09	0.3	1 (0.31) 11 (0.65) 24 (0.04)	0.14	0.02	0	0	0	0
f7	124.05%	1	0	0.58	0	0.11	0.31	1 (0.28) 11 (0.65) 24 (0.07)	0.12	0.03	0	0.01	0	0
f8	142.59%	1	0	0.26	0.2	0.12	0.42	1 (0.18) 11 (0.61) 22 (0.05) 24 (0.16)	0.13	0.04	0	0	0	0
f9	143.84%	1	0	0.48	0	0.19	0.32	1 (0.19) 11 (0.54) 24 (0.27)	0.12	0.03	0	0	0	0
f10	144.71%	1	0	0.21	0.2	0.2	0.39	1 (0.25) 11 (0.10) 22 (0.43) 24 (0.23)	0.12	0.01	0	0	0	0
f11	100.00%	1	1	0	0	0	0	28						
f12	100.00%	1	0	0	0.32	0	0.68	2						
f13	100.00%	1	0	0.13	0	0	0.87	5						
f14	109.55%	1	0	0.19	0	0.06	0.75	11 (0.16) 13 (0.63) 22 (0.11) 24 (0.09)	0	0.02	0	0	0	0
f15	104.35%	1	0	0.18	0	0.07	0.76	11 (0.31) 13 (0.24) 22 (0.32) 24 (0.13)	0	0.03	0	0	0	0
f16	107.58%	1	0	0	0.49	0	0.51	1 (0.25) 11 (0.13) 21 (0.63)	0	0.01	0	0	0.01	0
f17	112.88%	1	0	0	0.46	0	0.54	1 (0.22) 11 (0.08) 21 (0.70)	0	0.01	0	0	0.01	0
f18	112.72%	1	0	0	0.47	0	0.53	1 (0.22) 11 (0.18) 21 (0.60)	0	0.02	0.01	0	0	0
f19	119.46%	1	0	0	0.39	0	0.61	1 (0.15) 21 (0.85)	0.01	0	0	0	0	0

f20	127.46%	1	0	0.1	0.24	0.11	0.55	1 (0.12) 11 (0.11) 21 (0.19) 22 (0.58)	0.02	0.01	0	0	0	0
f21	100.00%	1	0	0	0.22	0	0.78	15						
f22	100.00%	1	0	0	0	0.05	0.95	12						
f23	103.19%	1	0.03	0	0.2	0.32	0.44	1 (0.00) 11 (0.02) 22 (0.32) 24 (0.66)	0.02	0	0	0	0	0
f24	100.00%	1	0	0	0	1	0	14						
f26	149.50%	1	0.01	0	0.37	0	0.63	1 (0.09) 11 (0.48) 21 (0.43)	0.05	0	0.01	0	0	0
f27	157.87%	1	0.01	0	0.38	0	0.62	1 (0.13) 11 (0.16) 21 (0.71)	0.03	0	0.01	0	0	0
f28	159.54%	1	0.02	0	0.35	0.08	0.55	1 (0.14) 11 (0.05) 21 (0.69) 22 (0.12)	0.04	0	0	0	0	0
f29	160.01%	1	0.09	0	0.32	0.18	0.42	1 (0.14) 11 (0.41) 22 (0.17) 24 (0.27)	0.04	0	0.01	0	0	0
f30	159.23%	1	0.07	0	0.32	0.23	0.38	1 (0.15) 11 (0.30) 22 (0.07) 24 (0.48)	0.04	0	0.01	0	0	0
f31	110.05%	1	0	0.62	0.38	0	0	1 (0.18) 11 (0.76) 13 (0.07)	0	0.05	0	0	0	0.11
f32	134.69%	1	0	0.03	0.44	0	0.53	1 (0.22) 11 (0.55) 21 (0.23)	0.01	0.03	0	0	0	0
f33	137.33%	1	0.01	0	0.44	0	0.55	1 (0.22) 11 (0.10) 21 (0.68)	0.03	0	0	0	0.01	0
f34	148.11%	1	0	0	0.42	0	0.57	1 (0.19) 11 (0.08) 21 (0.73)	0.02	0	0.01	0	0	0
f35	163.34%	1	0	0	0.42	0.11	0.47	1 (0.24) 21 (0.10) 22 (0.66)	0.02	0	0.01	0	0	0
f36	108.67%	1	0.01	0	0.49	0	0.5	1 (0.26) 11 (0.50) 21 (0.24)	0.02	0	0.01	0	0	0
f37	111.84%	1	0.01	0	0.5	0	0.49	1 (0.29) 11 (0.39) 21 (0.32)	0.01	0	0.01	0	0	0
f38	118.55%	1	0.01	0	0.44	0	0.55	1 (0.20) 11 (0.36) 21 (0.44)	0	0	0.01	0	0	0
f39	116.42%	1	0	0	0.53	0.03	0.44	1 (0.14) 12 (0.47) 13 (0.38) 22 (0.01)	0	0.01	0.01	0	0	0
f40	116.37%	1	0	0	0.55	0.03	0.42	1 (0.17) 12 (0.55) 13 (0.18) 22 (0.10)	0	0.02	0.01	0	0	0

Technical efficiencies after removal of outliers

DMU	Score	gov exp {I}{V}	SE {O}{V}	YL {O}{V}	imm {O}{V}	inf mor {O}{V}	gov eff {O}{V}	Benchmarks	{S} gov exp {I}	{S} SE {O}	{S} YL {O}	{S} imm {O}	{S} inf mor {O}	{S} gov eff {O}
f1	0	0.22	0.27	0.56	1.45	0.09	0	17						
f2	0.32	0	0.06	0.04	0.56	0.05	0	1 (0.49) 11 (0.45) 22 (0.07)	0.01	0.01	0	0	0	0.3
f3	0.16	0	0.12	0.03	0.57	0.09	0.14	1 (0.49) 11 (0.44) 22 (0.04) 24 (0.04)	0.01	0	0.01	0	0	0.15
f4	0.36	0	0.03	0.03	0.36	0.07	0.17	1 (0.16) 11 (0.64) 22 (0.20)	0.01	0.04	0	0	0	0.33
f5	0.38	0	0.02	0.68	0.02	0.19	0.16	1 (0.14) 11 (0.74) 24 (0.12)	0.01	0.06	0	0	0	0.32
f6	0.25	0	0.05	0.03	0.34	0.01	0.32	1 (0.09) 11 (0.91)	0.16	0.04	0	0	0	0.21
f7	0.3	0	0.04	0.03	0.01	0.02	0.33	11 (0.94) 22 (0.06)	0.14	0.04	0	0	0	0.25
f8	0.33	0	0.02	0.02	0.01	0.03	0.32	11 (0.83) 22 (0.17)	0.14	0.05	0.01	0	0	0.27
f9	0.34	0	0.02	0.02	0.01	0.03	0.3	11 (0.67) 22 (0.33)	0.13	0.04	0	0	0	0.3
f10	0.33	0	0.02	0.02	0.26	0.1	0.29	1 (0.03) 11 (0.44) 22 (0.54)	0.14	0.03	0	0	0	0.3
f11	0	0.16	0.62	0.32	0.21	0.08	0.82	32						
f12	0	1.02	0.1	0.03	1.43	0.05	2.04	0						
f13	0	0.88	0.06	0.07	0.63	0.02	0.93	0						
f14	0.07	0.32	0.02	0.02	0.01	0.02	0.5	11 (0.42) 22 (0.23) 24 (0.35)	0	0.03	0	0	0.01	0.03
f15	0.06	0.34	0.01	0.02	0.01	0.02	0.54	11 (0.40) 22 (0.38) 24 (0.23)	0	0.03	0	0	0.01	0.02
f16	0.12	0	0.02	0.02	0.37	0.05	0.44	1 (0.16) 11 (0.78) 22 (0.06)	0.01	0.05	0.01	0	0	0.05
f17	0.15	0	0.02	0.02	0.34	0.06	0.43	1 (0.11) 11 (0.76) 22 (0.13)	0.02	0.05	0.01	0	0	0.09
f18	0.15	0	0.02	0.02	0.34	0.07	0.43	1 (0.13) 11 (0.66) 22 (0.21)	0.01	0.05	0.01	0	0	0.09
f19	0.18	0	0.02	0.02	0.28	0.08	0.45	1 (0.03) 11 (0.65) 22 (0.32)	0.03	0.05	0.01	0	0	0.13
f20	0.22	0	0.01	0.02	0.01	0.04	0.43	11 (0.54) 22 (0.46)	0.03	0.04	0.01	0	0	0.17

f21	0	0.04	0.02	0.05	0.65	0.16	2.54	0						
f22	0	0.09	0.04	0.1	0.2	0.41	1.54	25						
f23	0.03	0	0.04	0.01	0.01	0.33	0.48	11 (0.01) 22 (0.39) 24 (0.60)	0.02	0	0	0	0	0.03
f24	0	0.06	0.07	0.1	0.17	1.16	0.57	5						
f26	0.29	0	0.04	0.01	0.01	0.01	0.37	11 (1.00)	0.06	0.05	0.02	0	0	0.21
f27	0.32	0	0.02	0.01	0.01	0.02	0.34	11 (0.93) 22 (0.07)	0.05	0.06	0.02	0	0	0.24
f28	0.33	0	0.02	0.01	0.01	0.03	0.34	11 (0.80) 22 (0.20)	0.06	0.06	0.02	0	0	0.25
f29	0.35	0	0.03	0.01	0.01	0.03	0.29	11 (0.64) 22 (0.36)	0.05	0.03	0.01	0	0	0.3
f30	0.37	0	0.03	0.01	0.01	0.05	0.27	11 (0.39) 22 (0.61)	0.04	0.02	0.01	0	0	0.34
f31	0.24	0	0.03	0.03	0.35	0.01	0.33	1 (0.11) 11 (0.89)	0	0.06	0	0	0	0.18
f32	0.29	0	0.02	0.02	0.3	0.01	0.34	1 (0.02) 11 (0.98)	0.02	0.06	0.01	0	0	0.22
f33	0.3	0	0.02	0.01	0.01	0.02	0.35	11 (0.99) 22 (0.01)	0.06	0.06	0.01	0	0	0.22
f34	0.32	0	0.02	0.01	0.01	0.02	0.34	11 (0.88) 22 (0.12)	0.04	0.06	0.02	0	0	0.24
f35	0.37	0	0.02	0.01	0.01	0.03	0.29	11 (0.73) 22 (0.27)	0.03	0.05	0.01	0	0	0.3
f36	0.1	0	0.06	0.02	0.39	0.01	0.41	1 (0.18) 11 (0.82)	0.03	0.02	0.01	0	0	0.07
f37	0.14	0	0.05	0.02	0.39	0.01	0.38	1 (0.18) 11 (0.82)	0.02	0.03	0.02	0	0	0.09
f38	0.19	0	0.04	0.02	0.32	0.05	0.41	1 (0.07) 11 (0.92) 22 (0.01)	0.02	0.04	0.01	0	0	0.13
f39	0.21	0	0.03	0.02	0.3	0.05	0.42	1 (0.04) 11 (0.91) 22 (0.05)	0	0.05	0.01	0	0	0.14
f40	0.2	0	0.03	0.01	0.32	0.06	0.41	1 (0.07) 11 (0.83) 22 (0.10)	0	0.05	0.02	0	0	0.13

Estimated results of general to specific model

```
                  Coefficient  Std.Error  t-value  t-prob Part.R^2
Lexp                **-0.109643**     **0.1028**    **-1.07**  **0.2955**   **0.0405**
Lfdi             -2.59231e-005    0.02268 -0.00114  0.9991   0.0000
Lms               -0.000956445    0.09488  -0.0101  0.9920   0.0000
Lliab                -0.187377     0.1744    -1.07  0.2920   0.0410
Lrol                  0.148816     0.2950    0.504  0.6181   0.0093
lcoc                  0.155845     0.1271     1.23  0.2309   0.0527
lRQ                  -0.309153     0.1582    -1.95  0.0612   0.1239
Lva                  0.0251327    0.05735    0.438  0.6647   0.0071
PR                   -0.145498     0.2521   -0.577  0.5686   0.0122
CL                   -0.485042     0.7758   -0.625  0.5371   0.0143
PG                    0.205023     0.1558     1.32  0.1992   0.0603
PS                  -0.0382912     0.1322   -0.290  0.7743   0.0031

sigma                0.0565642  RSS              0.0863865885
log-likelihood         63.8548
no. of observations         39  no. of parameters          12
mean(INEFF)          0.0829015  se(INEFF)           0.0706679

AR 1-2 test:      F(2,25)   =  0.76147 [0.4775]
ARCH 1-1 test:    F(1,37)   =   1.5962 [0.2143]
Normality test:   Chi^2(2)  =  0.70806 [0.7019]
Hetero test:      F(24,14)  =   1.0274 [0.4944]
Chow test:        F(11,16)  =   2.1890 [0.0751]   for break after 2018

Autometrics: dimensions of initial GUM ----------
no. of observations         39  no. of parameters          12
no. free regressors (k1)    12  no. free components (k2)    0
no. of equations             1  no. diagnostic tests        5

[0.2] Presearch reduction of initial GUM

Starting variable reduction at 0.33365
Testing Lexp          LRF( 1) [0.2955]
Testing Lfdi          LRF( 1) [0.9991]
Testing Lms           LRF( 1) [0.9920]
Testing Lliab         LRF( 1) [0.2920]
Testing Lrol          LRF( 1) [0.6181]
Testing lcoc          LRF( 1) [0.2309]
Testing lRQ           LRF( 1) [0.0612]
Testing Lva           LRF( 1) [0.6647]
Testing PR            LRF( 1) [0.5686]
Testing CL            LRF( 1) [0.5371]
Testing PG            LRF( 1) [0.1992]
Testing PS            LRF( 1) [0.7743]
Trying  Lfdi          LRF( 1) [0.9991] removed
Trying  Lms           LRF( 1) [0.9919] LRF_iGUM( 2) [0.9999] removed
Trying  PS            LRF( 1) [0.7657] LRF_iGUM( 3) [0.9935] removed
Trying  Lva           LRF( 1) [0.6291] LRF_iGUM( 4) [0.9893] removed
```

```
Trying  Lrol          LRF( 1) [0.7385] LRF_iGUM( 5) [0.9948] removed
Trying  PR            LRF( 1) [0.5993] LRF_iGUM( 6) [0.9949] removed
Trying  CL            LRF( 1) [0.4048] LRF_iGUM( 7) [0.9879] removed

Presearch reduction: 7 removed,  LRF_iGUM( 7) [0.9879]
Presearch removed:
[0] = Lfdi
[1] = Lms
[2] = Lrol
[3] = Lva
[4] = PR
[5] = CL
[6] = PS

[0.3] Testing GUM 0:  LRF( 5) [0.0000] kept

[1.0] Start of Autometrics tree search

Searching from GUM 0  k=   5 loglik=     62.9812
Found new terminal 1  k=   4 loglik=     60.8382 SC=   -2.7442

Searching for contrasting terminals in terminal paths

Encompassing test against GUM 0 removes: none

p-values in GUM 1 and saved terminal candidate model(s)
                     GUM 1  terminal 1
Lexp            0.03035633  0.03035633
Lliab           0.00001287  0.00001287
lRQ             0.03422819  0.03422819
PG              0.00000028  0.00000028
k                        4           4
parameters               4           4
loglik              60.838      60.838
AIC                -2.9148     -2.9148
HQ                 -2.8536     -2.8536
SC                 -2.7442     -2.7442

Searching from GUM 1  k=   4 loglik=     60.8382 LRF_GUM0( 1) [0.0550]
Recalling terminal 1  k=   4 loglik=     60.8382 SC=   -2.7442

Searching for contrasting terminals in terminal paths

[2.0] Selection of final model from terminal candidates: terminal 1

p-values in Final GUM and terminal model(s)
                  Final GUM  terminal 1
Lexp            0.03035633  0.03035633
Lliab           0.00001287  0.00001287
lRQ             0.03422819  0.03422819
PG              0.00000028  0.00000028
k                        4           4
```

```
parameters              4          4
loglik              60.838     60.838
AIC                -2.9148    -2.9148
HQ                 -2.8536    -2.8536
SC                 -2.7442    -2.7442
                           =======

coefficients and diagnostic p-values in Final GUM and terminal model(s)
                 Final GUM  terminal 1
Lexp              -0.10825    -0.10825
Lliab             -0.28462    -0.28462
lRQ               -0.11457    -0.11457
PG                 0.28246     0.28246
k                        4           4
parameters               4           4
loglik               60.838      60.838
sigma               0.053676    0.053676
AR(2)               0.26832     0.26832
ARCH(1)             0.01473     0.01473
Normality           0.70975     0.70975
Hetero              0.12295     0.12295
Chow(70%)           0.06797     0.06797
                           =======

p-values of diagnostic checks for model validity
          Initial GUM     cut-off   Final GUM     cut-off Final model
AR(2)         0.47751     0.01000     0.26832     0.01000     0.26832
ARCH(1)       0.21435     0.01000     0.01473     0.01000     0.01473
Normality     0.70185     0.01000     0.70975     0.01000     0.70975
Hetero        0.49440     0.01000     0.12295     0.01000     0.12295
Chow(70%)     0.07508     0.01000     0.06797     0.01000     0.06797

Summary of Autometrics search
initial search space     2^12  final search space        2^4
no. estimated models       14  no. terminal models         1
test form                LR-F  target size      Default:0.05
outlier detection          no  presearch reduction        no
backtesting              GUM0  tie-breaker                SC
diagnostics p-value      0.01  search effort        standard
time                     0.39  Autometrics version      1.5e

EQ(22) Modelling INEFF by OLS
       The dataset is: D:\thesis m.phil\new04 g to s ful data.in7
       The estimation sample is: 1991 - 2029

                 Coefficient  Std.Error  t-value  t-prob Part.R^2
Lexp               -0.108254    0.04796    -2.26  0.0304   0.1270
Lliab              -0.284620    0.05610    -5.07  0.0000   0.4237
lRQ                -0.114565    0.05199    -2.20  0.0342   0.1218
PG                  0.282458    0.04461     6.33  0.0000   0.5339

sigma               0.0536762  RSS               0.100839709
```

```
log-likelihood        60.8382
no. of observations        39  no. of parameters           4
mean(INEFF)         0.0829015  se(INEFF)           0.0706679

AR 1-2 test:      F(2,33)   =   1.3694 [0.2683]
ARCH 1-1 test:    F(1,37)   =   6.5470 [0.0147]*
Normality test:   Chi^2(2)  =  0.68570 [0.7097]
Hetero test:      F(8,30)   =   1.7698 [0.1229]
Hetero-X test:    F(14,24)  =   1.6865 [0.1260]
RESET23 test:     F(2,33)   =  0.84285 [0.4395]
```

…….xxxxxxxxxxxxxxx……