THE IMPACT OF GOVERNMENT EXPENDITURE COMPOSITIONS ON ECONOMIC GROWTH: AN EMPIRICAL ANALYSIS

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Abstract

The aim of this research is broadly to achieve 3 main objectives. The first objective is to investigate the relationship between the composition of government expenditure and economic growth. This objective further extends to examine how low to middle-income countries compare in their growth effects of government spending compositions with other economies from high-income countries. The second objective is to examine the effect of corruption on economic growth via the compositions of government expenditure. The third objective is to investigate the impact of government expenditure on human capital and its important indicators (health and education) on economic growth. These objectives are achieved by using quantitative data techniques.

For the first objective, the research develops an endogenous growth framework drawing on variables from existing models, and separates government expenditure into productive and non-productive forms. This analysis addresses some gaps in existing knowledge that persist in current economic growth research: comparing the impact of government expenditure compositions on economic growth at different stages of development, the possible endogeneity of fiscal variables and consequences of relying on the period-averaging process. Using panel data from 37 high-income and 22 low to middle-income countries covering 1993 to 2012, the findings are based on Ordinary Least Squares (OLS) two-way fixed effects and Generalised Method of Moments (GMM) techniques. It challenges much of the existing empirical literature in relation to developing economies by showing that a shift in government expenditure away from non-productive government expenditure and towards productive forms of expenditure are associated with higher levels of growth in both high-income and low to middle-income economies. Moreover, this analysis identifies the differing components of government expenditure that are most associated with increased long-run output levels in both high-income and low to middle-income economies.

For the second objective, this thesis focuses on one channel that has received limited attention in current literature by examining the effect of corruption on the relationship between economic growth and government expenditure compositions. The research has formulated a system of equations in which corruption is modelled analytically as something that reduces the productivity of government spending in order to take account of the interdependency between government expenditure compositions, corruption and economic growth. The empirical strategy applied OLS two-way fixed effects methods to a panel of 37 high-income and 20 low to middle-income nations based on the availability of International Country Risk Guide (ICRG) corruption index during the period from 1993 to 2012. The findings show that by comparing the corruption-adjusted coefficient of productive and non-productive government expenditure for both low to middle-income and high-income economies, there is no evidence that corruption has a marked impact on the strength relationship between government expenditure, whether in from of productive or non-productive, and economic growth. These findings do not discount the possibility of corruption affecting growth through other means. For example, through altering the division of total government expenditure between productive and non-productive types.

Lastly, the third objective focuses on examining the association between human capital and economic growth on a sample of high-income and low to middle-income economies (25 OECD countries and 5 ASEAN countries) for the period 1993 to 2012. There are a number of empirical researches carried out in developed economies, but there is limited research on the case of Asian countries, especially the ASEAN area, to investigate the effect of government expenditure on human capital on economic growth. Education has often been the main factor in the literature on human capital and economic growth, but this thesis also includes health as another factor. Therefore, this thesis concentrates on assessing the growth effects of government expenditure on human capital and its components (education and health). The findings show that an increase in the share of government expenditure on education enhances economic growth for both sets of data. However, the analysis recognises a negative effect of shifting more public spending towards the health component in OECD economies, while there is no significant impact of this component in ASEAN countries. With regards to the combined government expenditure on human capital, this analysis observes that there is a positive and significant connection between this expenditure and economic growth in ASEAN economies, but no significant effect in OECD countries.

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Abbreviations

ASEAN	Association of South East Asian Nations
CES	Constant Elasticity of Substitution
CPI	Corruption Perception Index
EGLS	Estimated Generalised Least Squares
EU	European Union
FDI	Foreign Direct Investment
FE	Fixed Effects
FGLS	Feasible Generalised Least Squares
GFS	Government Finance Statistics
GFSM	Government Finance Statistics Manual
GLS	Generalised Least Squares
GMM	Generalised Method of Moments
GNI	Gross National Income
ICRG	International Country Risk Guide
IFS	International Financial Statistics
IMF	International Monetary Fund
LM	Lagrange Multiplier
LSDV	Least Squares Dummy Variable
MG	Mean Group
MSE	Mean Squared Errors

OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Square
PMG	Pooled Mean Group
PRS	Political Risk Services
SEE	Standard Errors of the Estimates
SRMSE	Square Root of Mean Squared Errors
SSE	Sum of Squared Errors
TI	Transparency International
WB	World Bank
WDI	World Bank Development Indicators
WGI	World Governance Indicator

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This journey so far has been a wonderful experience. It does not smooth all the time but surely it filled with fond memories and dedication (determination). At certain time in this journey this quote by Michelle Obama really kept me strong.

"The only limit to the height of your achievements is the reach of your dreams and your willingness to work hard for them"

-Michelle Obama, 2008

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my wife Lam Tran, the little two-year old Linh Chu and my new born Minh Chu, whose support and encouragement gave me the strength when I needed it most.

Declaration

I declare that this thesis contains no material that has been accepted for the award of any other degree or diploma in any institution or university. The thesis is based on my original work except for quotations and citations which have been acknowledged accordingly. I also declare that this thesis has not been previously or simultaneously submitted, either partially or wholly, for any other qualification at any university or institution.

Thanh Tuan Chu

July, 2018

Dedication

I dedicate this thesis to my wonderful wife – Lam Tran, my lovely two-year old daughter – Linh Chu, my new born Minh Chu, my sweet mum – Thai Tran and my great dad – Sang Chu.

PART A: THEORETICAL AND METHODOLOGY APPROACHES

Chapter One

General Overview

1.1 Introduction

This thesis examines the impact of government expenditure on economic growth. Can a government enhance long-term economic growth by changing the composition of government spending? This question has been raised by many economists and policymakers around the world for various reasons. For example, if a government faces high levels of indebtedness and decides to carry out fiscal austerity measures to reduce the debt burden, increasing government expenditure might be unrealistic for several years. The UK government in "2012 autumn statement" states that the ongoing fiscal austerity program would remain through 2018. Therefore, with limited budget for increasing total government spending, it is important for governments to reallocate government spending compositions in alternative areas in order to promote economic growth. With current demographic trends of population aging, governments may find it foreseeable to raise health and social protection expenditure over the next decade. Since at least part of the increasing bill may need to be covered by a reduction in spending in other components, policymakers will need to decide which type of expenditure to reduce while trying to preserve growth. One relevant historical example of spending reallocations is found in western countries after the end of the Cold War. Facing the fall in defence-related outlays, policymakers then needed to consider how to reallocate this so-called 'peace dividend' to other components such as economic infrastructure or social protection to cope with the economic and social challenges of that time (Acosta-Ormaechea and Morozumi, 2013).

In addition to examining the effect of government expenditure compositions on economic growth, the role of different levels of economic development and the size of government expenditure may also have important consequences on this relationship. Figure 1 display the average economic growth rate for 37 high-income, 22 low to middle-income and mixed sample of 59 economies from 1993 to 2012. The average growth rate of low to middle-income economies was lower than high-income countries for the period 1993 to 2001 as most of the low to middle-income countries are Asian and experienced financial crisis in 1997-1998. However, the growth rate of these economies has improved and been higher than high-income economies during 2002 to 2012, especially after high-income economies suffered the global financial crisis in 2007-2008.

Figure 1.1: Economic growth rate (GDP per capita, %) for high-income economies, low to middle-income economies and mixed sample economies (1993-2012)

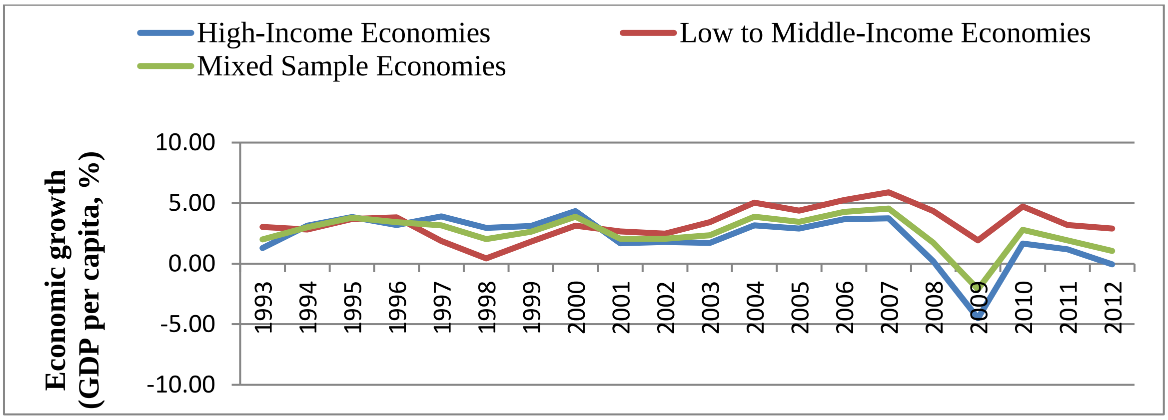
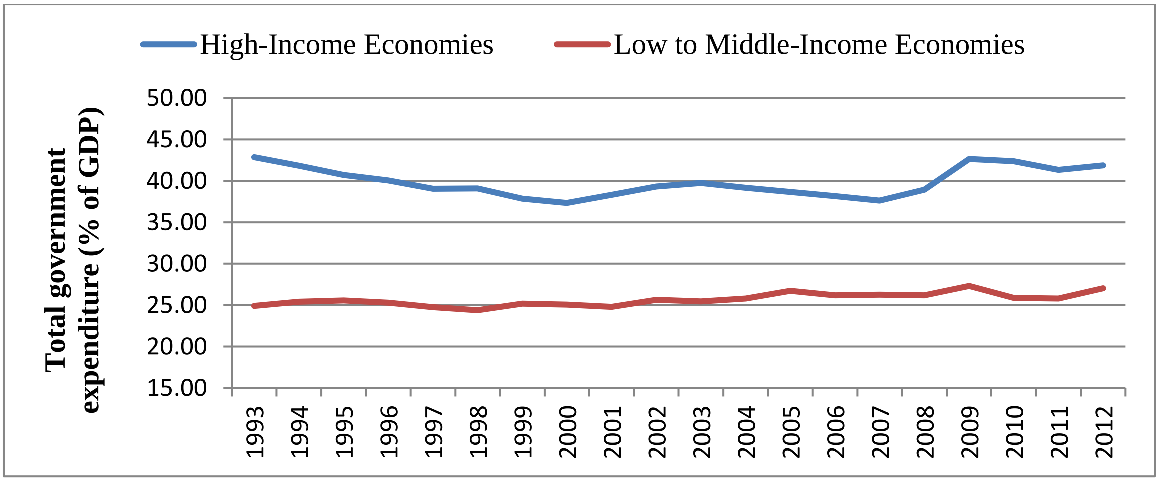
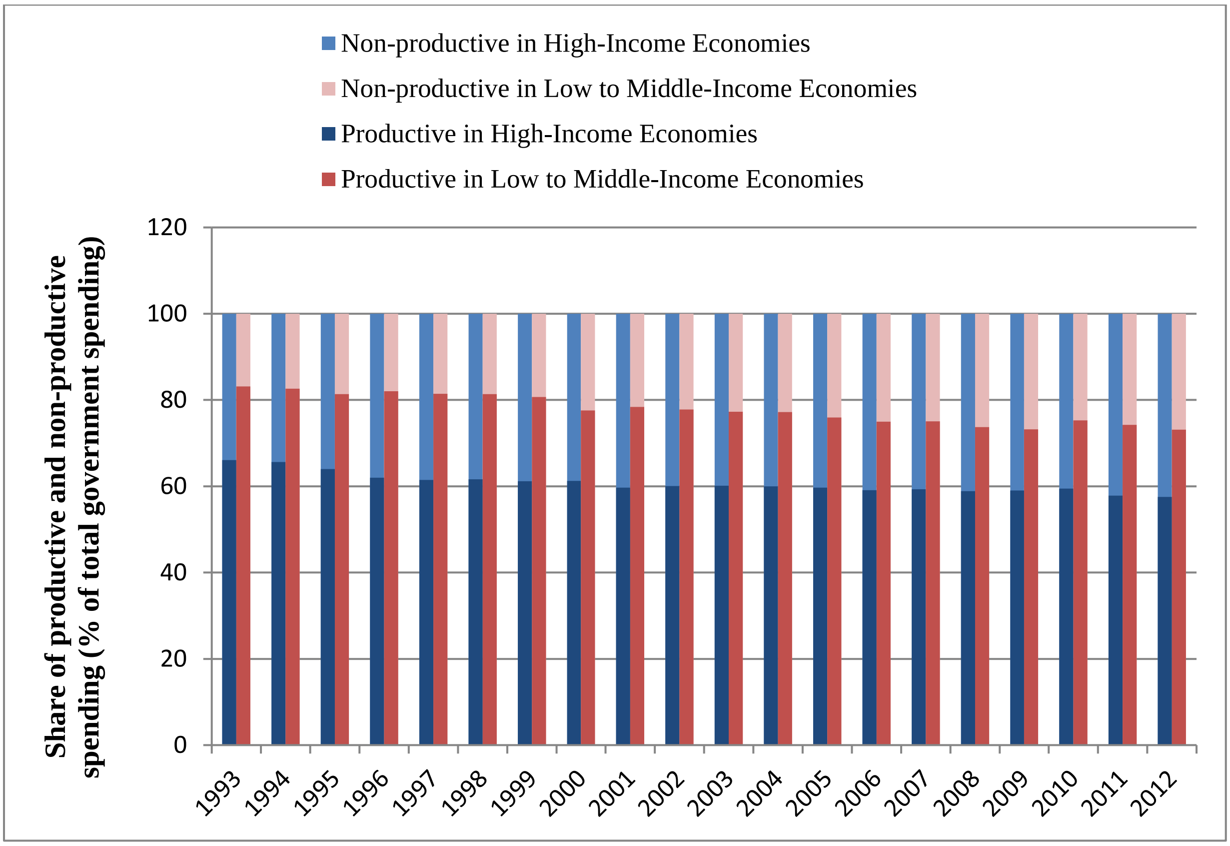


Figure 1.2: Total government expenditure (% of GDP) for high-income economies and low to middle-income economies (1993-2012)



Meanwhile, figure 2 shows that high-income economies have bigger size of government expenditure than low to middle-income economies during this period, which accounts for approximately 39% and 26% of total GDP respectively. Despite the decreased average growth rate from 2007 to 2012 due to global financial crisis, the high-income and low to middle-income economies have still kept or increased total government spending as a percentage of GDP. In response to the financial slowdown and its impact on the economy, the government plays a key role by reallocating government spending and thereby alter the compositions of budgetary spending in alternative areas in order to boost economic growth. With so much spending going in this area, it becomes important for the policymakers to review which compositions of government expenditure are actually promoting economic growth.

Figure 1.3: Productive government expenditure and Non-productive government expenditure for high-income economies and low to middle-income economies (1993-2012)



Again, understanding how best to allocate scarce public resources between various productive or growth-enhancing components of expenditure and non-productive components is not just an issue for policymaker but also for economic researchers. Pushak et al. (2007) indicated that while small governments tend to focus spending on the provision of key public goods (defence and infrastructure) and efficiency-improving services (education and health care), large governments are likely to spend more on ”un-productive” core government functions, such as: social transfer and subsidies that are not conducive to growth. Figure 3 displays evidence of this feature. Low to middle-income countries spend over 78% of government spending on productive spending such as infrastructure, health, defence and education, to help boost economic growth and catch up with the development of high-income countries who spend approximately 61% of total government expenditure on productive components for the period 1993 to 2012. Meanwhile, high-income countries use roughly 39% of total expenditure on non-productive spending, compared to 22% in low to middle-income countries. With limited resources, governments must choose what services need to be provided in priority, whether it is to maximise the rate of economic growth or individual welfare (Agenor and Neanidis, 2011).

It can be seen that there are differences in allocating government expenditure compositions between high-income and low to middle-income economies during the period 1993 to 2012. With these differences, it is meaningful to ask the following question: how does the growth effect of changing government expenditure compositions depend on the stage of economic development? In addition, most previous studies use a mixed sample of high-income and low to middle-income countries, or examine exclusively high-income or low to middle-income countries only (Kneller et al., 1999; Bleaney et al., 2001; Gupta et al., 2005; Ghosh and Gregoriou, 2008; Afonso and Alegre, 2011; Christie, 2012; Gemmell et al., 2016). Accordingly, there remains little understanding of the process by which public spending compositions shape the prospect of economic growth for high-income vis-à-vis low to middle-income countries. The first contribution of this thesis is to bridge this gap in the existing literature.

While the theory linking the growth effects of government expenditure compositions in which classify into two groups: productive and non-productive government expenditure appears reasonably clear (Barro, 1990; Devarajan et al., 1996; Kneller, 1998; and Kneller et al., 1999), the results from related empirical research are not, especially when distinguishing between the effects of changes in the absolute level of government expenditure and changes in relative amount of these categories expenditure. In term of absolute levels of expenditure compositions (as a share in GDP), empirical results have consistently reported a positive relationship between productive government expenditure and economic growth, and either a negative or no-impact relationship between non-productive expenditure and economic growth for high-income economies. However, findings on the relationship between the level of public spending and economic growth in low to middle-income economies are mixed. It is surprising that relatively little attention has been given to comparing and contrasting the impact of the relative division of total expenditure between productive and non-productive uses on economic growth in countries at different stages of development. Therefore, the second contribution of this thesis is that it focuses exclusively on examining the effect of the composition of public expenditure as a proportion of total expenditure on long-run economic growth. The main added value of the analysis is to show that changing the absolute value of government expenditure (as a percentage of GDP) has a crowding out effect and thus negative/neutral impact on economic growth. In addition, by shifting the mix of public spending away from non-productive forms of expenditure and towards productive forms, countries can move closer to a more optimum growth level. This key distinction has been emphasised throughout this thesis.

In evaluating fiscal policy effects on economic growth, the empirical methodology proposed by Kneller et al., (1999); Bleaney et al., (2001); Bose et al., (2007); Ghosh and Gregoriou, (2007) and Gemmell et al., (2016) have suggested that it should ideally take into account both the sources and the uses of funds. These studies recognised the fact that the growth effect of public expenditure depend not only the volume and composition of the public spending but also on how these expenditures are financed. An empirical does not incorporate the government budget constraint in full into the analysis could have biased results in their parameter estimates (Kneller et al., 1999; and Ghosh and Gregoriou, 2007). From this empirical standpoint, this thesis contributes to a growing debate on effects of government spending compositions on growth by including variables on the revenue side of the government budget more fully, e.g., tax revenue, non-tax revenue and budget surplus or deficit variables. This will enable the thesis to compare with the previous studies which are heterogeneous in terms of results when consider the overall budget constraint. The results find strong support that countries should not increase revenue by tax or non-tax means to have a greater government budget surplus (which enhances economic growth), as this increase would have a negative impact on economic growth.

Tanzi and Davoodi (1997), and Ghosh and Gregoriou (2008) suggest that a possible reason for misallocating government funds towards non-productive spending was attributed to the possible presence of corruption that generally affects government expenditure compositions. The literature finds that corruption either may facilitate economic growth by helping firms circumvent the burden of the public sector or may hinder it by increasing this burden and reducing the efficiency of government expenditure that contributes to productivity and growth (Huntington, 1968; Lui, 1985; Mauro, 1995; Knack and Keefer, 1997; Colombatto, 2003; Paul, 2010; Ugur, 2014 and Huang, 2016). The literature highlights that whether the positive or negative impact dominates rely on the size of the public sector, the structure of government expenditure, and the level of economic development; as these factors play an important role in corruption outcomes (Dzhumashev, 2014). However, there are some inconsistencies and gaps in the literature in explaining the dependence of the corruption growth nexus on these factors, which need a further research. This thesis addressed these gaps by capturing corruption in terms of a parameter that potentially reduces the productivity of government spending in the analytical model. As this thesis has considered two types of government spending and corruption could impact on these two to differing extents, the thesis can examine the effect of corruption on growth via the composition of government expenditure and provide insights on the role that different levels of economic development play in moderating the level of corruption impact.

The next contribution is that this thesis investigates the growth effect of government expenditure on human capital and its components on economic growth. Since human capital investments are essential for the accumulation of human capital and human capital has been underlined as the key engine of growth in endogenous growth theory, the empirical evidence about their growth impacts is mixed and inconclusive (Barro, 1990; Mankiw et al., 1992; Barro and Lee, 1993; Perotti, 1996; Bassanini and Scarpetta, 2001; Prichett, 2001; Baldacci et al., 2004; Miyakoshi et al., 2010; and Dalic, 2013). Besides, although health has been identified as another vital element of human capital, literature has often paid much attention on education impact on economic growth. This thesis is to bridge this gap in the existing literature of human capital and economic growth. It also contributes to shedding some light on examination the effect of government expenditure on education and health on economic growth in ASEAN countries in which there is a limited research that has been focused on so far. ASEAN countries are now the emerging economies of the world, the third largest market next to China and India and also have a substantial influence on world economy. Due to the growing economic activities of this area, the development of education sector, health system and their contributions to the economic development is crucial. Therefore, it is interesting to seek an answer to the question: how government expenditure on education and health affect economic growth in ASEAN countries compared with OECD countries.

Previous efforts to examine the relationship between government expenditure and economic growth have been affected by limitations in data availability and sensitiveness of the results to small variations in the model specification (Barro, 1990; Easterly and Rebelo, 1993). Recently, data quality has improved and the large numbers of empirical research have provided valuable information about the variables that should be included in economic growth model (Devarajan et al., 1996; Bose et al., 2003; Ghosh and Gregoriou, 2008; Gemmell et al., 2016). However, there remains a need for more research to address two specific limitations that persist in current economic growth regressions: the selection of estimation method and the consequences of relying on the period-averaging process to capture long-term growth rates (Bleaney et al. 2001; Kneller et al. 1999). The effects of government expenditure can be adequately captured by the OLS fixed effects method. Nonetheless, with the introduction of GMM technique by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998), it can be argued that this technique captures the endogeneity aspects of the model better given the cross-country heterogeneity in the data. In addition, the association of economic growth to fiscal variables has been traditionally estimated under the form of static model in which the use of variables expressed in long-frequency periods accounts for the long-term relationship. However, some studies found the sensitivity of the results due to averaging process of variables (Levine and Renelt, 1992; Kneller et al., 1999; Afonso and Alegre, 2011). The reason for these sensitive results may be due to the absence of automatic stabilisers in different levels of economic developments and the impact of some categories of public expenditure on growth distributed across several periods. Although there are several studies that are very similar in terms of the method estimated and the dataset used, previous studies are extremely heterogeneous in terms of results. For this reason, the contribution of this thesis is useful is terms of shedding some light on the fragility of the results to alterations of the model and the methodology used.

The above discussed contributions for this thesis spurred some research objectives in the areas of government expenditure, human capital, corruption and economic growth.

- Determine the different effects on economic growth rate of size and structure of productive and non-productive government spending in the presence of the revenue side of government budget constraint.

- Compare and contrast the impact of government expenditure components on economic growth in low to middle and high income countries.
- Determine the influence of widespread corruption presence to economic growth in terms of government spending components.
- Determine the role that differing levels of economic development play in investigating the economic growth effects of corruption via indirect channel, government expenditure compositions.
- Assess the impacts of government expenditure on human capital and its important components (Education and Health) on economic growth.
- Compare and contrast the effects of government expenditure on human capital and its important components (Education and Health) on economic growth in ASEAN and OECD countries.

Based on those contributions and objectives, this thesis consists of three distinct empirical analysis chapters ranging across the relationship between government spending compositions and long-term economic growth. The first chapter deals with the growth effects of government expenditure compositions in which categorise into two groups: productive and non-productive government expenditure. This classification of government expenditure elements has widely been applied in the public policy endogenous growth models such as: Barro (1990), Devarajan et al. (1996), Kneller et al. (1999), Gupta et al. (2005), Ghosh and Gregoriou (2007), Christie (2012), Acosta-Ormaechea and Morozumi (2013), and Gemmell et al. (2016). In the endogenous growth model – one extension of neoclassical growth model, it is believed that policies which encourage factor input accumulation induce faster growth. Barro (1990) and Devarajan et al. (1996) have developed endogenous growth models that fiscal policy can determine both the level of the output path and the long term growth rate. Barro's model (1990) indicated that public spending is discriminated according to whether they are involved in the private production function or not. Productive government expenditures affect private sector productivity and therefore have a direct impact on the rate of growth. Whereas, non-productive spending do not contribute to private production function and thereby do not affect the steady-state growth rate, but have impact on citizens' welfare (including the possibility of zero welfare impact). Devarajan et al. (1996) extended the Barro's model and showed that the long-run growth effects not only depend on the structure of government spending but also their relative budget shares. In regardless of its apparent importance, the impacts of government spending compositions on economic growth have been rarely examined, apart from a few notable exceptions. Barro (1990) was one of the pioneers to investigate the link between public expenditure composition and growth under the endogenous growth literature. His model indicated that when a government increases "utility enhancing" government consumption while reducing "production enhancing" government spending, economic growth rates will decrease despite of the level of total government expenditure. A number of recent researches have modelled the association between government expenditure compositions and economic growth, such as, Blankenau and Simpson (2004), Agenor and Neanidis (2011), Agenor (2008), Agenor (2010) and Agenor (2011). They have investigated various extensions of the Barro/Devarajan models which focus explicitly on particular public spending categories (infrastructure, education and health expenditures) as inputs into private production and their interactions on economic growth. For example, Agenor (2010) stated that a shift from non-productive government expenditure to infrastructure expenditure supports a country move to a steady state of higher growth. While theoretical models linking various components of government expenditure to economic growth appears reasonably clear, their empirical research results are often not specific enough for active policymaking.

Over the past two decades, a substantial volume of empirical research has been directed towards identifying how compositional reallocation in government expenditure affects economic growth. However, this empirical literature varies in terms of data sets and econometric techniques, and often produces conflicting results. For high-income countries, empirical results are consistent in finding a positive effect of productive government expenditure on economic growth, and either a negative or no-impact relationship between non-productive expenditure and economic growth (Barro and Sala-i-Martin, 2006; Bleaney et al., 2001; Kneller et al., 1999 and Gemmel et al., 2016). However, findings on the relationship between the structure of public spending and economic growth in low to middle-income countries are mixed. Gupta et al. (2005) used a panel of 39 low-income countries between 1990 and 2000 and found that productive government spending enhances growth, whilst non-productive expenditure fails to do so. Meanwhile, Ghosh and Gregoriou (2007) and Christie (2012) revealed an inverse relationship between productive government spending as a share of total government spending and real GDP per capita for developing economies. Given these inconsistencies in empirical findings, it is surprising that relatively little attention has been given to comparing and contrasting the impact of government expenditure composition on economic growth in countries at different stages of development. Besides, Adam and Bevan (2005), Bose et al. (2007) and Gemmel et al. (2016) highlight that the need to consider both the sources and the uses of simultaneously for a meaningful evaluation of the impacts of government expenditures on economic growth, e.g. ignoring the implications of the GBC for expenditure-growth regression may bring bias to the estimates of the growth impacts.

The first analysis chapter helps fill in these gaps and thereby makes three distinct contributions to the body of knowledge. Firstly, this analysis examines the growth effects of government expenditure compositions for a panel data of 37 high-income and 22 low to middle-income countries for the period 1993 to 2012, thus providing insights on the role that differing levels of economic development play in moderating the relationship. In both groups of countries, the analysis finds that increased levels of government expenditure has a negative impact on growth, while a change in the expenditure mix towards productive forms of expenditure and away from non-productive forms of expenditure enhances economic growth rate. Secondly, by regressing economic growth on budgetary economic categories, which takes into account variables on the financing side more fully (tax revenue, non-tax revenue and budget deficit variables) and a set of other relevant variables, the first analysis chapter contributes to a growing debate on variations between productive and non-productive forms of government expenditure. The results show that budget deficit variables encourage growth for both sets of countries, while tax revenue and non-tax revenue variables have different effects on growth. Finally, this analysis contributes to overcoming the methodological issues commonly found in similar studies. It computes a 5-year moving average for all variables instead of the traditional 5-year average to smooth over some of the cyclical features of the data. Moreover, based on previous analysis studies and the developments in econometrics theory (Arellano and Bover 1995; Blundell and Bond 1998), this analysis applies a dynamic panel GMM one-step system approach to deal with the issue of growth and fiscal variables not always being strictly exogenous.

The second analysis chapter examines the role of corruption in the effects of government expenditure compositions on long-run economic growth. In theory, many researchers and international organisations state that corruption causes unfavourable effect on long-run economic growth and sustainable development by increasing the production costs, linking with tax evasion, decreasing national and foreign investment, distorting the effectiveness of allocating national resources, increasing inequality and poverty in society, and creating uncertainty in government decision making (Mauro, 1995; Knack and Keefer, 1997; Wei, 1997; Mo, 2001; Pellegrini and Gerlagh, 2004; Meon and Sekkat, 2005; Blackburn et al., 2006; Podobnik et al., 2008; Ugur, 2014, Huang, 2016 and Abdixhiku et al., 2017). Meanwhile, other researchers believe that corruption can make a positive contribution on economic growth as individuals and corporations under certain circumstances may bride policy makers to turn around unfavourable situations caused by existing laws and regulation, which in turn ends up promoting economic efficiency (Leff, 1964; Bayley, 1966; Huntington, 1968; Lui, 1985; Colombatto, 2003; Paul, 2010; Meon and Weill, 2010; and Swaleheen, 2011).

The empirical findings on the relationship between corruption and economic growth are heterogeneous due to different measures of corruption, different estimation methods, country coverage and sample periods (Ugur, 2014). While not denying that corruption may have a positive effect at particular times in specific countries, however the main findings of theoretical and empirical literatures have been that corruption leads to lower growth, weakens both private and public investment spending and inhibits the efficiency of public services (Mauro, 1995; Tanzi, 1995; Jain, 1998; Gupta et al., 2002; Habib and Zurawicki, 2002; Lambsdorff, 2006; Ugur, 2014 and Ben Ali and Sassi, 2016). Furthermore, it is worth noting that the cost of corruption for each country is different, depending on their level of development and on surges in their national incomes. Saha and Gounder (2013)’s study shows that corruption increases at low economic development stage and decreases as nations' achieve higher levels of economic development. A small increase in income at a low economic development stage is not sufficient to reduce corruption; instead it increases opportunities for more corruption. Consequently, as nations' achieve a higher economic development status (i.e. higher income level) corruption declines.

While generally accepting the impact of corruption on economic growth, the literature remains divided on the channels and magnitude of the direct and indirect effects. One channel that has received limited attention in current literature is government expenditure. Mauro (1996, 1998) represented the first cross-country evidence that corruption has an effect on the composition of government spending. In his conclusion, corruption misleads government spending away from high-productivity areas, such as education and health toward other areas which are less productivity promoting. Similar to Mauro's research, Tanzi and Davoodi (1997) showed that corruption can reduce economic growth by increasing public investment while quality of this investment tends to fall. The authors came to a conclusion that corruption distorts public expenditure to where brides are easiest to collect, implying a diversion of government expenditure compositions towards low-productivity areas at the expense of growth-promoting projects. They also state that corruption can reduce economic growth by lowering government revenue needed to finance productive government expenditure. More recent empirical research has had access to examine the effect of corruption on government expenditure, such as, Delavallade (2006), Hessami (2010), Hashem (2014), Jajkowicz and Drobiszova (2015) and Hague and Kneller (2015). Their conclusions have reached the same point as higher level of corruption distorts the structure of government expenditure in favour of defence and general public service, whereas the proportion of spending on education, health, recreation, culture and religion decrease.

There exists empirical evidence to suggest that corruption associated with a misallocation and misappropriation of government expenditure components, hence has indirect effect on economic growth. Therefore, the second analysis paper examines the effect of corruption on economic growth via the composition of public spending for a panel data of 37 high-income and 20 low to middle-income countries, hence providing insights on the role that different levels of economic development play in moderating the level of corruption impact. In order to take the interdependency between government expenditure compositions, corruption and economic growth we have formulated a system of equations where corruption is modelled analytically as something that reduces the productivity of public spending. The findings show that corruption has impacts on economic growth through government expenditure components, but the effect is rather small. The results suggest that corruption reduces the growth benefits by decreasing share of productive spending component as a proportion of total expenditure in high-income economies, while it helps to lessen the negative impact of non-productive expenditure share in this sub-sample. On the other hand, corruption in low to middle-income countries is good in the context of reducing the share of productive government expenditure, which is extreme high and perhaps above the optimal level in the first analysis chapter, and thus is associated with higher levels of growth.

The third analysis studies the association between government expenditure on human capital and its components and economic growth. In this chapter, I examine the robustness of the empirical results in first and second analyses with respect to some important functional components of productive government expenditure (e.g. education and health) and also some useful information contained in the common structure in a regional context (e.g. ASEAN and OECD countries). It is well known and widely accepted that investment in human capital is important for economic growth and sustainable development. Education and health are two critical indicators of human capital. The growing global focus on the Millennium Development Goals of the United Nation has further emphasised the importance of making tangible progress in key education and health indicators. Theoretical contributions highlight different mechanisms through which human capital has impact on economic growth. First, education and health care spending improve the quality of workforce and positively contribute to the production capacity and thus to the economic growth (Kesikoglu and Ozturk, 2013). Second, in endogenous growth theories, education and health care expenditures play an important role in increasing the innovative capacity of the economy, knowledge of new technologies, products and processes, and therefore has a significant contribution to the sustainable economic growth in long-run (Hanushek and Woessmann, 2008).

While there is strong theoretical support for a vital role of human capital in the growth process, empirical evidence is not straightforward to policymakers. There are some empirical studies that show an important positive relationship between human capital and long-run economic growth (Barro, 1990; Mankiw et al., 1992; Barro and Lee, 1993; Bassanini and Scarpetta, 2002; Baldacci et al., 2004; Bose et al., 2007). However, some other studies have found that there is a negative (Prichett, 1996; Bil and Klenow, 2000; and Dalic, 2013) or in some cases insignificant effect (Benhabib and Spiegel, 1994; Perotti, 1996; Miyakoshi et al., 2010). Besides, studies either assess the growth effects of public spending on education or health primarily focus on the impact of the government expenditure on education, while the empirical literature on the effects of government spending on health on growth is relatively thin. In a meta-analysis, Churchill et al. (2015) examines the relationship between economic growth and human capital by using a sample of 306 estimates drawn from 31 primary studies, but only 12 studies focus on health expenditure. Furthermore, even empirical research generally confirm that government expenditure on education boost economic growth (Barro and Lee, 1993; Barro and Sala-i-Martin, 1995; Zhang and Casagrande, 1998; Bose et al. 2007; Baldacci et al., 2008; Neycheva, 2010; Afonso and Jalles, 2013; and Mallick et al., 2016), some studies find the macroeconomic evidence to be unconvincing and inconsistent with the findings at microeconomic level and theoretical on the impact of this public spending (Devarajan et al., 1996; Kelly, 1997; Keller, 2006; Mo, 2007; Ghosh and Gregoriou, 2007; and Miyakoshi et al., 2010). The mixed results from empirical studies are also found on the effects of government expenditure on health on economic growth (Landau, 1997; Miller and Russek, 1997; Singh and Weber, 1997; Bloom and Canning, 2003; Bloom et al., 2004; Gyimah-Brempong and Wilson, 2004; Jamison et al., 2004 and Cooray, 2009; Dao, 2012; Dalic, 2013).

One possible explanation for the inconsistent results on economic growth effects of human capital and its important indicators is the matter of country heterogeneity. The solution for its problem is to estimate single-country regressions. However, while single-country estimates of the parameters of physical capital and human capital can capture the heterogeneity of the individual country structures, they ignore some useful information contained in the common structure in a regional context. A common geographical terrain, similar governance structure and similarities in level of economic development and other similarities in culture and economic indicators should be considered when examine the effects of human capital and its government spending components. Therefore, the third analysis focuses on investigating the association between human capital and its components and economic growth for a panel data of 25 OECD countries and 5 ASEAN countries for the period 1993 to 2012; also examining the impact of corruption from those countries on economic growth via government expenditure on human capital and its indicators. The findings show that an increase in the share of government expenditure on education enhances economic growth for both sets of data. For the association between public expenditure on health and growth, this analysis recognises a negative effect of shifting more public spending on health component in OECD economies, while there is no significant impact of this component in ASEAN countries. With regards to the combined government expenditure on human capital, this analysis observes that there is a positive and significant connection between this expenditure and economic growth in ASEAN economies, but no significant effect in OECD countries.

1.2 Thesis Outline

The remainder of this thesis contains 6 chapters divided in 3 parts. Part A – Theoretical and Methodology approaches, which includes the first three chapters represents the general overview of the thesis on literature reviews on the relationship between economic growth and government expenditure compositions, and methodology for estimating this relationship. Chapter two provides the review of both theoretical and empirical literature on the effects of government expenditure and its components in endogenous growth models. Under the neoclassical growth model, governments are restricted to adopt policies which encourage technological change if they wish to permanently raise growth rate. In the endogenous growth model – one extension of neoclassical growth model, it is believed that policies which encourage factor input accumulation induce faster growth (Kneller, 1998). The endogenous growth model thus offers governments a much broader range of effective policies to choose from. However, the complexity and nature of the debate have yielded no unified conclusion as to which theory best fits the answer in terms of countries seeking positive significant changes in their growth rate. Hence, this PhD research thesis which is based on the foundation of neoclassical theory and its extension – the endogenous growth model will review the models' strength and weaknesses theoretically as well as empirically in order to recommend the most suitable model which can thoroughly depict the relationship between government expenditure components and economic growth.

Chapter three discusses in details the research method employed, sample and data. The construction of the dataset and the differences between the IMF's government finance statistics manual (GFSM) 1986, 2001 and 2014 frameworks will be introduced. These differences explain the reason why time period from 1993 to 2012 was chosen for this PhD thesis. This chapter introduces 10 categories of government expenditure used into productive and non-productive groups based on functional classification of expenditure. The methodology used to analyse the panel data will be presented. The two-way fixed effects which control both time-invariant individual country characteristics and time fixed effect is chosen as the main method of estimation for this thesis. This method addresses an issue that excluding unobservable country-specific effects could lead to serious biases in the econometric estimates, especially when these effects are correlated with other covariates. Besides, GMM dynamic panel estimators developed by Arellano and Bond

(1991), Arellano and Bover (1995) and Blundell and Bond (1998) are using for assessing the robustness of the baseline results. These estimators have advantages of dealing with unobserved country-specific effects and potential endogeneity problems.

In the next three chapters of part B – Selected outputs of empirical analyses, which focus on examining how government spending and governance policies affect economic growth. Chapter four examines the growth effects of government expenditure compositions – productive and non-productive government spending for a panel data of 37 high-income and 22 low to middle-income countries for the period 1993 to 2012, thus providing insights on the role that different levels of economic development play in moderating the relationship. Meanwhile, chapter five investigates the impacts of corruption on economic growth via the compositions of government spending for a panel data of 37 high-income and 20 low to middle-income countries. Chapter six then concentrates on assessing the relationship between human capital and its components and economic growth for 2 groups (ASEAN and OECD). The thesis was concluded with chapter seven of part C - Perspective. Chapter seven discusses a summary of the research objectives, research contributions, possible policy implications, limitations of research, and possible areas of further research.

Chapter Two

Literature Review

As this thesis focuses on the impact of government expenditure on economic growth, this chapter provides the review of both the theoretical and empirical literature on the government spending and economic growth. The literature on the growth effects of corruption and government spending on human capital are discussed in detail in chapter 5 and 6. Therefore, this chapter is divided into two sections: economic growth theories are introduced in section one and government expenditure is inserted into growth models in section two. In section one, the research begins with a brief description of the classical and neoclassical growth model, before moving to the 'AK' model and Romer type one-sector endogenous growth models and conclude by discussing the two-sector endogenous growth models and other growth theories. Section two starts with a discussion of fiscal policy irrelevance in the neoclassical growth model, before describing the impact of government expenditure in a simple one-sector model and then expanding the model to include two-sector endogenous growth models. Section two also examines relevant empirical findings in the area.

2.1 Economic Growth Theories

Classical economists, such as Adam Smith (1776), Thomas Malthus (1798) and David Ricardo (1817) identified many of the basic ingredients in modern theories of economic growth: the basic approaches of competitive behaviour and equilibrium dynamics; the role of diminishing returns and its relation to the accumulation of physical and human capital; and the interplay between per capita income and the growth rate of population. However, from a chronological viewpoint, the classic article of Ramsey (1928) is considered as the starting point for modern growth theory. Ramsey's treatment of household optimisation over time goes far beyond its application to growth theory and his separable utility function is as commonly used today as the Cobb-Douglas production function. Building on Ramsey (1928), Harrod (1939) and Domar (1946) made an effort to integrate Keynesian analysis with elements of economic growth, to which they attempted to apply production functions with little substitutability among the inputs and stated that the rate of economic growth in an economy is dependent on the level of saving and the capital output ratio.

More important contributions to growth theory were those of Solow (1956) and Swan (1956), who developed a model of economic growth utilising the neoclassical form of the production function. Their specification assumes constant returns to scale, diminishing returns to each input, and some positive and smooth elasticity of substitution between the inputs. This production function is combined with a constant-saving-rate rule to generate a simple general-equilibrium model of the economy (Barro and Sala-i-Martin, 2006). After the mid-1980s, research on economic growth experienced resurgence as a result of the concerns about a slowdown in global economic growth (Liu and Premus, 2000), beginning with the studies of Romer (1986) and Lucas (1988). The inspiration for their studies was the determinants of long-run economic growth, which have become a solid pillar for modern economic growth and have proved even more significant than the mechanics of business cycles or the countercyclical effects of fiscal and monetary policies. As a result, the designation of Endogenous growth models was introduced (Agell et al, 1997).

2.1.1 Classical Growth Theories

Classical growth theories refer to studies done by a group of economists in the eighteenth and nineteenth centuries. The generalised classical theory on growth is a combination of the contributions of Adam Smith, David Ricardo and Robert Malthus. These theories described the growth process in terms of rates of technological progress and changes in the population. Technological progress depended on capital accumulation, which would permit increasing mechanisation and greater division of labour (Smith, 1776). Meanwhile, the rate of capital accumulation depended on the level and trend of profits (Higgins, 1968). Even though classical economists did not always agree with each other, their basic approach and framework for growth theories is the same and consist of the production function, technological progress, investment, the determinant of profit, size of labour force and the wage system (Barro and Sala-i-Martin, 2006). They all expressed the same production function in which output depends on the stock of capital, labour force, land and the level of technology. Therefore, the classical theory of economic development may be stated as follow: suppose an expected increase in profits brings about an increase in investment, which adds to the existing stock of capital and to the steady flow of improved techniques. This increase in capital accumulation raises wages and induces accelerated population growth, which causes the demand for food to increase. Food production is raised by employing additional labour and capital. However, diminishing returns to land brings about a rise in labour cost and as a result the price of corn goes up. In turn, rents increase, wages rise, thereby reducing profits. Reduction in profit implies a reduction in investment, retarded technological progress, diminution of wage funds and slowing down of population growth and capital accumulation. When this happens, capital accumulation ceases, population becomes constant and stationary state sets in.

However, there are two main limitations in the classical theory of growth: the role of entrepreneurs in the process of production has not been addressed; and technical progress is assumed to be greatly dependent on savings and investment (Higgins, 1968).

2.1.2 Harrod – Domar Growth Theory

Harrod (1939) and Domar (1946) attempted to integrate Keynesian analysis with elements of economic growth. They used production functions with little substitutability among the inputs to explain changes in the economic growth rate (Barro and Sala-i-Martin, 2006). In their model, the rate of growth of GDP is determined jointly by the net national savings ratio and the national capital-output ratio. The savings ratio has a positive impact on the growth rate of national income in the absence of government (Harrod, 1939; Domar, 1946). The model showed that the savings rate times the marginal product of capital minus the depreciation rate equals the output growth rate. Hence, a nation can increase its economic growth rate by increasing the savings rate, increasing the marginal product of capital or decreasing the depreciation rate (Hochstein, 2006). The model also implies that the more investment an economy uses, the higher growth rate it can generate (Hagemann, 2009). The model suggested that less developed countries do not normally have an adequately high income to enable a sufficient rate of savings to replace exhausted or managed capital goods. Therefore, accumulation of physical-capital stock through investment is low, and this leads to reduce economic progress (Todaro and Smith, 2009).

Since Harrod and Domar wrote their theory during or immediately after the Great Depression, these arguments have received support from many economists. Although these contributions generated a good deal of research at the time, there have been many criticisms of their work and very little of their analysis plays a role in today's thinking (Barro and Sala-i-Martin, 2006). The main limitation to the Harrod and Domar model is the relatively low level of new capital formation in developing and poor economies. The model implies that these countries should seek financial investment in capital from abroad to trigger economic growth, but history has shown that this often causes repayment problems later (Jackson and Pearson, 1998).

2.1.3 Neoclassical Growth Theory

Those limitations in classical growth theories and Harrod-Domar growth models had pushed economists to find the way to improve or supersede them. Neoclassical growth theory developed in the late 1950s and attempted to explain long-run economic growth by looking at capital accumulation, labour or population growth and increases in productivity. This neoclassical methodology and language have introduced some concepts such as aggregate capital stocks, aggregate production functions, and utility functions for representative consumers for modern growth theory later on. Vital contributions to the neoclassical theory model came from the work done by Solow and Swan model (1956) which extended the Harrod-Domar model.

The Solow-Swan growth model is known as an exogenous growth model which puts labour as a factor of production and does not assume fixed capital labour ratio (Helpman, 2010; Reyes, 2011). The central point to their growth model is the production function with some key assumptions on it. Furthermore, by acknowledging a constant-saving-rate rule, the production function (Cobb-Douglas) creates a simple general-equilibrium model in which it is impossible to achieve sustained long-run economic growth and the economy can be stagnated at its zero growth dynamic equilibrium (Savvides and Stengos, 2008).

One important suggestion of the Solow-Swan model is conditional convergence. Their model pointed out that a country with a lower starting level of per capital GDP will have a faster growth rate in the short-run relative to the long-run position. This is due to the assumption of diminishing returns to capital, as economies have a tendency to receive higher output and a higher economic growth rate when they have less short-run capital per worker relative to long-run capital per worker (Barro and Sala-i-Martin, 2006). The reason the convergence is conditional in the Solow-Swan model is that different economies could have a different savings rate, a different growth rate of population and a different position of the production function, which affect the steady-state levels of capital and output per worker. Hence, the concept of conditional convergence in the Solow-Swan model helps explain economic growth across countries and regions (Barro and Sala-i-Martin, 2006; Savvides and Stengos, 2008).

Another important recommendation of the model is identifying the role of technology in the economic growth process. Increasing the amount of any input quickly does not lead to increased growth in output in the long run due to diminishing returns in the accumulation of inputs. As adding an additional unit of an input increases output, but by less than the previous unit, then per capita output stops growing and becomes stagnant (Savvides and Stengos, 2008). By continuing an improvement in technology, the model can allow accumulating production function inputs over time and thus the positive rates of per capita growth can persist for long term and these growth rates have no clear tendency to decline. Technical progress offsets the diminishing returns to capital investment that would otherwise limit growth (Liu and Premus, 2000; Petrakos et al, 2007). However, the obvious limitation in Solow-Swan growth model is that the long-run per capita growth rate depends on exogenous elements – the rate of technological progress and population growth (Barro and Sala-i-Martin, 2006 and Acemoglu, 2009). Moreover, the Solow-Swan model does not explain the determinants of long-run per capita growth (Acemoglu, 2009; Barro and Sala-i-Martin, 2006; Snowdon, 2009). (The Solow-Swan growth equation is expressed in Appendix A).

2.1.4 Endogenous Growth Theories

Developments in endogenous growth theories have been motivated by theorists dissatisfied with common accounts of exogenous factors determining long-run growth. The initial wave of new research built on the work of Arrow (1962), Sidrauski (1967), and Uzawa (1965). In endogenous growth models, a constant positive rate of steady state growth is possible in the nonexistence of labour and technology growth. In the one-sector models this arises by preventing the private returns to capital from falling towards zero over time; whereas in the two-sector models this is attained through the separate endogenous accumulation of human capital. By introducing human capital as a component of capital goods, which does not exhibit diminishing returns, the growth rate of capital and output is prevented from falling to zero. Furthermore, technological change resulting from purposive R&D activity has a significant impact on the growth framework

(Romer, 1987; Aghion and Howitt, 1992; and Grossman and Helpman, 1991). The growth rate can be positive in the long run if the economy does not tend to reduce innovation. The following section will introduce a brief description of the endogenous growth models.

2.1.4.1 AK Endogenous Growth Models

One way to construct a theory to surpass the problem of exogenous model is to eliminate the long-run tendency for capital to experience diminishing returns. The AK model (Jones and Manuelli, 1990), which is the simplest endogenous growth model, gives a constant positive steady state growth rate of output. The constant positive growth rate is an assumption rather than a result of the model. There are constant returns to capital and therefore the rate of interest and the growth rate are also constant in the steady state. The violation of the Inada condition of diminishing marginal returns to capital is vital for this result1. In the AK model, technology is considered so that the returns to capital diminish but asymptotically approached a positive constant. It has been assumed for simplicity that the supply of labour is constant and therefore can be taken out of the production function. The capital term is generally understood as including both physical and human capital as a means of justifying the assumption of constant returns.

The simplest form of production function with non-diminishing return is (Jones and Manuelli, 1990):

$$Y = F(K) = AK \tag{1.1}$$

---

1 The Inada conditions of production function is that the marginal product of capital or labour approaches infinity as capital or labour goes to 0 and approach 0 as capital or labour goes to infinity:

$$\lim_{K\to 0}\left(\frac{\partial F}{\partial K}\right) = \lim_{L\to 0}\left(\frac{\partial F}{\partial L}\right) = \infty$$

$$\lim_{K\to \infty}\left(\frac{\partial F}{\partial K}\right) = \lim_{L\to \infty}\left(\frac{\partial F}{\partial L}\right) = 0$$

Where A is a positive constant that reflects the level of the technology. K is capital (including physical and human capital). Assuming that output per capita is determined by the constant $A > 0$

$$y = f(k) = \ Ak \qquad (1.2)$$

where k is capital per worker, and y is output or income per worker.

By substituting $\frac{f(k)}{k} = A$ in equation of transitional dynamics of Solow-Swan model (Appendix A, equation 1.9).

$$\gamma_K = \ \frac{\dot{k}}{k} = \frac{sf(k)}{k} - (n + g + \delta)\frac{k}{k} \qquad (1.3)$$

where n and g are the rate of population growth and the rate of labour augmenting technological progress. δ is the constant depreciation rate of capital. The number of effective units of labour grow at the rate $(n + g)$. The term $(n + g + \delta)\frac{k}{k}$ is the break-even investment.

They return here to the case of zero technological progress, g = 0, because it can be showed that per capita growth can occur in the long-run even without exogenous technological change.

$$\gamma_K = sA - (n + \delta) \qquad (1.4)$$

The net marginal product of capital $\frac{\delta Y}{\delta K} = A - \ \delta$, can be substituted for the interest rate in the consumption growth equation to yield the consumption growth equation,

$$\gamma_c = \ \frac{1}{\sigma}[A - \ \delta - n - p] \qquad (1.5)$$

where p is the constant rate of time preference, σ is the rate at which households are willing to substitute consumption across time.

It can be seen that the steady state of growth rate is then a positive constant value when$A > (\delta + n + p)$. The growth rate of consumption therefore does not depend on the capital stock in this model, which results in permanent differences in growth rates across countries. Fiscal policies have impact on the steady state growth rate in AK model due to their influences to shift the technology parameter A. Thus, the AK model presents a dramatically different picture of growth, and one in which the link between government actions and growth is much more obvious than in the Solow model (Barro and Sala-i-Martin, 2006).

The preceding model showed that AK models cannot be dismissed as easily as one might first have thought. There are still some reasons to doubt the predictions about long-run growth generated by this model. There are some non-accumulated factors in the real world, such as land, that cannot simply be accumulated indefinitely such as energy. Other reason is the treatment of human capital. The strict parallel between human capital and physical capital in the model is probably not completely accurate. For instance, not all expenditures on education will produce the same effect on output. Thus, there may be limits to which one can increase growth just by boosting educational enrolment (Helpman, 2010; Savvides and Stengos, 2008).

In conclusion, the AK approach may overestimate the effect of savings rates on long-run growth rates, despite them having larger level effects than in the basic Solow model. Also, while the AK models may be wrong about there being no “convergence dynamics” towards a steady-state level of output, these dynamics may be slower than the Solow model predicts (Barro and Sala-i-Martin, 2006).

2.1.4.2 Romer-type Endogenous Growth Model

There are some forms of externality to the accumulation capital, which can lead to constant returns to capital at the aggregate level. It can be seen that in Romer model (1986), the accumulation of capital can rise by the stock of generally available knowledge, which is known as learning-by-doing. Romer mentioned that aggregate knowledge is a non-rival and non-excludable input for all firms’ production function and it is offered to all at a zero cost. Knowledge accumulation and thus growth is believed as endogenous to the economy, however it is assumed by each individual firm to be exogenously determined due to the influence of its own investment being small (Kneller, 1998). This assumption is vital to allow the model to retain the assumption of perfect competition at the firm level. By using Cobb-Douglas functional form, the production function for the individual firm in which no growth in the labour input and removing it from the production function for simplicity is assumed, is given:

$$Y_i = AK_i^{\alpha} K^{1-\alpha} \tag{1.6}$$

where $0 < \alpha < 1$ is the elasticity of output with respect to capital for individual firm. The diminishing marginal return still happens to physical capital but constant returns apply across physical capital and knowledge. This assumption of constant returns to scale across physical capital and knowledge is important as we aggregate all firms to arrive back at an AK type of production function, $Y = AK$. It can be seen that the marginal product of capital is constant and therefore a sustainable positive constant growth rate in the steady state of an economy can be gained (Acemoglu, 2009 and Barro and Sala-i-Martin, 2006).

2.1.4.3 Two-sector Endogenous Growth Models (Role of Human Capital)

Long-term per capita growth without exogenous technological progress can be achieved if the returns to capital are constant. It has been widely argued that the absence of diminishing returns might apply as a broad view of capital which includes both human and physical capital. This section will outline models that separate the role of physical and human capital on economic growth. The amount of human capital investment is expressed by utility-maximising households and is produced using alternative technology to that of consumption goods.

Following Rebelo (1991) and using a setup with two Cobb-Douglas production functions:

$$Y = C + \dot{K} + \delta K = A(vK)^{\alpha}(uH)^{1-\alpha} \tag{1.7}$$

$$\dot{H} + \delta H = B[(1 - v) \times K]^{\eta}[(1 - u) \times H]^{1-\eta} \tag{1.8}$$

where Y is the output of goods (consumables and gross investment in physical capital); A, B > 0 are technological parameters; α ($0 \leq \alpha \leq 1$) and η ($0 \leq \eta \leq 1$) are the shares of physical capital in the outputs of each sector; ν ($0 \leq \nu \leq 1$) and μ ($0 \leq \mu \leq 1$) are the fraction of physical and human capital used in production function respectively. $(1 - \nu)$ and $(1 - \mu)$ are the fraction of physical and human capital used in education in order to generate human capital. As $\alpha \neq \eta$, equation 1.8 indicates that human capital is produced from a technology that differs from that for goods. Both equations use a setup of Cobb-Douglas production functions which each describe a constant return to scale in the quantities of the two capital inputs. Therefore, the model will exhibit endogenous steady-state growth of AK type that presented in section 4.1.1 (indeed in the steady-state C, K, H and Y all grow at a common rate) (Acemoglu, 2009 and Barro and Sala-i-Martin, 2006).

If the utility function is maximised in the usual way, it presents a time path of consumption that looks similar to those described in different sections above,

$$\gamma_C = \frac{1}{\sigma}[A\left(\frac{uH}{vK}\right)^{(1-\alpha)} - \delta - \rho] \qquad (1.9)$$

Since H and K grow at identical rates in the steady-state then the marginal product of physical capital is constant and the economy presents a sustainable rate of growth.

The inclusion of fiscal policy is not necessary to endogenise the growth rate in these two-sector models. Even if fiscal policy performs the same function as in the Romer model, there are problems of how to model increasing return to scale in a dynamic optimisation framework and retain the assumption of perfect competition. One possible means of overcoming this problem is to restrict the form of government expenditures such that they amount to one-off shifts in the level of technology through the parameters A and B. This behaves in the same way as in the one-sector AK models.

There are some other models of endogenous growth and other growth theories, such as the role of non-economic (socio-cultural factors, demography and geographical factors), management and organisation, and institution framework factors. However, in the scope of this thesis, this research does not focus further on them.

2.1.5 Conclusion

As the literature suggests, there have been a lot of theoretical research on the determinants of economic growth. However, the complexity and nature of the debate has generated no unified conclusion as to which theory best fits in terms of countries seeking positive significant changes in their growth rates. Diminishing returns to capital investment in the neoclassical growth model means firms find it profitable to invest only when technology in the economy improves. On the other hand, in the endogenous growth model, output is not limited by diminishing returns and grows as fast as firms invest in the factors of production. These different theories on the causes of growth have therefore had diverse implications for government policy. Under the neoclassical growth model, governments are restricted to adopting policies that encourage technological change if they wish to permanently raise growth rates. In the endogenous growth model, in contrast, policies which encourage factor input accumulation induce faster growth. Therefore, the endogenous growth model offers governments a much broader range of effective policies to choose from. The next part of this chapter considers the role of government expenditure in economic growth models in both theoretical and empirical research.

2.2 Government Expenditures in Models of Economic Growth

In the previous chapter it was said that governments can boost economic growth rates if they can bring goods and services to private sectors in which there would otherwise be sub-optimal investment. Under the neoclassical model, taxation and government expenditure may affect the incentive to invest in human and physical capital, but in the long-run these affect only the equilibrium factor ratios, not the growth rate, although in general there will be transitional growth effects. Meanwhile, the endogenous growth model predicts that taxation and government expenditure will influence the long-run growth rate. Within this part, this thesis will focus solely on reviewing government expenditures side, which is assumed to be financed using lump-sum tax in order to recognise the differences of government spending between neoclassical and endogenous growth models. A lump-sum tax are favoured for building an economic growth framework as it has no effect on household or firm's decisions (saving and investment) and thus will not change the effects of expenditures on growth. Policy enters both models in an identical manner, so the differences in the results rest not on the behaviour of fiscal policy, but instead of on the treatment of capital in the production function (Kneller, 1998). In addition, the categorisation of government expenditure has a different impact on economic growth. Expenditure that is labelled productive results in government goods and services that complement private sector production. Meanwhile, expenditure labelled as non-productive includes much of government consumption that enters into the household's utility function. In this part, the research reviews the characteristics of expenditures and their role in economic growth models. In the neoclassical growth model, the distinction between productive and non-productive types of spending is unnecessary as no type of expenditure determines the steady state level of growth (results are reviewed in section 2.2.2). The endogenous growth models discussed in this chapter start from an 'AK' form, before moving to multiple forms of productive government expenditure in section 2.2.3. This section adds government expenditure to a two-sector endogenous growth model where growth is achieved through the separate accumulation of human capital. Finally, section 2.2.4 provides the review of the empirical literature.

2.2.1 Characteristics of Government Expenditure

One issue that concerns researchers when they study public spending in endogenous growth models is whether fiscal policy fits into either the production or consumption sectors of the model. Only productive expenditures that are included in the production sector as a complementary to private sector production can have a direct effect on growth (Barro, 1990). Meanwhile, non-productive expenditures which include much of government consumption are assumed to be perfect substitutes for private consumption and therefore modelled as additional inputs to the household utility function. The non-productive expenditures have no effect on the saving and investment decision due to the assumed nature of the preference function (Kneller, 1998). A large proportion of government spending could be thought of as increasing or decreasing the production of output in the economy, but it is possible that only a few of them affect output growth in a homogeneous manner. By using Barro (1990)'s model, the relationship between government expenditures and the growth of output can be discussed widely under two types; i) changes in the manner by which spending affects the production of output (spending that encourages the accumulation of additional reproducible factors); and ii) changes to characteristics of the productive spending term.

Barro (1990) and Kneller (1998) assume that all productive expenditures are complementary to private production and can be modelled as additional inputs to the firm's production function. Government expenditures are expected to encourage growth by correcting the market failure caused by the public good nature of some types of capital, as they will reallocate the stock of available resources. This assumption obviously limits the role of expenditure policies, and ignores expenditures that have an indirect effect on production via investment or human capital accumulation for instance, such as public sector R&D or health expenditures. Barro and Sala-i-Martin (2006) developed the idea of these productive expenditures and modelled them as increasing the possibility of maintaining ownership of output, as in the protection of property rights and then the investment decision. The underlying transmission mechanism is altered in these models, but it has no consequence for the way public goods behave in the steady state.

Barro (1990) assumed that all public spending are productive government expenditure as flows of goods into the production function. This characteristic of productive expenditure may not be correct in every case, as some forms of productive expenditures, for example transport infrastructure may be thought of as a stock of public capital. Therefore, the difference between flows and stocks of public goods make very little contribution to the model in term of classifying productive and non-productive spending. Other assumption on productive expenditure which has been given by Barro is that productive public spending is homogeneous in its impact on production. The marginal benefits of different expenditure categories are identical; therefore they can be aggregated into a single term. In reality it is unlikely that the impact of one unit increase in health expenditure on the rate of growth is the same as to that of education expenditure, and this is proved by empirical evidence (Devarajan et al. 1996). Hence, removing this assumption and allowing multiple forms of productive goods within the same production function adds to the set of results, through the probability of growth influences from the mix as well as the level of expenditure.

To sum up, this thesis classifies productive government spending as the spending influence private sector productivity and hence has a direct impact on economic growth. Meanwhile non-productive expenditures, which normally have effect on citizens' welfare, are likely to have a zero or negative growth impact. There are some characteristics of productive expenditure which has been considered by Barro (1990) and Kneller (1998) such as, flows of public capital, homogeneous and subject to rivalry and excludability; however given that the interest of the thesis is in the empirical analysis rather than theoretical model building this is not a model this thesis explores in any great depth.

2.2.2 Policy Ineffectiveness

Growth models regarding the effect of fiscal policy mainly come in two main forms, Neoclassical and Endogenous. In what follows, it begins with a discussion of policy irrelevance in the neoclassical model, before describing a simple one-sector endogenous growth model. Once it has discussed some of the developments in this basic one sector model, this thesis will move to public policy in two-sector endogenous growth model. To demonstrate the distinction between neoclassical and endogenous growth models clearly, it involves fiscal policy in an identical manner to the Barro (1990) endogenous growth model. It is assumed that the rate of growth of the labour force and labour-augmenting technological change are zero.

The production function is written in a Cobb-Douglas form, with constant returns to scale in capital and labour for simplicity. The term G_Y is used to denote productive government expenditures. Productive expenditures are described as non-rival, non-excludable public goods and a flow of goods and services. G_Y is presumed to be produced under an identical technology to that of private goods; to affect production directly; and for all productive goods have a homogeneous effect on output (Barro and Sala-i-Martin, 1992 and Kneller, 1998). The elasticity of output with respect to government spending is given by β, and it is assumed that $0 < \beta < 1$ so that public goods like all inputs in (2.1) are subject to diminishing marginal returns (Barro and Sala-i-Martin, 2006).

$$Y = AK^{\alpha}L^{1-\alpha}G_Y^{\beta} \tag{2.1}$$

Government spending is financed by a lump-sum tax at the rate τ. The reason the lump-sum taxes have been chosen is that they are non-distortionary and therefore have no impact on any part of the models that we consider. The GBC which is assumed to balance at every moment in time is given by:

$$G = \tau \tag{2.2}$$

Where $G = G_Y + G_C$ and G_C denotes as government consumption expenditure

The resource constraint of the economy is given as:

$$Y = C + I + G \tag{2.3}$$

Where C is consumption, I is investment and G is total government spending.

Using $I = \dot{K} + \delta K$ and $G = \tau$ the growth equation of capital can be written as given:

$$\dot{K} = Y - C - \delta K - \tau \tag{2.4}$$

As in previous chapter, household utility is supposed to be a function of private consumption and government consumption expenditure. It further supposes that government consumption expenditure and private consumption are perfect substitutes. Household utility is maximised subject to economy's resource constraint to yield the growth path for consumption as given:

$$\gamma_c = \frac{1}{1-(1-\sigma)(1-\xi)}\left[\alpha AK^{\alpha-1}L^{1-\alpha}G_Y^{\beta} - \delta - \rho\right] \tag{2.5}$$

The interest rate is constant, $\dot{r} = 0$, when the growth rate of the capital stock is equal to the growth of the labour force plus technology and when the growth in government spending is constant. This can be seen in equation 2.5 where the growth rate of consumption is constant when the capital-labour ratio is constant and the level of government expenditure is constant. If it differentiates the production function with respect to time and substitute for the growth of technology, population and government expenditure similar to equation 1.18; it can show that the growth rate of output is also zero, $\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A} + \alpha \frac{\dot{K}}{K} + (1-\alpha)\frac{\dot{L}}{L} + \beta \frac{\dot{G_Y}}{G_Y} = 0$. This happens because of an assumption that the growth of population and technology is zero, $\frac{\dot{A}}{A} = \frac{\dot{L}}{L} = 0$ and differentiating the GBC in (2.2) reveals that the growth of government spending is also zero, $\frac{\dot{G}}{G} = \frac{\dot{\tau}}{\tau} = 0$. Including public goods to aid private production or provide utility to households has no impact on the steady state growth rate in this model. Even if it alters the mix of government expenditures between productive and non-productive expenditures, it has no effect on the steady state growth rate. Hence, firms can find it optimal to invest only to the point at which the capital stock depreciates; therefore there is no growth in the inputs and then output. These results are robust to all changes in the characteristics of productive government expenditures (Kneller, 1998). The role of fiscal policy in the neoclassical model has been well researched even though the fact that it is ineffective in influencing the growth rate.

2.2.3 Endogenous Growth Model – Effective Fiscal Policy

2.2.3.1 AK Endogenous Growth Model

Barro (1990) established one of the first and simplest models of public policy endogenous growth model in the literature. His model uses an identical set of assumptions to the neoclassical model. Production is supposed to be linearly homogenous in capital, so fiscal policy is believed to be effective in this model. Furthermore, the addition of productive government expenditures to a growth model is not adequate in itself to endogenise the growth rate; therefore endogenise growth is expected as an assumption of the model. Endogenous growth is not caused by fiscal policy in the ‘AK’ model as this has been made one of the assumptions through constant returns to capital. The distinction between the results of the neoclassical and endogenous models is based mainly on as mathematical restriction on the assumed nature of production technology (Barro and Sala-i-Martin, 2006).

The production function is given by the ‘AK’ form described in chapter 1 section 2.1.3.1. Now we add government spending as an input into this process. There is a constant return to capital, but increases in public goods are subject to diminishing marginal returns.

$$Y = AKG_Y^{\beta} \qquad\qquad 0 < \beta < 1 \tag{2.6}$$

Household utility is assumed to be a function of private consumption and government consumption expenditure. Utility is maximised in the usual way (Euler's equation) and the steady state growth rate of consumption is as equation:

$$\gamma_C = \frac{1}{1-(1-\sigma)(1-\xi)}\left[AG_Y^{\beta} - \delta - \rho\right] \tag{2.7}$$

The growth rate of consumption is a positive constant because the determinants of the steady state are all constant, as there is no growth in technology and the level of government expenditure. In equilibrium productive government expenditures have a positive impact on the marginal product of capital and then on the growth rate (Kneller, 1998). The steady state growth rate is an increasing function at all sizes of government, but subject to diminishing returns as the slope of the function is given by the elasticity of parameterβ. Government consumption expenditures have little influence on the steady state of consumption, because it does not distort the Euler equation. Cashin (1994) stated that some forms of government consumption have a positive impact on the rate of growth rate and achieved it by modelling government consumption as an input into the production function. Therefore, by altering the mix of total government spending towards productive government spending and away from non-productive spending there should be an increase in the steady state growth rate.

2.2.3.2 Multiple forms of Productive Government Expenditure

Devarajan et al. (1996) and Kneller (1998) developed the Barro (1990) model to allow multiple forms of public goods to enter the aggregate production function. In Kneller (1998), output is produced using Cobb-Douglas production technology and for straightforwardness there are two forms of productive public goods G_{Y1} and G_{Y2}:

$$Y = AKG_{Y1}^{\beta}G_{Y2}^{\lambda} \tag{2.8}$$

This productive government spending allows for a better description of the connection between the rate of growth and government spending, as the elasticity parameters on government spending are no longer constrained to be identical, $\beta \neq \lambda$. The government is supposed to fully finance expenditure, G_{Y1} and G_{Y2}, through lump-sum taxation and to be balanced at every moment in time. Using $G_{Y1} = \emptyset G_Y$ and $G_{Y2} = (1-\emptyset)G_Y$ in equation 2.8 (where $\emptyset$ is the proportion of each spending in the budget) and maximising household utility lead to the following equation for the steady state growth rate of consumption:

$$\gamma_C = \frac{1}{1-(1-\sigma)(1-\xi)}\{A[\emptyset G_Y]^{\beta}[(1-\emptyset)G_Y]^{\lambda} - \delta - \rho\} \quad (2.9)$$

Both forms of government expenditure have an impact on the rate of growth through the marginal production of capital; however their relative influence varies upon the relative productivity of G_{Y1} and G_{Y2}, and their relative budget shares, $\emptyset$ and$(1-\emptyset)$. If G_{Y1}has a greater elasticity value than G_{Y2} $(\lambda < \beta)$ then the rate of growth may still not increase if the expenditure share of G_{Y1} to G_{Y2} is too high. The condition for the mix of productive government expenditures to be at its optimum is:

$$\frac{\emptyset}{1-\emptyset} = \frac{\beta}{\lambda} \quad (2.10)$$

On the other hand, Devarajan et al. (1996) described G_1 and G_2 as either productive or non-productive spending, depending whether the effect on growth from changing the mix of expenditure is either positive or negative. This definition differs with the classification between productive and non-productive used in Kneller (1998) and Kneller et al. (1999).

Devarajan et al. (1996) used a constant elasticity of substitution (CES) production function. The aggregate production function (Y) has three arguments: private capital K, and two types of government expenditures G_1 (productive) and G_2 (non-productive):

$$Y = \left[\alpha K^{-\zeta} + \beta G_1^{-\zeta} + \gamma G_2^{-\zeta}\right]^{-1/\zeta} \quad \alpha > 0;\ \beta,\gamma \geq 0;\ \alpha+\beta+\gamma = 1;\ \zeta \geq -1 \quad (2.11)$$

They assumed that the government finances its expenditure by a flat rate income tax, τ

$$G_1 + G_2 = G = \tau Y \quad (2.12)$$

The share of total government expenditure that is used to two type of government spending,

$$G_1 = \emptyset\tau Y \quad \text{and} \quad G_2 = (1-\emptyset)\tau Y \qquad 0 \leq \emptyset \leq 1 \tag{2.13}$$

With an isoelastic utility function, Devarajan et al. (1996) indicated that the long-run growth rate in this model, λ, given by:

$$\lambda = \frac{\alpha(1-\tau)\{\alpha\tau^{\zeta}/[\tau^{\zeta}-\beta\phi^{-\zeta}-\gamma(1-\phi)^{-\zeta}]\}^{-(1+\zeta)/\zeta}-\rho}{\sigma} \tag{2.14}$$

where σ and ρ are constant that reflect parameters in the utility function.

From equation 2.14, it can be derived a relationship between long-run growth rate, λ, and the share of government spending devoted to G_1:

$$\frac{d\lambda}{d\phi} = \frac{\alpha(1-\tau)(1+\zeta)(\alpha\tau^{\zeta})^{-(1+\zeta)/\zeta}[\beta\phi^{-(1+\zeta)}-\gamma(1-\phi)^{-(1+\zeta)}]}{\sigma[\tau^{\zeta}-\beta\phi^{-\zeta}-\gamma(1-\phi)^{-\zeta}]^{-1/\zeta}} \tag{2.15}$$

From equation 2.15, the government expenditure component g_1 is productive if $d\lambda/d\phi > 0$. Since $\zeta \geq -1$, equation 2.15 indicates that $d\lambda/d\phi > 0$ if:

$$\frac{\emptyset}{1-\emptyset} < (\frac{\beta}{\gamma})^{\theta} \tag{2.16}$$

where $\theta = 1/(1+\zeta)$is the elasticity of substitution

Similar to Kneller (1998), a shift in the compositions of government expenditure to increase the growth rate depends not only on the productivity of these components, but also on the initial share. Hence, an increase in an objectively more productive type of expenditure may not raise the growth rate if its initial share is too high.

In the special case of Cobb-Douglas technology ($\xi = 0\ and\ \theta = 1$), the condition in the equation 2.16 for the two types of government expenditure becomes:

$$\frac{\emptyset}{1-\emptyset} < \frac{\beta}{\gamma} \tag{2.17}$$

It can be seen that if the relative share of government expenditure on the two goods G_1 and G_2 is below their relative output elasticity (β and γ), then a shift in the mix towards G_1 will increase the long-run economic growth rate. Both elasticities may be positive (i.e., both components of government expenditure are complementary with private production and both expenditures are described as being productive in Kneller (1998) model), yet if the above condition holds, relocating resources from G_2 to G_1 will increase the long-run growth rate. However, $\beta > \gamma$ is not sufficient to ensure that increase in favour of G_1 will raise the growth rate; it must be the case that the relative budget shares are below the relative output elasticities.

Assume $\beta > \gamma$ and define $\emptyset^*$ as the critical value above in general case of a CES technology (where $\theta \neq 1$) which an increase in the share of expenditure going to G_1 will not increase the growth rate. Then condition in equation 2.16 becomes

$$\frac{\emptyset^*}{1-\emptyset^*} = \left(\frac{\beta}{\gamma}\right)^{\theta} \quad (2.18)$$

Simple manipulation shows that:

$$\frac{d\emptyset^*}{d\theta} = (1-\emptyset^*)\left(\frac{\beta}{\gamma}\right)^{\theta} ln\left(\frac{\beta}{\gamma}\right) \quad (2.19)$$

Since $\beta > \gamma$ so $d\emptyset^*/d\theta > 0$. $\emptyset^*$ increases as the two components of public spending become more and more substitutable. It is possible that the more substitutable the two components of expenditure are, the more likely that an increase in the share going to the one with the higher coefficient will increase the growth rate. On the other hand, when substitution elasticity is low, shifting the amount toward G_1 may not increase the growth rate even if the initial share is small.

The Devarajan et al. (1996) model described above introduced an important understanding into what makes particular components of government expenditure productive. The outcome depends on the relationship between the coefficient and the actual share in the budget, which determines whether a component is productive or not. However, their model concentrated on the composition of expenditure and disregarded financing issues of government spending, as they assumed that the government finances its expenditure by a flat-rate income tax. Kneller et al. (1999) and Bose et al. (2007) have cautioned that by not taking full account of GBC in growth models, the coefficient estimates tend to be biased. Therefore, when one evaluates the effect of fiscal policy on growth it should ideally take into account both the sources and the uses of funds. This thesis will base on Devarajan et al. model (1996), but also take into account a balance budget as recently theoretical models do.

2.2.3.3 Two-sector Models with Government Expenditure

The productive government expenditure in a two-sector endogenous growth model performs similar way to the one-sector 'AK' model. The two-sector framework models the accumulation of human capital under an alternative technology to private output, and then distinguishes between expenditures which influence human capital accumulation from those which aid private production. The main factor of the steady state is the accumulation of physical and human capital changes in government expenditures, which are similar to changes in the level of technology.

Using the same two-sector model as the model introduced in Section 1.3.3.2, it has added government spending to the model where the production aggregate output and human capital sector are given by the following equations:

$$Y = C + \dot{K} + \delta K + G = A(\emptyset G_Y)^{\beta_1}(vK)^{\alpha}(uH)^{1-\alpha} \qquad (2.20)$$

$$\dot{H} + \delta H = B[(1-\emptyset)G_Y]^{\beta_2}[(1-v)\times K]^{\eta}[(1-u)\times H]^{1-\eta} \qquad (2.21)$$

where β_1 and β_2 are the elasticity parameters of output with respect to public goods and $\emptyset \ and \ (1-\emptyset)$ the budget shares allocated to each public good. Both sectors present constant returns to human and physical capital in production, then for this reason K and H growth at identical constant rates in the steady state.

The steady state growth rate of consumption is as equation: (maximising household utility)

$$\gamma_C = \frac{1}{1-(1-\sigma)(1-\xi)}[A(\emptyset G_Y)^{\beta_1}(\frac{uH}{vK})^{(1-\alpha)} - \delta - \rho] \qquad (2.22)$$

If H and K grow at identical constant rates in the steady state, the marginal product of physical capital is constant and the economy demonstrates a sustainable rate of growth. An increase in public goods in the production sector (a change inG_{Y1}) performs as a once and for all increase in the technology parameter in the private goods sector, A. Meanwhile, an increase in expenditure on public goods in the human capital accumulation sector, G_{Y2} acts like once and for all increase in the technology parameter B. Hence, there are both direct and indirect impacts from changes in spending on public goods (Monteiro and Turnovsky, 2008).

It can be seen that fiscal policy is only effective in endogenous growth models. Furthermore, these theoretical models have not been much different for both developed and developing countries; however, the empirical results are slightly varied. The next section of this literature review pays close attention to the previous empirical studies which present the effects of government expenditure components on economic growth between developed and developing countries.

2.2.4 Review of the Empirical Literature

Endogenous growth models provide a number of possible channels by which government policy can have an impact on the long-run growth rate of a country. There are several empirical research studies examining the relationship between various components of government expenditure and economic growth. These studies vary in terms of data set, econometric technique and quality. One objective of this research is to determine the effects of productive and non-productive government spending on economic growth, so the classification of expenditures into productive and non-productive plays a vital role. Researchers have differentiated between productive and non-productive government expenditure and have shown how a country can increase its economic growth by changing the mix between these alternative forms of expenditure. Kneller et al. (1999) underlined that productive government spending influences private sector productivity and hence has a direct impact on growth, while non-productive expenditure, which normally has an effect on citizens' welfare, is likely to have a zero or negative growth impact. Devarajan et al. (1996) was one of the first to introduce a model that expresses the difference between productive and non-productive expenditures by how a change in the proportion of total expenditure dedicated to either one impacts on long run economic growth. They stated that a country's desire to reach a more optimal growth rate can be achieved by increasing the proportion of total government expenditure dedicated to productive areas. The broader empirical literature on the classification of government expenditure shows a mixed record for the effects of productive and non-productive expenditure on economic growth.

Another objective of this review is to demonstrate how the growth performance of different groups of countries over time was affected by the composition of their public expenditures. Little attention has been given to comparing and contrasting the impact of government expenditure composition on economic growth in countries at different stages of development. Therefore, this section will firstly review previous empirical research on the effects of government compositions on growth, and then revise recent studies on comparing the growth performance of different groups of countries.

2.2.4.1 Productive versus Non-productive Government Expenditure

Landau (1983) used a cross-sectional study of 104 countries for the period 1961 – 1976 and found a negative relationship between the share of government consumption expenditure and the growth rate of real per capita GDP. His definition of government consumption was government spending excluding public investment and transfer. It also found the same results for sub-set sample for high income, upper-middle income and low income economies in his paper. Meanwhile, the negative relationship did not hold for the lower-middle income countries. A positive and significant impact of total investment in education on the growth rate, which would be one component of an economy's defined investment (Barro, 1990), has been realised for all time periods and both the full set and subsets of sample data. However, due to weaknesses in the data availability, the conclusion drawn from the results of this paper may be tentative (Landau, 1983).

Kormendi and Meguire (1985) studied cross-sectional of 47 countries during the post-war period, using data on total government consumption expenditure and other variables from International Financial Statistic. Government consumption measurement was the same as Landau (1983), but included most expenditure on defence and education. Using data for each country averaged over 20-year period, they found that average growth rates or levels of the share of government consumption spending in GDP has no significant impact on average growth rates of real GDP. Grier and Tullock (1989) extended Kormendi and Meguire (1985) empirical model of cross-country growth by using 5-year average for a pooled cross-sectional and time-series data of 115 economies from 1950 to 1981. They stated that government production of basic valuable public goods, such as, roads and property rights, contributed to provide the enabling environment for growth; while government consumption expenditure was again the same as Landau' study (1983). They separated the sample into the 24 OECD countries and other 89 rest of the world countries (ROW), then further divided the ROW by continents to test the validity of a pooled sample. They found a significant negative relationship between the government consumption's share of GDP and the growth rate of real GDP for both sets of countries. This result was not found by Kormendi and Meguire (1985) who used the same variable definition, but a different countries sample and data source. They also indicated that it is inappropriate to pool OECD and ROW countries. Aschauer (1989) stated that government investment expenditure, such as the provision of infrastructure, provides the environment for enhancing economic growth. His research found that investment in core infrastructure (streets, highways, airports, mass transit, and other public capital) increase the private-sector productivity in the US between 1949 and 1985, thereby leading to higher economic growth.

Barro (1991) based on his simple version of economic growth model in 1990 which took government expenditure to be complementary with private production and assumed that all government expenditure is productive in his case. His study introduced some empirical literature on the topic that highlighted the different effects of productive and non-productive expenditure on growth for 98 countries over the period 1960 – 1985. While Kormendi and Meguire (1985) and Grier and Tullock (1989) classified government spending on defence and education as government consumption and hence non-productive, Barro (1991) modelled them as productive. The idea was that these expenditures are likely to affect private-sector productivity or property rights, which matter for private investment. Using a cross-sectional of 98 countries, Barro (1991) showed that an increase in the ratio of government consumption expenditure to GDP is associated with lower growth rate of per capita real GDP. He explained that this non-productive government spending introduced distortions, such as high tax rates, but did not provide an offsetting stimulus to investment and growth. He also found a positive relationship between public investment and economic growth rate. However, it could not explain a weak relationship between government expenditure and growth performances of developing countries in his sample (Sub-Sahara Africa and Latin America).

Easterly and Rebelo (1993) used a set of 119 cross-sectional countries for the period 1970 – 1988 to provide a comprehensive conclusion of the statistical association between measures of fiscal policy and the rate of growth. They found a positive relationship between the share of public investment in transport and communication and economic growth. Besides, general government investment had a positive impact on growth. The government budget surplus was consistently correlated with growth rate and private investment in their cross-section data. However, the association between government expenditure in education and housing, and economic growth was insignificant. They suggested that public spending on infrastructure has a supernormal return, but they needed much more data collection on infrastructure to address the causality from infrastructure to growth and the high magnitude of coefficient on public infrastructure expenditure in their sample.

Devarajan et al. (1996) observed the above empirical studies and was one of the first to express a theoretical framework in which there are two types of government expenditure, productive and non-productive. Their model showed the difference between productive and non-productive government spending in how a change in mix between them affects the long run growth rate. Their empirical analysis was focused exclusively on developing countries. They used a panel data of 43 developing countries from 1970 through 1990 to shed light on the association between the compositions of government spending and long run economic growth. To test whether the share allocated to different components of public spending is related to higher growth, their key explanatory variables were the share of each component in total government expenditure. These components were classified by two main lines of International Monetary Fund's (IMF) Government Financial Statistic (GFS). The first line is based on the economic classification of expenditure in which central government expenditure divides into capital (productive) and current (non-productive) expenditure. The second line is based on the functional classification of expenditure in which components are grouped as expenditures on defence, health, education and transportation and communication. Contrary to expectations, their paper found a positive relationship between a greater share of total government expenditure toward non-productive government expenditure and economic growth, while also reporting a negative relationship between a greater share on productive expenditure and growth. Their empirical analysis also reported that infrastructure and health government expenditures have a negative correlation with per capita real GDP growth. On the other hand, expenditures in defence and education are positive and significant impact on economic growth on 43 developing countries. One limitation of the paper is that they focus exclusively on the expenditure rather than revenue side of the GBC; therefore, their coefficient would tend to be biased (Bose et al., 2007 and Ghosh and Gregorious, 2007).

Kneller et al. (1999) and Bleaney et al. (2001) used a similar sample set of 22 OECD countries during 1970 and 1995 to investigate the effect of fiscal policy on economic growth. Both papers pointed out four problems arising when testing regression of public policy endogenous growth models. Firstly, there may be limited data on government expenditures and revenues, and the definition of particular public expenditure as productive or non-productive or particular taxes as distortionary and non-distortionary can be controversial. The second problem is that economic growth regression equations can easily be biased if the researcher focuses on one side of the budget constraint and ignores the other. The third problem is that whether this is an adequate procedure based on single cross-sectional or panel of five-year averages on the period-averaging process to capture long run economic growth. The final problem is the possibility of endogeneity of regressors in growth equations. They pointed out that the coefficients in growth equations based on cross-section or static panel approaches may be biased if fiscal variables are not strictly exogenous. Kneller et al. (1999) focused on solving the first two of these problems. They found that complete specification of the GBC and careful attention to fiscal classifications gives different results compared with previous empirical literature. They classified government spending according to whether they are participated in the private production function or not. If these expenditures are, they are grouped as productive expenditure, a sum of expenditure on education, health, defence, housing, economic affairs and general public services; hence have a direct impact on economic growth. If these expenditures are not, they are classified as non-productive expenditure; a form of expenditure on social security, welfare and recreation, which do not have an effect on long run growth. Using panel data of 22 OECD countries, Kneller et al. (1999) found that there is a positive relationship between productive government expenditure and economic growth, while non-productive expenditure does not have an impact on the growth rate. Their results also showed that an increase in distortionary taxation significantly reduces economic growth, whilst non-distortionary taxation does not. Budget surplus has a positive and significant impact on the growth rate. Kneller et al. (1999) run robustness test with reclassification of fiscal variables to determine the relationship between fiscal variables with economic growth for developed countries case. They separated public spending based on the functional classification of expenditure similar to Devarajan et al. (1996). Their new government spending variables included: productive flows (expenditure on defence and general public services), productive stocks (expenditure on education, housing and transport and communication), health expenditure, social security and welfare expenditure and other expenditure (expenditure on recreation and economic services). They summarised that the further disaggregation of the budgetary data does not improve the fit of the model.

Bleaney et al. (2001) handled the latter two problems with the same panel data of 22 OECD countries from 1970 to 1995. They focused on answering the questions whether five-year averaged data are enough to capture long run economic growth rate, and whether using static results will be undermined when they allow for dynamic responses and the endogeneity of fiscal policy. Instead of taking five-year averages, they used original annual data with long lags to estimate the model. Their results suggested that the period averaging does not appear to capture full fiscal effects on long run economic growth, but both approaches produce consistent evidence of fiscal effects on growth. They had also tested the robustness of their results to potential endogeneity of the fiscal regressors by comparing the dynamic panel data model with static one. They considered the potential endogeneity between investment and fiscal variables and the growth rate. They found no clear evidence on the endogeneity of investment; while there are some changes in the coefficient magnitude of these fiscal variables, but these do not substantially affect the long-run estimates of the main fiscal variables. They concluded that there is evidence in favour of potential endogeneity of the endogenous growth model.

Other than those discussed above, there are also many studies to estimate the link between government expenditure and economic growth during the period from 1980s to 1990s. It can be seen that most of these studies use a mixed sample of developed and developing countries or developed countries only. Due to the poor data availability and restrictions in relevant estimation methodology techniques, the results from these empirical research studies are not consistent. The findings of these empirical studies are summarised in Table 2.1. With the improving of data quality, the large number of empirical research studies on the determinants of government expenditure compositions effects on growth provides valuable information in the next period (2000s – 2010s).

Bassanini and Scarpetta (2002) pointed out that empirical study, which use a large mixed set of countries to examine the relationship between fiscal policy and growth, present unsatisfied results. Once the research focuses on the OECD sub-sample, the cross-country variability in both fiscal explanatory and growth variables is smaller. By using pooled cross-country time-series of 21 OECD countries over period 1971 – 1998, their empirical results explained both cross-country differences in growth performance as well as the evolution of performance over time in each country. Their study found that the overall size of government in the economy may reach a level which can be harmful for growth. Government consumption expenditure and government investment expenditure in their sample tend to have non-negative impacts on output per capita. Furthermore, government investment spending may affect growth by improving the framework conditions in which private agents operate. Besides, public spending on health, education and research sustain living standard in long term but they have to be financed.

Adam and Bevan (2005) examined the relationship between fiscal deficits and growth for a panel data of 45 non-OECD countries during the period 1970-1999. They grouped total non-interest government spending into two groups. Productive spending defined as spending on health, education, infrastructure, public order and safety (including defence) and public administration; as they believed that all of these have been identified to have positive impact on growth. Meanwhile, residual spending (non-productive) is classified as spending on economic services, recreation and culture, and other miscellaneous expenditure. They mentioned that they could not assume residual expenditure have no impact on growth as some previous research. Furthermore, they noticed the necessary of GBC in examining the relationship between fiscal variables and growth; therefore there are five ways to finance government spending in their models. These include taxes, grants and three forms of deficit finance by printing money and issuing domestic or external debt. Their results found that there is a negative relationship between economic growth and residual expenditure financed by tax and non-tax revenue. However, grant financing of residual expenditure has no significant effect on growth. It can be seen that the impact of non-productive expenditure on economic growth depends on how it is financed. Meanwhile, higher productive expenditure significantly increases average per capita growth in either grant or tax financing. Adam and Bevan also found that a deficit financing increase in residual expenditure reduces the average growth.

Similar to Adam and Bevan (2005), Gupta et al. (2005) tested the effects of fiscal consolidation and government expenditure composition on growth in a panel data of 39 low income countries between 1990 and 2000. To estimate these effects by regressing the annual rate of real per capita GDP growth on a set of regressors, Gupta et al. (2005) used different specification models. One of these models is that fiscal variables are measured as a share of GDP without a variable included on the fiscal balance; this allows them to assess the effects of particular expenditure items. Other model estimated fiscal variables in relation to total spending or total revenues so as they can capture the direct effect of expenditure or revenue compositions on growth, while it included a variable for budget balance at the same time. The empirical results found that reducing selected current (non-productive) expenditure is likely to raise growth rates, while boosting capital (productive) expenditure does the same in low income countries sample. A decrease in the ratio of fiscal deficit to GDP leads to an increase in per capita real GDP growth. They drew attention to presence of endogeneity in the literature on fiscal policy and economic growth. Accounting for the endogeneity of fiscal variables, the robustness test leads to the same effects on the growth as in the baseline regressions. Their empirical result recommended that introducing a dynamic specification does not change the results significantly from baseline regressions, but it improves the results compared to the static model. The study also found that in post-stabilisation countries (sub-sample from their data) an expansion of selected non-productive expenditure may be compatible with higher growth; low budget deficits additional fiscal consolidation may not increase economic growth. Hence, the role of macroeconomic stability is important factor to assess the fiscal policy effects on economic growth.

Park (2006) tested the complex relation between government fiscal policy and economic performance by collecting data from 93 industrial and developing countries between 1990 and 2000. His study found that a productive government spending, a sum of expenditure on education, transport and communication, defence, housing, health and general public services, can have direct positive impacts on the efficiency and growth of private economic sectors. In his model with endogenous fiscal variables, there is a negative relationship between tax rate and productive government expenditure both in the short and long run of OECD sub-sample countries. Therefore, when public spending is productive, the tax rate can be decreased in a socially optimal allocation of OECD countries. The study suggested that the effective implementation of government policy is crucial to economic growth, as weak institution and corruption can reduce the efficiency of government policy.

Bose et al. (2007) examined the impacts of government expenditure by sector on economic growth rate from a set of 30 developing countries using decade averages over period 1970 – 1990. They paid attention to the GBC by including the important financing variables (government budget surplus/deficit and tax revenue) to avoid the biased coefficient that would result from their omission. Their empirical findings were that the share of productive government spending (capital expenditure) has a significant positive impact on economic growth, while the non-productive expenditure (current expenditure) is insignificant correlated with economic growth. At the disaggregated level, government expenditure on education was the only sector that remains significant positive effect on economic growth throughout their analysis. Public spending on other sectors (defence, transport and communication) initially had significant association with growth, but did not persist when they incorporate the GBC into their analysis. They also found that tax revenue has a negative impact (not always significant) on economic growth, and the government deficit has the same highly negative significant effect on growth. They recommended the allocation of scarce government resources from other sectors towards the education sector, or from current to capital expenditure, will enhance growth for at least some developing countries in their sample. Their paper result is consistent with developed country experience.

On the other hand, Ghosh and Gregoriou (2007) attempts to study optimal fiscal policy and concludes a opposite result with Bose et al. (2007) that non-productive rather than productive government expenditure has contributed to economic growth for 15 developing countries over 28 years (1972 – 1999). Like Devarajan et al. (1996), they do not classify government expenditure as being productive and non-productive to start with, they allow the data prove it. Taking into account the possible reverse causality between government expenditure and economic growth, they use a five-year moving average of growth to remove business cycle –type short run fluctuations induced by shifts in government spending. Furthermore, paying attention to GBC, they take into account variables on the financing side more fully (including the government budget deficit/surplus, tax revenue and non-tax revenue). Their empirical results find that tax revenue and non-tax revenue both have significant positive effect on economic growth in 15 developing countries sample. The government deficit/surplus variable turns out to have an insignificant impact on the growth rate. They also run the robustness test with respect to some important functional components of capital expenditure (productive) like education and health expenditure and current expenditure (non-productive) with operations and maintenance expenditure. They observe that the coefficients on both education and health expenditure variables are significant negative, while operations and maintenance expenditure have a significant positive impact on the per capita growth rate. These results seem counter-intuitive from the view of previous expectations. One reason for these differences is that Ghosh and Gregoriou (2007) is that they focus on the growth effect of government expenditure compositions as the share of total government expenditure, similar to Devarajan et al. approach (1996). They also suggest that corruption can contribute to tax evasion and inefficient tax administration, and therefore gave the link between corruption and capital spending on low tax revenue.

Romero-Avila and Strauch (2008) use data for general government expenditure and revenue in all EU member state from 1960 to 2001 to assess the potential impact of fiscal policy on growth. The public capital formation have been counted as productive expenditure, while government consumption includes wage payments, salaries and purchases for the social security system assume to be non-productive expenditure in their sample. By using time series properties of the data, they find public finances provide policy instruments contributing to higher trend growth in the short run. They estimate the relationship between fiscal policies and long run growth rate by using a distributed lag approach and by better controlling for real business cycle effects and reverse causality. The empirical findings are that the expenditure size of the budget seems to have consistently impact on long run growth over the business cycle. Government size and government consumption negatively affect growth, while public investment has a positive effect on growth which reveals the likely gains in economic performance from shifting welfare expenditure to productive investment.

In a panel data set of 15 EU countries over the period 1971 – 2006, Afonso and Alegre (2011) attempt to determine whether a reallocation of government budgetary components has been useful to enhance economic growth. They have suggested that public variables have an impact on economic growth not only through an effect on productivity, but also by altering the conditions in the production factor market, labour and productivity. They estimate a dynamic panel date model with lags of the explanatory variables from which they are able to capture long run relationships. This methodology let them cope with the main problems in current growth regressions: the presence of endogeneity, the dynamic behaviour of the relations and the omitted variables issue. Their empirical results are government consumption and social security contributions expenditures have a negative effect on long run growth, while public investment expenditure has positive impact. The budget deficit has a positive impact on economic growth, even if it is not always statistically significant in their sample.

Christie (2012) uses a panel of 136 countries over the period 1971 – 2005 to analysis the relationship between government size and long run economic growth. The empirical finding is that government size as measured by total government expenditure as a share of GDP has significant negative impact on growth. Productive government expenditure has similar definitions have been used by Adam and Bevan (2005), Bleaney et al. (2001), and Park (2006), as a sum of expenditure on education, health, defence, and transport and communication. The effect of productive government spending on economic growth is similar to the comparable case using total government expenditure. Christie (2012) re-runs the productive spending models using dynamic GMM to account for endogeneity. The results are consistent with the baseline regressions. The study also suggests highly effective governments appear to be able to offset some of the negative impact of large size.

Based on the theoretical and empirical of Afonso and Alegre research (2011), Afonso and Jalles (2014) examine the relationship of fiscal composition and long-term growth using a large panel of 155 developed and developing countries for the period 1970 to 2008. Their empirical findings suggest that government expenditures seem to have significant negative impact on economic growth, while revenues appear to have no impact for full sample. Regarding sectoral decompositions of government expenditure, the results are more robust and consistent across samples and econometric specifications; in particular public wages, interest payments, subsidies and government consumption are found to negatively affect economic growth. Whereas, government expenditure on education and health increases long run economic growth. Expenditures on social security and welfare obstruct growth.

Gemmell et al. (2016) has indicated new evidence for 17 OECD countries on the impact of size and composition of public expenditure on economic growth during period 1972 – 2007. The study is based on an extension of the Kneller et al., (1999), and Bleaney et al., (2001) dataset. Their empirical results find that there is robust long run positive effects on economic growth for government spending on transport and communication, and education, with some evidence supporting positive impacts from expenditure on housing and health; while spending on welfare have negative effects. They cannot find a positive effect from switching expenditure towards defence spending on per capita GDP levels. Their findings also suggest that the assumed form of expenditure financing is crucial, as there is an evidence of negative long run effects on output from deficit-financed increases in total government expenditure.

Despite the fact that the link between government spending compositions (productive and non-productive expenditure) and economic growth has been investigated in the literature, the results from related empirical research are not, especially when distinguishing between the effects of changes in the absolute level of government expenditure and changes in relative amount of productive and non-productive expenditures. In term of absolute levels of expenditure compositions (as a share in GDP), empirical results have consistently reported a positive relationship between productive government expenditure and economic growth, and either a negative or no-impact relationship between non-productive expenditure and economic growth for high-income economies. However, findings on the relationship between the level of public spending and economic growth in low to middle-income economies are mixed. On the other hand, fewer studies have examined the case of effects of the relative division of government expenditure between productive and non-productive uses (as a proportion of total expenditure) on economic growth. It is interesting that studies focused on developing countries have presented a slightly different result to those looking at developed countries. Therefore, in the next section this thesis will review previous empirical research in which examine the impacts of productive and non-productive expenditure on economic growth but in terms of comparing developed to developing countries.

2.2.4.2 Developed versus Developing Countries

Devarajan et al. (1996) was one of the first to have a clear comparison impact of government spending compositions on growth between developed and developing countries. They firstly used a panel data of 43 developing countries from 1970 to 1990 and found that allocating public spending in favour of productive expenditure at the expense of non-productive expenditure have a significant negative impact on economic growth. They subsequently re-tested their regressions with a sample of 21 developed countries for the same period and found that the results are reversed, with shifting towards productive government expenditure encouraging economic growth and non-productive expenditure failing to do so. There are several reasons why productive government expenditure could be more productive in developed countries had been explained by Devarajan et al., (1996). First reason is that an increase in the share going to productive government expenditure components may not raise the growth rate as the initial shares of these are already too much, so this increase is counterproductive. Other reason is due to distortions in the economy. If distortions in developing countries are in smaller desired level of public goods, then an additional spending on these public goods may be non-productive.

Bose et al. (2007) based on a data set over period 1972-1999 for 40 developing countries and 21 OECD countries and generated the results that the growth effect is large and significantly negative in the case of developing countries, while the same coefficient is found to be insignificant for developed countries. Unfortunately, their research focused on the optimal public expenditure financing policy or government revenue side only, hence will not assess this relationship in terms of different level of economic development.

Acosta-Ormaechea and Morozumi (2013) capture the effect of government expenditure allocation on growth using 56 countries (14 low-income, 16 medium-income and 26 high-income countries) for the period from 1970 to 2010. They recognised that the reallocation effects may differ relying on the different development level, thus it would be ideal to run separate regressions for different income levels country groups. They run the regressions without the G20-Advanced countries as they knew that having a smaller sample makes estimation results inaccurate because the number of instruments in their methodology technique become too relative to the number of countries. Their study found that the share of education spending to total spending (productive expenditure) enhances economic growth, particularly when an increase in this spending component is compensated by social protection spending (non-productive expenditure) to the subset of countries with a lesser degree of development. However, this result is not entirely satisfied with their full sample results.

Recently, Afonso and Jalles (2014) use a panel data of 155 countries (OECD and emerging countries) during the period 1970-2008 to assess the fiscal decomposition effects on economic growth. They differentiate the impacts of spending on education, health and social security from the main items of government spending (a share of GDP) to compare these impacts on growth between OECD and emerging sub-groups. In the case of OECD sub-sample, expenditures on social security are less growth enhancing, while spending on both education and health increase long run growth. Meanwhile, only expenditure on education is found to have a positive impact on growth in the emerging economies sub-group.

It can be seen that there are a limited number of studies paying attention to comparing and contrasting the impact of government expenditure compositions on economic growth in countries at different stages of development. The results are opposite between effects of developed and developing economies on long-run economic growth. This provides some gaps in existing empirical research to examine the link between government expenditure compositions and economic growth at different stages of development, especially when distinguishing between the effects of changes in the absolute level of government expenditure and changes in relative amount of those expenditures compositions. Therefore, this thesis is to bridge these gaps in existing empirical research by investigating the growth effects of government expenditure compositions (as relative division of total expenditure), corruption and government expenditure on human capital in the next three empirical chapters (chapter 4,5 and 6).

Furthermore, there have recently been many empirical researches to determine the effects of government expenditure, government expenditure compositions on economic growth. With the improving of data quality, a wide range of methodology techniques, the number of empirical studies has contributed useful information to economic growth effects of fiscal policy fields. These studies now focus more on each group country sample and specific country case study, but the results from those are not consistent, especially when considering low and middle-income economies. The finding of these studies are also summarised in Table 2.1.

Table 2.1: Empirical studies on the relationship between Economic Growth and Government Expenditure

Author	Countries	Years	Econometric method	Length of average	Main results
Landau (1983)	104 countries	1961-1976	Cross-section	16 years	Government consumption expenditure has a negative effect; while a positive impact of total investment in education
Kormendi, Meguire (1985)	47 countries	Post-war	Cross-section	28 years	Government consumption expenditure has no effect
Grier, Tullock (1989)	115 countries	1950-1981	Panel data	5-year	Government consumption expenditure has a negative effect
Aschauer (1989)	US	1949-1985	Time-series	36 years	Investment in core infrastructure leads higher growth
Romer (1990)	90 countries	1960-1985	Cross-section	16 years	Government consumption expenditure has a positive effect
Barro(1991)	98 countries	1960-1985	Cross-section	16 years	Transport & communication are significant; total public investment is insignificant

Easterly, Rebelo (1993)	100 countries	1970-1988	Cross-section	19 years	Transport & communication are significant; total investment, education, health are insignificant
Devarajan, Swaroop, Zou (1996)	14 developed countries	1970-1990	Panel	5-year moving average	Health, transport & communication are significant positive; defence, education are significant negative. Total capital expenditure is significant positive
Devarajan, Swaroop, Zou (1996)	43 developing countries	1970-1990	Panel	5-year moving average	Health, transport & communication are significant negative; defence, education are significant positive. Total capital expenditure is significant negative; current expenditure is positive
Kocherlakota, Yi (1997)	US, UK	US 1891-1991 UK 1831-1991	Time-series	Annual	Health, transport and communication are significant positive; Defence and education is significant negative. Total capital expenditures are positive
Fuente(1997)	21 OECD	1965-1995	Panel	5-years	Public investment is significant positive impact on economic growth
Kneller, Bleaney, Gemmell(1999)	22 OECD	1970-1995	Panel	5-years	Productive government expenditure enhances growth, whilst non-productive expenditure does not

Bleaney, Gemmell, Kneller (2001)	22 OECD	1970-1995	Panel	5-year	Productive government expenditure enhances growth, whilst non-productive expenditure does not
Bassanini, Scarpetta (2002)	21 OECD	1971-1998	Panel	Annual	Government consumption and investment expenditure have non negative impacts. Health, education, research public spending are positive
Gupta, Clements, Baldacci and Mulas-Granados (2005)	39 low income countries	1990-2000	Panel	10-year	Cutting selected current expenditure tend to raise growth rates, while protecting capital expenditure does the same
Adam, Bevan (2005)	45 developing countries	1970-1999	Panel	5-years	Residual (non-productive) expenditure has a negative impact. Productive expenditure has a positive effect.
Park (2006)	93 countries	1990-2000	Cross-country	10 years	Productive expenditure has a positive impact. negative relationship between tax rate and productive government spending

Bose, Holman and Neanidis (2007)	40 developing and 21 developed countries	1972-1999	Panel	5-year	Total government expenditure have a negative impact on growth in the case of developing countries, while it is found to be insignificant for developed countries
Bose, Hague and Osborn (2007)	30 developing countries	1970-1990	Panel	10-year	Productive expenditure has a positive effect. Non-productive is insignificant correlated. Education expenditure has a positive effect. Defence, transport and communication do not persist.
Ghosh, Gregoriou (2007)	15 developing countries	1972-1999	Panel	5 years moving average	Current (capital) spending has positive (negative) and significant effects on the growth rate. Education and health are negative, while operation and maintenance expenditure are positive.
Romero-Avila, Strauch (2008)	All EU members	1960-2001	Time-series	Annual	Public investment has a positive effect, government size and government consumption has a negative impact.

Afonso, Alegre (2011)	15 EU countries	1971-2006	Panel	5-years	Government consumption and social security have a negative effect. Public investment spending has a positive impact.
Bayraktar, Moreno-Dodson (2012)	7 fast-growing countries	1970-2005	Panel	Annual	Public expenditures in core sectors, which consist of a combination of current and capital spending on infrastructure, health, education have a significant impact on growth.
Chamorro-Narvaez (2012)	12 Latin American countries	1975-2000	Panel	5-years	Neither government capital spending nor current spending have any impact on the per capita economic growth rate
Christie (2012)	136 countries	1972-2005	Panel	5-years	Total government spending has a negative effect on growth. Productive government expenditures have a negative impact on economic growth.
Acosta-Ormaechea, Morozumi (2013)	56 countries	1970-2010	Panel	5-years	Education expenditure is growth-enhancing effect. Infrastructure and social protection expenditure are insignificant.

Bojanic (2013)	Bolivia	1940-2010	Time-series	Annual	Defence and health expenditure are negative effect. Education expenditure is positive impact
Afonso, Jalles (2014)	155	1970-2008	Panel	5-years	Public wages, interest payments, subsidies and government consumption are negative. Expenditure on education and health are positive. Expenditure on social security and welfare are negative.
Olulu, Erhieyovwe and Andrew (2015)	Nigeria	1970-2014	Time-series	Annual	Expenditure on administration, social and community services are positive; economic services expenditure is negative.
Gemmel, Kneller and Sanz (2016)	17 OECD countries	1970s-2008	Panel	5-years	Expenditure on transport &communication, education are positive. Spending on welfare is negative.

2.3 Conclusion

The major difference between the impacts of government policy in the neoclassical and endogenous growth theories is that government expenditures only affect the growth rate in the endogenous growth theory. However, not all types of government expenditures are expected to have influence on the steady state in endogenous growth models. The government's expenditures are constrained to be financed solely by lump-sum taxation in this chapter and with the implication that the level of government expenditure is constant in the steady state. Due to the linear relationship between fiscal policies implied by the GBC, biases can easily be present in regression equations if the studies ignore the implicit financing assumption built into the specification. Also, there remains a need for more research to address how the changes in relative amount of government expenditure compositions have effects on economic growth, especially at different stages of development. Based on the theoretical and empirical of government expenditure composition on endogenous growth model, the next chapter will apply the most suitable methodology to determine the impact of government expenditure compositions on economic growth. It can be seen that the empirical evidence about impact of government expenditure compositions on economic growth is varied. Different types of government expenditure, different types of methodology and different kinds of countries present different results. Chapter 4 will focus on examining the relationship between composition of government expenditure and long-run economic growth, with particular attention on comparing and contrasting high-income to low and middle-income countries.

Chapter Three
Methodology

This chapter provides information on the research method employed. Firstly, the construction of the dataset and the differences between the GFSM 1986, GFSM 2001 and GFSM 2014 frameworks will be introduced. These differences explain the reason why the time period from 1993 to 2012 was chosen for the economic growth model. The discussion then classifies the 10 categories of government expenditure used into productive and non-productive groups, and explains the difference in the level effect as a percentage of total spending and a percentage of GDP. This chapter also discusses the classification of countries based on estimates of gross national income per capita from the World Bank. It also explains the advantages of applying 5-year forward moving averages for all variables. Finally, the methodology used to analyse the panel data will be presented.

3.1 Construction of the Dataset

3.1.1 GFSM 1986 vs GFSM 2001 vs GFSM 2014

To study the compositional effects of changes in government spending on growth, data availability from sources such as the IMF's GFS yearbook is an important factor for both country selection and period examined. The GFS manual (GFSM) is a series of international guidelines on statistical methodology that have been issued by IMF. The GFSM, which updated the first edition published in 1986, is designed for compilers of government finance statistics, fiscal analysts, and other users of fiscal data. Under the analytic framework of GFSM 1986, governments had kept their accounts on a cash basis. Meanwhile, with developments in government accounting and fiscal analysis during period from middle 1990s to early 2000s, the analytic framework of GFSM 2001introduced the accrual basis of recording economic events so all resource flows are included, integrates balance sheets with transactions and other flows. Also, the concepts and principles set out in the GFSM 2001 were reconciled with those of the System of National Account 1993 therefore government finance statistics can be utilised with other macroeconomic statistics. Recently, IMF has introduced GFSM 2014, however its framework is new for collecting data, hence the recent studies are normally using either

GFSM 1986 or GFSM 2001. Most of the recent empirical research use fiscal data covering a wide set of countries from 1970s forward, which mean that both GFSM 1986 and GFSM 2001 framework have been applied (Adam and Bevan, 2005; Ghosh and Gregoriou, 2007; Afonso and Alegre, 2011; Afonso and Jalles, 2014 and Gemmel et al., 2016). However, a major methodological change with the introduction of GFSM 2001 compared to GFSM 1986 makes the previous fiscal data series somewhat incomparable with later ones. The recent empirical research studies above do not explain how they deal with these methodological changes in constructing comparable data series covering a period from 1970. These changes may bring biased results to their empirical analysis. In what follows, this thesis briefly illustrates some major changes that were introduced in GFSM 2001 and explains the chosen regression time from 1993 to 2012.

First of all, expenditures are classified differently by GFSM 1986 and GFSM 2001 (Wickens, 2002). For example, the definitions of current and capital expenditure is somewhat different. The capital spending concept, denoted as net acquisition of non-financial assets in GFSM 2001, accepts a net concept in the sense that the government revenue from the sale of fixed capital assets are taken into account. Meanwhile, capital government spending concept under GFSM 1986 adopts a gross concept which the revenue from capital sales is not deducted. Furthermore, capital transfers under GFSM 2001 are one component of the current expenditure concept, while these expenditures are part of the capital expenditure in GFSM 1986. In terms of the functional classification, GFSM 1986 divides expenditures into 14 functional categories, while GFSM 2001 divides them into 10 categories.

Secondly, the form that governments report statistics has been changed between GFSM 1986 and GFSM 2001. The reporting in GFSM 1986 is based only on a cash basis, while under GFSM 2001 this is mainly on accrual basis. To understand the difference, transactions are recorded when cash actually flows under cash concept. Meanwhile, flows are recorded at the time when transactions accrue, independently of the flow of cash under accrual concept. Some countries data for the different subcategories are recorded by different accounting bases during a different given year under GFSM 2001 framework.

Acosta-Ormaechea and Morozumi (2013) is unique amongst empirical studies as being the only one that has mentioned and converted all expenditure items of their dataset under GFSM 1986 into the concepts defined by GFSM 2001. They defined capital expenditure as a net concept while the functional expenditure components divided into 10 categories. Facing these differences between GFSM 1986 and GFSM 2001 framework guidelines, this thesis focuses on the fiscal data covering time period from 1993 to 2012 under GFSM 2001 framework only.

3.1.2 Subcomponents of Expenditure: Economic and Functional Classifications

Devarajan et al. (1996) was one of the first empirical studies to test whether the share allocated to different components of public spending is related to higher growth. Their key explanatory variables were the share of each component in total government expenditure. These components were based on the IMF's GFS yearbook from 1970 to 1990, and these were classified by two main lines under GFSM 1986. The first line is based on an economic classification of expenditure in which central government expenditure divides into capital and current expenditure. In their theoretical framework, capital expenditure is denoted as productive government expenditure while current expenditure is denoted as non-productive government expenditure. Following this economic classification, Gupta et al. (2005) and Ghosh and Gregoriou (2007) separated government expenditure components into capital and current for their datasets, from 1990 to 2000 and 1972 to 1999 respectively. One common feature of these empirical analyses is that they are limited to the data period from 1970s to 1990s. To include data from after 2000, they would face the challenges arising from difference between GFSM 1986 and GFSM 2001 framework for economic classifications report. Some empirical studies that examine the relationship of composition of expenditure and growth for the period after 2000 concentrate more on items in economic classification, such as: compensation of employees, interest payments, subsidies, consumption of fixed capital, and net acquisition of non-financial assets (Acosta-Ormaechea and Morozumi, 2013; and Afonso and Jalles, 2014).

The second line of Devarajan et al. (1996) is based on the functional classification of expenditure in which components are grouped into 14 categories under GFSM 1986. Most of empirical studies use this functional classification of expenditure to examine the relationship between various components of government expenditure and economic growth. It could be easier to convert all 14 expenditure items under GFSM 1986 to 10 categories under GFSM 2001 in functional classifications compared to economic classifications. Table 2 presents the details of total outlays which are classified under GFSM 2001 and GFSM 1986. Given that this thesis focus is on the composition of expenditures (i.e., the expenditure shares among subcomponents to total government expenditure), the difference in timing of recording between cash and accrual basis appears to be less of a problem as long as all expenditure items are recorded on the same accounting basis within a given year. Regarding the economic classification, there are 86 countries which have reported all relevant components at least once in the period 1970 to 2010. Turning to the functional classification, the number of countries covered at the same period is 102 (Acosta-Ormaechea and Morozumi, 2013). From this point of view, this thesis collects all historical fiscal data available for 59 countries that have reported data to the IMF's GFS yearbook from 1993 to 2012 under GFSM 2001 and also bases on the functional classifications to group productive and non-productive government expenditure from 10 categories.

Table 3.1: Functional classifications under GFSM 2001 and GFSM 1986

GFSM 2001 Category	Comprise GFSM 1986 category
701 General public services	General public services [B1] plus expenditure not classified by major group [B14]
702 Defense	Defense affairs and services [B2]
703 Public order and safety	Public order and safety affairs [B3]
704 Economic affairs	Economic affairs [B9 through B13]
7041 General economic, commercial and labour affair	General economic and commercial affairs other than general labour affairs [B13.4] plus general labour affairs and services [B13.5]
7042 Agriculture, forestry, fishing and hunting	Agriculture, forestry, fishing, and hunting affairs and services [B10]
7043 Fuel and energy	Fuel and energy affairs and services [B9]
7044 Mining, manufacturing, and construction	Mining and mineral resource affairs and services, other than fuels; manufacturing affairs and services; and construction affairs and services [B11]
7045 Transport 7046 Communication	Transport and communication affairs and services [B12]

7047 Other industries	Distributive trade affairs and services including storage and warehousing; hotel and restaurant affairs and services [B13.1] plus tourism affairs and services [B13.2] plus multipurpose development projects affairs and services [B13.3]
7048 R&D: Economic affairs	Cannot be compiled from GFSM 1986 due to lack of detail.
7049 Economic affairs n.e.c	Other economic affairs and services n.e.c. [B13.6]
705 Environmental protection	The GFSM 1986 did not classify environmental protection separately.
706 Housing and community affairs	Housing and community amenity affairs and services [B7]
707 Health	Health affairs and services [B5]
708 Recreation, culture, and religion	Recreational, cultural, and religious affairs and services [B8]
709 Education	Education affairs and services [B4]
710 Social protection	Social security and welfare affairs and services [B6]

3.1.3 The Difference in the Level Effect as a Percentage of GDP and Percentage of Total Government Expenditure

The model in this thesis is based on that of Devarajan et al. (1996), which studies the effects of public expenditure compositions as a proportion of total expenditure on long-run economic growth. Its level effect has been controlled for separately in the regression analysis by each GDP variable being expressed as a share of total expenditure. The Devarajan et al. (1996) approach was also followed by Ghosh and Gregoriou (2007), Acosta-Ormaechea and Morozumi (2013) and Gemmel et al. (2016), while alternative empirical studies examined the relationship between economic growth and government expenditure compositions as a percentage of GDP. The rationale for expressing productive expenditure as a ratio of total government expenditure is that under this measure a unit increase in the budgetary share of productive expenditure has to be matched by a unit decrease in non-productive expenditure, as the size of total spending remains fixed. Under the alternative approach to measurement (i.e. expenditure as a ratio of GDP), a unit increase in the share of productive government expenditure in GDP does not necessarily mean that other expenditure items are decreasing. This may lead to varied findings for different sets of data. For example, Devarajan et al. (1996) found that there is a negative relationship between public investments in transport and communication and economic growth in their developing countries sample, and this result contrasts with the finding of Easterly and Rebelo (1993). These contrasting results were due to Devarajan et al. (1996)'s empirical analysis focusing on the composition effect of public expenditure (the share of transportation and communication in total government expenditure) on growth; while Easterly and Rebelo (1993) found a positive coefficient on the share of transportation and communication expenditure in GDP, a variable that mixed the level effect of spending with the composition effect. There are several reasons why this thesis follows the Devarajan et al. (1996) approach. First, as an increase in total government expenditure normally has a crowding out effect and thus has a negative impact on economic growth, it is worth noting for policy makers and researchers to find approach to reallocate government expenditure components in a more optimal way to increase economic growth within a given government expenditure decision. Second, there are limited studies in existing current growth literature have examined the effects of the relative division of government expenditure between productive and non-productive uses (as a proportion of total expenditure) on economic growth, especially comparing high-income and low to middle-income economies. Therefore, this thesis examines the relationship between government expenditure compositions and economic growth, so the main variables, such as productive and non-productive public spending are a percentage of total government expenditure and their financing is controlled by GBC variables. Furthermore, in chapter 4 this thesis also re-runs the robustness test on the regression equations with productive and non-productive government expenditures as a percentage of GDP to see how the results are changing compared with previous studies.

3.1.4 Central Government and General Government

Another important element to clarify about our dataset is the institutional coverage level of government. Countries under GFSM 1986 framework reported data mostly at the consolidated central government level. Meanwhile, under GFSM 2001 framework they also provide data for the consolidated general government. Central government expenditure is defined as the central government budget expenditure as reported in the final central government accounts. Meanwhile, general government spending, as a share of GDP and per person, provides an indication of the size of the government across countries. General government spending generally consist central, state and local governments, and social security funds. The degree of fiscal decentralisation (measured by the share of spending at the central government level relative to that of the general government level) differs across subcomponents. Thus, the central government level data may not accurately capture the share of those subcomponents at a national level. This actually appears to be the case, because some components such as defence tend to be centralised in most countries, while other such as health and education tend to be more decentralised. Furthermore, when the trend of fiscal decentralised differs across those components over time, using the central government level data can be problematic in a panel data analysis (Acosta-Ormaechea and Morozumi, 2013). Christie (2012) mentions that using the consolidated central government means that not all government expenditure items in countries with a decentralised system are captured. As previous empirical research (Devarajan et al., 1996 and Acosta-Ormaechea and Morozumi, 2013) retest the results when comparing data between consolidated central government level and consolidated general government level, and provide evidence suggesting the same statistically results for both level; this thesis will use either consolidated central government or consolidated general government level which depends on its availability from each country under GFSM 2001 framework.

3.1.5 Country Classification

Each year on July 1, the World Bank revises analytical classification of the world's economies based on estimates of gross national income (GNI) per capita for the previous year. The updated GNI per capita estimates are also used as input to the World Bank's operational classification of economies that determines lending eligibility. As of 1 July 2013, low-income economies are defined as those with a GNI per capita, calculated using the *World Bank Atlas* method, of $1,025 or less in 2012; middle-income economies are those with a GNI per capita of more than $1,026 but less than $12,476; high-income economies are those with a GNI per capita of $12,476 or more. Lower-middle-income and upper-middle-income economies are separated at a GNI per capita of $4,035. Therefore, based on the World Bank’s classification using GNI per capita, the panel data sample of 59 countries in this thesis is separated into 2 sub-groups: 37 high-income economies and 22 low to middle-income economies covering the period from 1993 to 2012.

There are some reasons why this thesis chose those countries for sample group and separated them into 2 sub-groups. First, it can be seen that previous studies commonly used to categorise the world into developing and developed countries without a clear definition. The recent World Bank Group Strategy (World Bank, 2013) stated that the traditional grouping of developing countries become less relevant and fragility across the development spectrum. Therefore, classification using thresholds for income categories based on the current GNI per capita indicator is a useful benchmark to analyse development trends. In order to comparing with existing literature in the area of examining growth effects of government expenditure compositions, this thesis classifies the country sample into 2 sub-groups: high-income and low to middle-income, similar to OECD uses income classification to distinguish two groups of countries: the developed countries (i.e, high-income) and developing countries (i.e, low and middle-income) (OECD,2015). It also has been applied by Gupta et al. (2005), Park (2006), Christie (2012), Acosta-Ormaechea and Morozumi (2013), and Afonso and Jalles (2014). Second, some of the values were outliers that would bias the estimates, a few countries were removed. For example, Belarus was excluded from the analysis on account of high volatile of inflation rate or Seychelles was excluded due to missing the labour force growth information. Also, due to the availability of all historical fiscal data from IMF'GFS yearbook during the period 1993 to 2012, only 59 countries (37 high-income and 22 low to middle-income) has been collected to this research. Table 3.2 below presents the list of countries covered in the thesis.

Table 3.2: List of countries

High-income Economies		Low to Middle-income Economies	
Country	**Classification**	**Country**	**Classification**
Bahamas	High Income	Ethiopia	Low Income
Bahrain	High Income	Kenya	Low Income
Croatia	High Income	Nepal	Low Income
Cyprus	High Income	Bolivia	Lower Middle Income
Latvia	High Income	Egypt	Lower Middle Income
Malta	High Income	India	Lower Middle Income
Oman	High Income	Indonesia	Lower Middle Income
Singapore	High Income	Philippines	Lower Middle Income
Australia	High Income OECD	Sri Lanka	Lower Middle Income
Austria	High Income OECD	Vietnam	Lower Middle Income
Belgium	High Income OECD	Zambia	Lower Middle Income
Canada	High Income OECD	Bulgaria	Upper Middle Income
Chile	High Income OECD	China	Upper Middle Income
Czech Republic	High Income OECD	Costa Rica	Upper Middle Income
Denmark	High Income OECD	Hungary	Upper Middle Income
Estonia	High Income OECD	Iran	Upper Middle Income
Finland	High Income OECD	Jordan	Upper Middle Income
France	High Income OECD	Lebanon	Upper Middle Income
Germany	High Income OECD	Mauritius	Upper Middle Income
Greece	High Income OECD	Romania	Upper Middle Income
Iceland	High Income OECD	Thailand	Upper Middle Income
Ireland	High Income OECD	Tunisia	Upper Middle Income
Israel	High Income OECD		
Italy	High Income OECD		
South Korea	High Income OECD		
Luxembourg	High Income OECD		
Netherlands	High Income OECD		
New Zealand	High Income OECD		
Norway	High Income OECD		
Poland	High Income OECD		
Portugal	High Income OECD		
Slovak Republic	High Income OECD		
Slovenia	High Income OECD		
Spain	High Income OECD		
Sweden	High Income OECD		
Switzerland	High Income OECD		
United Kingdom	High Income OECD		

3.1.6 Five – year Averages versus Five – year Moving Averages

Traditionally, to capture the long-run relationship of economic growth to fiscal variables and eliminate business cycle effects, the data is expressed in long-frequency periods – usually 5 years. While some previous studies applied 5-year average for all variables (see for example: Adam and Bevan, 2005; Bleaney et al., 2001; and Christie, 2012) or decade average value for all variables (see for example: Bose et al., 2007); others used 5-year forward moving averages of GDP growth on yearly fiscal variables (Devarajan et al., 1996, and Ghosh and Gregoriou, 2007). However, both of these period-averaging processes have some drawbacks. Using five-year moving average only for dependent variables could lead to the possibility of reverse causality, as governments would predict the increase in the growth rate up to five years into the future and raise productive government expenditure today. Meanwhile, using five-year average for growth regressions tends to produce biased result. The reason for these biased results may be the absence of automatic stabilisers. Developed economies normally achieve macroeconomic stability, so changing between 5-year average and 5-year moving average is unlikely to affect the relationship between components of government spending and long-run economic growth. Meanwhile, for developing economies, 5-year average for pre-stabilisation countries may lead to bias results as their governments set up several five-year Socio-Economic Development Plans to achieve development and economic growth. Therefore, any study uses the wrong 5-year average period between the two 5-Year Plans may lead to incorrect estimates. Regarding the autoregressive behaviour of economic growth, fiscal variables may bring an influence on economic growth distributed across several periods. Some categories of government spending may induce a certain effect in the period in which they are actually realised and a different impact later on. Other variables could have the same story.

Therefore, this thesis will use 5-year forward moving averages for all variables, as we believe that it can remove business cycle effects, increase the number of time series observation in our panel data, minimise the reverse causality argument in our model and account for endogeneity.

3.1.7 Additional Macro Variables

The dataset also contains some macroeconomic variables including: initial level of GDP, investment, labour growth, inflation rate and openness of a country (calculated as the value of imports and exports relative to GDP). These variables are used as control variables in the regression analysis for the impact of government expenditure, corruption on economic growth in the next chapters. They have been obtained from the International Financial Statistics (IFS), Government Finance Statistics (GFS) database of the IMF, and the World Bank's Development Indicators (WDI). Initial GDP, investment ratio and labour force growth conditioning variables are found in the usual Barro-type regression. The initial level of GDP is a logarithm, to control for the convergence effect mentioned in Solow-Swan model (Adam and Bevan, 2005; Christie, 2012 and Kneller et al., 1999). Investment is an important determinant of the growth rate and expected to express the positive effects of physical capital accumulation (Ghosh and Gregoriou, 2007 and Gupta et al., 2005). Labour force growth is one of the production factors related to economic growth and has therefore been added by previous researchers (Afonso and Alegre, 2011; Bleaney et al., 2001 and Gupta et al., 2005). The latter variables (inflation rate and openness variables) capture macroeconomic policy. The inflation rate is believed to have an adverse effect on growth rates when it is high. High inflation is associated with increased price variability and an uncertainty about future profitability of investment projects, then this lead to lower levels of investment and economic growth (Christie, 2012 and Pushak et al., 2007). Rodrik (1998) stated that openness to international trade has a higher rate of industrial concentration and it is therefore an important variable in empirical models testing fiscal policy and growth.

In additions, this thesis is based on Devarajan et al. (1996) model which takes into account the balance budget variables as recent theoretical models. Hence, the revenue side of the GBC which includes government budget deficit or surplus, tax revenues and non-tax revenues; will be included in this study's analysis. These variables, as proportion of GDP, are obtained from GFS database of the IMF.

The rest of the additional macro variables are corruption and human capital variables. The current literature on corruption commonly uses subjective measures created by Transparency International (TI), the World Bank (WB) and Political Risk Services (PRS). The TI and WB measures are composite indices based on individual surreys of corruption.

The PRS measure uses expert rankings by specialised institutions. The corruption index which uses for examining the growth effects via government expenditure compositions will be discussed further in chapter 5. Meanwhile, the government expenditure on human capital and its components (education and health) will be collected from IMF's GFS 2001. They will be discussed in detail in chapter 6.

3.2 Methodology

The empirical analysis of this thesis uses panel data to examine the relationship between government expenditure and economic growth. Panel data is also called longitudinal data or cross-sectional time-series data. This longitudinal data has observations on the same units in several different time periods (Kennedy, 2008). A panel data set has multiple entities, each of which has repeated measurements at different time periods. Panel data may have individual (group) effect, time effect, or both, which are analysed by fixed effect and/or random effect models. Panel data have more variability and allow exploring more issues than doing cross sectional or time series data alone. "Panel data produce more informative data, more variability, less collinearity among the variables, more degrees of freedom and more efficiency" (Baltagi, 2001). Panel data may be long or short, balanced or unbalanced, and fixed or rotating. A short panel data has large numbers of individuals (N) but short in time periods (T), whilst a long panel data has many time periods but few individuals. Either a problem of too few N – type I error (incorrect rejection of a true null hypothesis) or too large N problem– type II error (incorrectly retaining a false null hypothesis) is a matter for researchers when examining these kinds of data. In a balanced panel, all individuals have been measured in all time periods. In cross-table of cross-sectional and time-series variables, each cell should have only one frequency. Thus, the total number of observations is NxT. Whereas, when some cells in the cross-table have zero frequency (i.e. each individual has different numbers of observation), the panel data is a unbalanced panel. The total number of observations is not NxT (Park, 2011). Furthermore, if the same individuals (or groups) are observed for each period, the panel data set is called a fixed panel. If a set of individuals changes from one period to the next, the data set is a rotating panel (Greene, 2008). This thesis has a well-organised balanced and fixed panel data set; therefore, this data can provide ways of dealing heterogeneity and test fixed and/or random effects in the longitudinal data. The first and second analysis of this thesis use short panel data, as these analysis examine the relationship between government expenditure components, corruption and economic growth for a panel data of 37 high-income and 22 low to middle-income countries (N = 37 and 22) for the period 1993 to 2012 (T = 15 for applying five-year moving averages). The final analysis uses long panel data as this thesis focuses on the growth effects of government expenditure on human capital and its components (education and health) for an Asia case study.

For a brief description of the methodology panel estimators based on the endogenous growth models, this thesis write basis growth equation as:

$$G_{it} = \alpha + \beta X_{it} + u_i + e_{it} \tag{3.1}$$

Where G_{it} is the GDP growth of country i at the time period t, X_{it} is a vector of the explanatory variables for country i in time period t, and e_{it} is the error for country i at the time period t. u_i is individual effect (country or time specific effect).

This panel data models are based on the work of Park (2011), who presents a brief and clear explanations of this methodology. Panel data models examine country effects, time effects, or both in order to deal with heterogeneity and individual effect that may or may not be observed. These effects are either fixed or random. A fixed effect model examines if intercepts vary across country or time period, whereas a random effect model explores differences in error variance components across country or time period. A one-way model includes only one set of dummy variables (e.g., country1, country 2 …) while a two-way model considers two sets of dummy variables (e.g., country1, country 2 … and year1, year2 …).

There are various approaches that can be used to examine the endogenous growth models. The commonly approaches which had been applied in previous studies are Pooled OLS, one-way (country dummies) fixed and random effects, and two-way (country and time dummies) fixed and random effects. Recently, the empirical research are using the GMM estimator developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998) as it helps to address problem of potentially endogenous of fiscal variables. The following sections introduces some approaches which were considered in this study.

3.2.1 Pooled OLS

If individual effect u_{it} does not exist (u_{it}=0), ordinary least square (OLS) produces efficient and consistent parameter estimates.

OLS consists of five core assumptions (Kennedy, 2008):

1. Linearity says that the dependent variable is formulated as a linear function of a set of independent variable and the error (disturbance) term.

2. Exogeneity says that the expected value of disturbances is zero or disturbances are not correlated with any regressors.

3. Disturbances have the same variance (3.a homoskedasticity) and are not related with one another (3.b non-autocorrelation)

4. The observations on the independent variable are not stochastic but fixed in repeated samples without measurement errors.

5. Full rank assumption says that there is no exact linear relationship among independent variables (no multi-collinearity).

If individual effect u_i is not zero in longitudinal data, heterogeneity (individual specific characteristics that are not captured in regressors) may influence assumption 2 and 3. In particular, disturbances may not have same variance but vary across individual (heteroskedasticity, violation of assumption 3.a) and/or are related with each other (autocorrelation, violation of assumption 3.b). This is an issue of nonspherical variance-covariance matrix of disturbances. The violation of assumption 2 renders random effect estimators biased. Hence, the OLS estimator is no longer the best unbiased linear estimator. Hence, panel data models provide a way to deal with these problems.

3.2.2 Fixed Effects and Random Effects

Panel data models examine fixed and/or random effects of country or time. The core difference between fixed and random effects models lies in the role of dummy variables. A parameter estimate of a dummy variable is a part of the intercept in a fixed effect model and an error component in a random effect model. Slopes remain the same across group or time period in either fixed or random effect model. The functional forms of one-way fixed and random effect models are:

$$\text{Fixed effect model: } G_{it} = (\alpha + u_i) + \beta X_{it} + e_{it} \quad (3.2)$$

$$\text{Random effect model: } G_{it} = \alpha + \beta X_{it} + (u_i + e_{it}) \quad (3.3)$$

where $u_i$is a fixed or random effect specific to country or time period in the growth models that is not included in the regression, and errors e_{it} are independent identically distributed.

A fixed group effect model examines country differences in intercepts, assuming the same slopes and constant variance across country. Since an individual specific effect is time invariant and considered a part of the intercept, u_i is allowed to be correlated with other regressors, so OLS assumption 2 is not violated. This fixed effect model is estimated by least squares dummy variable (LSDV) regression (OLS with a set of dummies) and within effect estimation methods.

A random effect model assumes that country effect (heterogeneity) is not correlated with any regressor and then estimates error variance specific to countries (or times). Hence, u_i is an individual specific random heterogeneity or a component of the composite error term. This is why a random effect model is also called an error component model. The intercept and slopes of regressors are the same across country. The difference among countries (or time periods) lies in their individual specific errors, not in their intercepts.

If one cross-sectional or time-series variable is studied, this is called a one-way fixed or random effect model. Two-way effect models have two sets of dummy variables for individual and time variables, therefore they cause estimation and interpretation issues (Park, 2011).

3.2.3 Estimating Fixed Effect Models

There are a number of approaches to estimate a fixed effect model such as, least squares dummy variable (LSDV), within estimation and between estimation. LSDV with a dummy dropped out of a set of dummies is broadly used since it is relatively easy to estimate and interpret. However, this approach can become problematic when there are large numbers of individuals in panel data. If the number of time periods (T) is fixed and the number of groups (N) is infinite, parameter estimates of regressors are consistent but the coefficients of group effect are not (Baltagi, 2001). In the short panel data, LSDV includes many dummy variables and the number of these parameters increase as the number of groups increase. Hence, LSDV loses N degrees of freedom but returns less efficient estimators (Park, 2011). Under this situation, LSDV is ineffective and thus another approach should be considered, the within effect estimation.

Unlike LSDV approach, the within estimation approach does not need to use dummy variables, but it uses deviations from individual or time period means. Therefore, it uses variation within each individual rather than a large number of dummies. The within estimation is:

$$\left(G_{it} - \overline{G_{i.}}\right) = \left(X_{it} - \overline{X_{i.}}\right)'\beta + (e_{it} - \overline{e_{i.}}) \quad (3.4)$$

Where $\overline{G_{i.}}$ is the means of dependent variables of individual i, $\overline{X_{i.}}$ represent the means of independent variables of group i, and $\overline{e_{i.}}$ is the means of errors of group i.

In this approach, the incidental parameter problem is no longer an issue. The parameter estimates of regressors in this approach are identical compared to those of LSDV (Park, 2011). This within estimation approach represents corrects the sum of squared errors (SSE). On the other hand, this approach has some drawbacks. One of them is that data transformation for within estimation eliminates all time-invariant variables that do not vary within an individual. As deviations of time-invariant variables from their average are all zero, it is not possible to estimate coefficients of such variables in within estimation. Therefore, LSDV is better to apply when a model has time-invariant independent variables. Second, within estimation approach may provide inaccurate statistics. Since no dummy is used, the within approach produces larger degrees of freedom for errors, then small mean squared errors (MSE), standard errors of the estimates (SEE) or square root of mean squared errors (SRMSE) and incorrect standard errors of parameter estimates. Finally, the R^2 of the within estimate approach is incorrect as the intercept term is suppressed (Kennedy, 2008).

The between estimation approach, known as the group mean regression, uses variation between individual entities. This approach calculates group means of the dependent and independent variables and as a result decreases the number of observations down to N. Therefore, it needs to run OLS on these transformed.

3.2.4 Estimating Random Effect Models

The one-way random effect model incorporates a composite error term; $w_{it} = u_i + e_{it}$. The u_i is assumed independent of error term e_{it} and regressor X_{it}, which are also independent of each other for all i and t. This assumption is not necessary in a fixed effect model. A random effect model is estimated by generalized least squares (GLS) when a covariance structure of an individual i, Σ (sigma), is known. The feasible generalized least squares (FGLS) or estimated generalized least squares (EGLS) method is used to estimate the entire variance-covariance matrix V (Σ in all diagonal elements and 0 in all off-diagonal elements) when Σ is not known. As Σ is regularly unknown, FGLS/EGLS is more commonly applied than GLS. A random effect model is normally more complicated to estimate compared to a fixed effect counterpart (Park, 2011). There are various estimation methods for FGLS including the maximum likelihood method and simulation (Baltagi and Chang, 1994).

A random effect model reduces the number of parameters to be estimated but will produce inconsistent estimates when individual specific random effect is correlated with regressors (Greene, 2008).

3.2.5 Testing Fixed Effect and Random Effect

Fixed effects are tested by the F test, while random effects are examined by the Lagrange multiplier (LM) test (Breusch and Pagan, 1980). The F test helps to compare s fixed effect model and OLS to see how much the fixed effect model can improve the goodness-of-fit. Meanwhile, the LM test contrasts a random effect model with OLS. If the null hypothesis is not rejected in either test, the pooled OLS regression is favoured. The Hausman specification test (Hausman, 1978) compares a random effect model to its fixed counterpart. If the null hypothesis that the individual effects are uncorrelated with the other regressors is not rejected, LSDV and GLS are consistent but LSDV is inefficient; otherwise, LSDV is consistent but GLS is inconsistent and biased. The estimates of LSDV and GLS should not differ systematically under the null hypothesis (Park, 2011).

$$LM = (b_{LSDV} - b_{random})\widehat{W}^{-1}(b_{LSDV} - b_{random}) \sim x^2(k) \quad (3.5)$$

Where $\widehat{W} = Var[b_{LSDV} - b_{random}] = Var(b_{LSDV}) - Var(b_{random})$ is the difference in the estimated covariance matrices of LSDV and GLS. This test follows the chi-squared distribution with k degrees of freedom.

The formula mentions that a Hausman test examines if the random effects estimate is insignificant different from the unbiased fixed effect estimate (Kennedy, 2008). If the null hypothesis of no correlation is rejected, it may conclude that individual effects u_i are significant correlated with at least one regressors in the model and therefore the random effect model is inconsistent and biased. Hence, it needs to use a fixed effect model rather than the random effect.

If one cross-sectional or time-series variable is considered, this is called a one-way fixed or random effect model. Two-way effect models have two sets of dummy variables for country and/or time variables and thus entail some issues in estimation and interpretation.

It can be seen that it is common from previous empirical analysis to use five different forms of panel data estimator to examine the relationship between government expenditure and economic growth: Pooled OLS, one-way (country dummies) fixed and random effect and two-way (country and time dummies) fixed and random effects models. The thesis initially considered these different forms and model selection is based on the log-likelihood and the adjust R^2 for the pooled OLS and the null hypothesis in the Hausman test between fixed effects and random effects. Based on those criteria, the two-way fixed effects which control both time-invariant individual country characteristics and time fixed effect is chosen as the main method of estimation for this thesis. This method addresses an issue that excluding unobservable country-specific effects could lead to serious biases in the econometric estimates, especially when these effects are correlated with other covariates.

3.2.6 Generalised Method of Moments (GMM)

A common issue in the previous literature on fiscal policy and growth is the probable presence of endogeneity and reverse causality (Afonso and Alegre, 2011 and Ghosh and Gregoriou, 2007). It could be the case that economic growth itself affects fiscal variables. If economic growth is a determinant of any of the right hand side variables in equation (3.1); estimation techniques that do not take into account this endogeneity will be biased and will lead to inconsistent parameter estimates. To tackle possible endogeneity of the explanatory variables in the panel, GMM technique has been applied by recent empirical analysis (Acosta-Ormaechea and Morozumi, 2013; Afonso and Alegre, 2011; and Christie, 2012). GMM was introduced by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). We estimate this dynamic panel data model using a GMM approach. There are various reasons for this choice. First, the GMM framework is flexible enough to accommodate our balanced panel. Second, it allows us to deal with country fixed effects. Third, it enables us to handle the potential endogeneity of all explanatory variables through the use of internal instruments (i.e., instruments based on lagged values of those variables). This is important because endogeneity issues appear to be non-trivial concerns in our context. In addition to the reverse causality issue mentioned in the introduction, omitted variable problems are also likely to be present. There are two common approaches of GMM estimator for dynamic panel data, Difference GMM and System GMM.

For a brief description of the GMM panel estimators, the equation (3.1) is rewritten to have a dynamic equation in which the lagged dependent variable appears in the right hand side.

$$G_{it} = \alpha + \gamma G_{i,t-1} + \beta X_{it} + \varepsilon_{it} \tag{3.6}$$

$$\varepsilon_{it} = u_i + e_{it}$$

$$E[u_i] = E[e_{it}] = E[u_i e_{it}] = 0$$

Subtracting $G_{i,t-1}$ from both side of equation (3.6) gives an equivalent equation for growth,

$$\Delta G_{i,t} = (\gamma - 1)G_{i,t-1} + \beta X_{it} + \varepsilon_{it} \tag{3.7}$$

Difference GMM is a proceeding estimation after first-differencing the data to eliminate the fixed effects. Whereas, System GMM strengthens Difference GMM by estimating simultaneously in differences and levels where the two equations being distinctly instrumented (Roodman, 2009b).

One advantage of GMM is the set of internal instruments used and built from past observations of the instrumented variables. In two-stage least squares (2SLS), there is a trade-off between the lag distance used to generate internal instruments and the depth of the sample for estimation. The standard instrument set for difference GMM [Holtz-Eakin, Newey and Rosen (HENR), 1988] avoids the trade-off between instrument lag depth and sample depth by giving the missing observations of lags a zero value. It also includes separate instruments for each time period. For example, to instrument ΔG_{i3}, a variable based on the twice-lag of G is used and it takes the value of ΔG_{i1} for period 3 and is 0 for all other periods (Roodman, 2009a). The result is a sparse instrument matrix **Z**,

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & \cdots \\ G_{i1} & 0 & 0 & 0 & 0 & 0 & \cdots \\ 0 & G_{i2} & G_{i1} & 0 & 0 & 0 & \cdots \\ 0 & 0 & 0 & G_{i3} & G_{i2} & G_{i1} & \cdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \ddots \end{bmatrix} \quad (3.8)$$

This matrix corresponds to the family of $(T-2)(T-1)/2$ moment conditions:

$$E\left(G_{i,t-z}\Delta\varepsilon_{it}\right) = 0 \qquad \text{for each } t \geq 3, z \geq 2 \quad (3.9)$$

The single equation GMM panel estimator generally specifies a dynamic panel model in first differences and exploits the above moment conditions. Therefore, the lagged (three time periods or more) levels of endogenous and weakly endogenous variables of the model become appropriate instruments for addressing endogeneity. The single difference GMM panel estimator provides consistent coefficient estimates.

However, while the GMM approach yields consistent estimators, the original difference GMM estimators developed by Holtz-Eakin, Newey, and Rosen (1988) and Arellano and Bond (1991) may suffer from finite sample biases. When the time-series dimension of the panel is fairly small, the single equation estimator suffers from the problem of weak instruments. In other words, there is a weak correlation between the regressors and the instruments. As a result of this problem, the estimated coefficients suffer from poor precision (Staiger and Stock, 1997). This problem can be overcome by using panel GMM system estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998), which radically reduces the imprecision associated with the single equation estimator.

To perform system GMM, a data set is built out of a copy from the original dataset in levels and another in differences. The standard instruments and any others specific to the differenced equation are assigned zero values for the levels equation while new instruments are added for the levels equation and are zero for the differenced data. The assumption behind these new instruments for levels is that past changes in G are uncorrelated with the current errors in levels, which include fixed effects. Based on this assumption, it can be built an exploded HENR-style instrument set, separately instrumenting G for each period with all lags variable to that period as in equation (3.8). However, most of the associated moment conditions are mathematically terminated with the HERN instruments for the differenced equation. Consequently, only one lag is used for each period and instrumenting variable (Blundell and Bond, 1998 and Roodman, 2009a). The typical instrument set to instrument G is a stack of blocks as follow:

$$\begin{bmatrix} 0 & 0 & 0 & \cdots \\ \Delta G_{i2} & 0 & 0 & \cdots \\ 0 & \Delta G_{i3} & 0 & \cdots \\ 0 & 0 & \Delta G_{i4} & \cdots \\ \vdots & \vdots & \vdots & \ddots \end{bmatrix} \quad (3.10)$$

This corresponds to the moment conditions:

$$E\left(\Delta G_{i,t-1}\Delta\varepsilon_{it}\right) = 0 \quad \text{for each } t \geq 3 \quad (3.11)$$

From the point of view of instrument count, the story looks the same when changing from difference to system GMM where the overall count is typically quadratic in T. However, the system GMM, an extended from difference GMM estimator, has provide smaller finite sample bias and greater precision when comparing to first-difference GMM (Bond et al., 2001). Therefore, this thesis will use system GMM to capture the endogeneity involve in the simultaneous determination of the key variables in the theoretical model. Furthermore, to reduce the number of instruments generated in the system, this thesis combines instruments through additions to smaller sets. This can be done by asking the estimator to minimize the magnitude of empirical moments only for each lag length rather than for each lag length and time. This measure had been taken because as Roodman (2009b) emphasizes, having too many instruments (relative to the number of countries) makes estimation results unreliable.

To ensure the validity of this system approach in the thesis context, this research conducts a number of specification tests. The first is the Arellano-Bond test. The consistency of the Arellano and Bond estimator depends on the assumption that the errors are not serially correlated. It is therefore crucial to test for the presence of serial correlation. Arellano and Bond’s test reports for first and second order serial correlation of the differenced residuals. Hence, there should be first order but not second order correlation (Roodman, 2009a). The second is the Hansen test for over-identifying restrictions, which tests the overall validity of the instruments when applying GMM technique. The null hypothesis for Hansen J test is that the instruments are valid in the sense that they are not correlated with the errors in the first differenced equation (Roodman, 2009a).

Difference and system GMM are typically used in one-step and two-step variants. In the one-step GMM estimator, the parameters are estimated based on an initial weight matrix and no updating of the weight matrix is performed except when calculating the appropriate variance-covariance matrix. The two-step variants use a weighting matrix that is the inverse of an estimate, **S,** of $var[\boldsymbol{Z}'\varepsilon]$, where **Z** is the instrument vector. This optimal weighting matrix makes two-step GMM asymptotically. However, the number of elements to be estimated in **S** is quadratic in the number of instruments. Furthermore, the elements of the optimal matrix, as second moments of the vector of the moments between instruments and errors, are fourth moments of the underlying distribution, which can be hard to estimate in small sample (Hayashi, 2000). The usual formulas for coefficient standard errors in two-step GMM tend to be downward biased when the instrument count is high. Therefore, this thesis is using the GMM one-step system for dynamic model instead of GMM two-step system. One-step GMM estimator is efficient when the errors are homoscedastic and not correlated over time. This is often too restrictive. However, the one-step results are consistent, and robust standard errors that adjust for heteroskedasticity and autocorrelation are easily obtained.

Recently, with increasing availability of data covering a large number of time series observations (T) and a large number of countries (N), some recent works on fiscal policy and growth (Arnold et al., 2011 and Gemmell et al., 2011) use the Mean-Group (MG) and/or Pooled Mean-Group (PMG) estimators developed by Pesaran and Smith (1995) and Pesaran, Shin, and Smith (1999), respectively. These estimators have their own advantages. Most notably, they allow for a simultaneous investigation of long-run equilibrium relations and short-run adjustments processes, in which key parameters are allowed to be heterogeneous. Since there is no particular reason to think that the effects of fiscal policy on long-run growth should be homogeneous, this could be an advantage over a GMM approach, where only the long-run relation is considered and heterogeneity is allowed only in terms of an intercept. However, one potential downside of these alternative approaches is that since ‘large T’ requires the use of annual data, the effect of business cycles can be more problematic than in the thesis 5-year moving averaged case. Besides, from a practical viewpoint, due to the fact that this highly disaggregated fiscal expenditure dataset which have several missing data, particularly for low-income countries, it does not allow to use either of these alternative estimators.

3.3 Conclusion

This chapter focuses on providing the information of construction of the dataset and methodology used in this thesis. The data used cover in total 59 countries (3 low-income, 8 lower-middle, 11 upper-middle and 37 high-income economies) during the period 1993-2012. The reason why this thesis chooses regression time from 1993 to 2012 for economic growth models is due to the difference between GFSM 1986 and GFSM 2001 framework for the main variables. With clear functional classification under GFSM 2001 of IMF's GFS yearbook, this thesis can easily estimate the effect of government expenditure components on long-run economic growth. Another important element about the institutional coverage level of the government in the dataset has been clarified in this chapter. This thesis will also use fiscal data at either consolidated central government or consolidated general government level which depends on its availability from each country. Since this research attempts to capture the effects of government spending reallocation on growth in terms of functional classification of expenditure, this thesis uses public expenditure compositions variables as a proportion of total expenditure which has been controlled in the regression analysis by the share of GBC in GDP variables. It is different to alternative empirical studies which examined the relationship between economic growth and government expenditure compositions as a percentage of GDP. This will help to compare and contrast the thesis results with previous studies. The impacts of fiscal policy when the government expenditure compositions shares are exogenously given can be captured by the OLS fixed effect. The OLS fixed effect model, known as the Least Squares Dummy Variable model is often applied to panel estimation. This method can perform better than Pooled OLS and OLS random effect depended on the log-likelihood and the adjust R^2 and the Hausman test. Therefore, based on these tests, the main results are reported by using the OLS fixed effect two-way method. However, even if this model is extensively used in the panel literature, it may fail to capture the bias from unobserved country-specific effect and deal with potential endogeneity problems. The GMM estimators developed by Holtz-Eakin, Newey, and Rosen (1988), Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998) make use of lagged instruments of the endogenous variables for each time period to tackle possible endogeneity of the explanatory variable in the dynamic panel data. Both difference and system GMM methods can capture this problem, but based on advantage of the system GMM this thesis will apply the one-step system GMM to retest the robustness of the thesis baseline results.

PART B: SELECTED OUTPUTS OF EMPIRICAL ANALYSES

Chapter Four
The Impact of Government Expenditure Compositions on Economic Growth

4.1 Introduction

As presented in the literature reviews chapter, endogenous growth theory predicts that any policy encouraging factor input accumulation results in enhanced long run economic growth. Researchers have differentiated between productive and non-productive government expenditure and have shown how a country can increase its economic growth by changing the mix between these alternative forms of expenditure. Kneller et al. (1999) underlined that productive government spending influences private sector productivity and hence has a direct impact on growth, while non-productive expenditure, which normally has an effect on citizens' welfare, is likely to have a zero or negative growth impact. Devarajan et al. (1996) was one of the first to introduce a model that expresses the difference between productive and non-productive expenditures by how a change in the proportion of total expenditure dedicated to either one impacts on long run economic growth. They stated that a country's desire to reach a more optimal growth rate can be achieved by increasing the proportion of total government expenditure dedicated to productive areas.

If the theory linking various components of government expenditure to economic growth appears reasonably clear, the results from related empirical research are not, especially when distinguishing between the effects of changes in the absolute level of government expenditure and changes in relative amount of productive and non-productive expenditures. In term of absolute levels of expenditure compositions (as a share in GDP), empirical results have consistently reported a positive relationship between productive government expenditure and economic growth, and either a negative or no-impact relationship between non-productive expenditure and economic growth for high-income economies (Afonso and Alegre 2011; Bleaney et al. 2001; Kneller et al.

1999). However, findings on the relationship between the level of public spending and economic growth in low to middle-income economies are mixed. Gupta et al. (2005) used a panel of 39 low-income countries and found that productive government spending enhances growth, whilst non-productive expenditure fails to do so. Christie (2012) revealed an inverse relationship between productive government spending and real GDP per capita for developing economies. Regarding the relative division of total expenditure between productive and non-productive uses, Devarajan et al. (1996) found that diverting expenditure from productive to non-productive can promote economic growth by using 43 developing countries. They subsequently re-tested their regressions with a sample of 21 developed countries for the same period and found that the results are reversed. Ghosh and Gregoriou (2008) also found similar results with Devarajan et al. (1996) in 15 developing countries, where a greater proportion of current (non-productive) spending was found to have a positive effect on the growth rate. Recently, Chu et al. (2018) compare the growth effects of government expenditure compositions between 37 high-income and 22 low to middle-income countries for the period 1993 to 2012. Their studies find that a change in the expenditure mix towards productive forms of expenditure and away from non-productive forms of expenditure enhances economic growth rate for both groups. Given these inconsistencies in empirical findings, it is surprising that relatively little attention has been given to comparing and contrasting the impact of government expenditure compositions on economic growth in countries at different stages of development.

Previous efforts to examine the above issues have also been affected by limitations in data availability and estimation methods (Barro 1990; Easterly and Rebelo 1993). More recent empirical studies have had access to data of improved quality and as a result developed more useful variables and estimation methods (Ghosh and Gregoriou 2008; Gemmell et al. 2016). Nevertheless, there remains a need for more research to address two specific limitations that persist in current economic growth regressions: the possible endogeneity of fiscal variables and the consequences of relying on the period-averaging process to capture long-term growth rates (Bleaney et al. 2001; Kneller et al. 1999).

This chapter attempts to address these gaps in existing literature and thereby make three distinct contributions to the body of knowledge. Firstly, it examines the growth effects of government expenditure compositions for a panel data of 37 high-income and 22 low to middle-income countries for the period 1993 to 2012, thus providing insights on the role that differing levels of economic development play in moderating the relationship. In both groups of countries, the analysis finds increased levels of government expenditure has a negative impact on growth, while a change in the expenditure mix towards productive forms of expenditure and away from non-productive forms of expenditure enhances economic growth rate. Secondly, by regressing economic growth on budgetary economic categories and a set of other relevant variables, this chapter contributes to a growing debate on variations between productive and non-productive forms of government expenditure. The results show that budget deficit variables encourage growth for both sets of countries, while tax revenue and non-tax revenue variables have different effects on growth. Thirdly, this study contributes to overcoming the methodological issues commonly found in similar studies. It computes a 5-year moving average for all variables instead of the traditional 5-year average to smooth over some of the cyclical features of the data. Moreover, based on previous analysis studies and the developments in econometrics theory (Arellano and Bover 1995; Blundell and Bond 1998), this study applies a dynamic panel Generalise Methods of Moments (GMM) system approach to deal with the issue of growth and fiscal variables not always being strictly exogenous.

This chapter is progressed as follows. Section 4.2 presents the model specification and Section 4.3 exhibits a description of the data and empirical methodology used. The main empirical results and the tests for robustness are then discussed in Section 4.4 and Section 4.5, respectively. Finally, Section 4.6 summarises the results and concludes with some policy implications.

4.2 Model Specification

The theoretical framework is based on Devarajan et al. (1996)'s model in which two types of government expenditure, productive and non-productive, are linked with the long run growth rate. However, this analysis includes a feature that is not present in Devarajan et al. (1996), namely a balanced budget (see part 2.4.2 of Literature Review chapter). In this section, the research will discuss the key equations of the model in the CES (constant elasticity of substitution) functional form. The aggregate production function (y) has three arguments: private capital k, and two types of government expenditures g_1 (productive) and g_2 (non-productive):

$$y = \left[\alpha k^{-\zeta} + \beta g_1^{-\zeta} + \gamma g_2^{-\zeta}\right]^{-1/\zeta} \qquad \alpha > 0;\ \beta,\gamma \geq 0;\ \alpha + \beta + \gamma = 1;\ \zeta \geq -1 \quad (4.1)$$

The government budget constraint is:

$$g_1 + g_2 + b = \tau y + NTR \qquad (4.2)$$

Where τ is the (constant over time) income tax rate, b is the budget surplus, and NTR is non-taxation revenue.

Defining net revenue (NR) as total revenue less budget surplus or plus budget deficit, the share of NR that are used to finance two type of government spending,

$$g_1 = \emptyset NR \quad \text{and} \quad g_2 = (1 - \emptyset)NR \qquad 0 \leq \emptyset \leq 1 \qquad (4.3)$$

With an isoelastic utility function, Devarajan et al. (1996) indicated that the long-run growth rate in this model, λ, given by

$$\lambda = \frac{\alpha(1-\tau)\{\alpha\tau^{\zeta}/[\tau^{\zeta} - \beta\phi^{-\zeta} - \gamma(1-\phi)^{-\zeta}]\}^{-(1+\zeta)/\zeta} - \rho}{\sigma} \qquad (4.4)$$

where σ and ρ are constant that reflect parameters in the utility function.

From equation (4.4), it can be derived a relationship between long-run growth rate, λ, and the share of government spending devoted to g_1:

$$\frac{d\lambda}{d\phi} = \frac{\alpha(1-\tau)(1+\zeta)(\alpha\tau^{\zeta})^{-(1+\zeta)/\zeta}[\beta\phi^{-(1+\zeta)} - \gamma(1-\phi)^{-(1+\zeta)}]}{\sigma[\tau^{\zeta} - \beta\phi^{-\zeta} - \gamma(1-\phi)^{-\zeta}]^{-1/\zeta}} \qquad (4.5)$$

From equation (4.5), the government expenditure component g_1 is productive if $d\lambda/d\phi > 0$. Since $\zeta \geq -1$, equation (4.5) indicates that $d\lambda/d\phi > 0$ if:

$$\frac{\emptyset}{1-\emptyset} < \left(\frac{\beta}{\gamma}\right)^{\theta} \quad \text{where } \theta = 1/(1+\zeta) \text{ is the elasticity of substitution} \qquad (4.6)$$

Both forms of government expenditure have an impact on the rate of growth through the marginal production of capital; however their relative influence varies upon the relative productivity of g_1 and g_2, and their relative budget shares, $\emptyset$ and $(1 - \emptyset)$. If g_1 has a greater elasticity value than g_2 $(\beta < \gamma)$ then the rate of growth may still not be increased if the expenditure share of g_1 to g_2 is currently too high. In the special case of Cobb-

Douglas technology ($\xi = 0\ and\ \theta = 1$), the condition for the two types of government expenditure to be at its optimum is:

$$\frac{\emptyset}{1-\emptyset} = \frac{\beta}{\gamma} \tag{4.7}$$

In the model, a government's expenditure decision is taken as a given rather than deriving from some optimising framework. As an optimising framework requires specifying the government's objective function and the results will depend on this function. Therefore, similar to Devarajan et al. (1996) work, this analysis does not attempt to exercise this extension in this paper. The importance of this model is to create insights into what makes particular components of government spending productive. The answer depends on the relationship between the coefficient and the actual share in the budget rather than the sign of the exponent in the production function. This thesis attempts to answer this question by examning empirically how the growth performance was affected by the composition of government expenditures with differing levels of economic development. Like Devarajan et al. (1996) and Ghosh and Gregoriou (2008), this study does not classify government spending as being productive and non-productive to begin with, but let the data direct us. As we shall see, if the regression results show that expenditures which are sum of public expenditure on education, health, general public services, etc; show themselves to have more growth effects, then it can be said that this type of expenditures is indeed more productive than expenditures that are perhaps in the form of public order and safety, recreation and social protection.

To see the implication of this for empirical testing, real output per capita growth is modelled as a function of government size (productive and non-productive government spending) and control variables. This analysis draws together variables from a number of existing endogenous growth models in order to create a more robust model to capture the relationship between components of government expenditure and growth. The set of control variables includes initial GDP per capita, labour force growth, investment (gross capital information as % of GDP), the inflation rate, and openness to trade (sum of exports and imports to GDP). Kneller et al. (1999) and Bose et al. (2007) have cautioned that by not taking full account of GBC in growth models, the coefficient estimates tend to be biased. Therefore, when one evaluates the effect of fiscal policy on growth it should ideally take into account both the sources and the uses of funds. To control for this view, we add components from the revenue side of the government budget to the model, including tax revenue, non-tax revenue and budget surplus or deficit variables.

The first set of regression model specifications for capturing the relationship between productive government expenditure and economic growth, which is based on the Devarajan et al. (1996)'s model is:

$$G_{it} = a_i + b_t + \beta_1 \left(\frac{g_{pro,it}}{g_{pro,it} + g_{nonpro,it}}\right) + \gamma_1 \left(\frac{g_{pro,it} + g_{nonpro,it}}{y_{it}}\right) + \sum_{l=1}^{k} \sigma_l I_{ilt} + \mu_{it}$$

(4.8)

The second set of regression model specifications for capturing the non-productive government expenditure is:

$$G_{it} = a_i + b_t + \beta_2 \left(\frac{g_{nonpro,it}}{g_{pro,it} + g_{nonpro,it}}\right) + \gamma_2 \left(\frac{g_{pro,it} + g_{nonpro,it}}{y_{it}}\right) + \sum_{l=1}^{k} \sigma_l I_{ilt} + \mu_{it}$$

(4.9)

where i and t denote the cross-sectional and time series dimensions respectively, capturing the time-invariant unobserved country-specific fixed effects and the unobserved individual-invariant time effects. G is the per capita real GDP growth rate. $g_{pro}/(g_{pro} + g_{nonpro})$, $g_{nonpro}/(g_{pro} + g_{nonpro})$ are productive and non-productive expenditure as a proportion of total government expenditure.$(g_{pro} + g_{nonpro})$/y is the public expenditure-to-GDP ratio. y is GDP and I_{ilt} is a vector of non-fiscal independent variables (initial GDP per capita, inflation, labour force growth, investment and openness).

Kneller et al. (1999), Bleaney et al. (2001), Bose et al. (2007) and Gemmell et al. (2016) have cautioned that by not taking full account of the GBC in growth models, the coefficient estimates tend to be non-robust. Therefore, when one evaluates the effect of fiscal policy on growth it should ideally take into account both the sources and the uses of funds. This analysis assesses whether our empirical results in regression equations (4.8) and (4.9) with the inclusion of this feature that is not present in the Devarajan et al. (1996)'s model.

Since the GBC describes a closed system, total government expenditure must be financed by revenues ($TR + NTR$) and/or a budget surplus/deficit ($Def\ or\ sur$). To control for this view, this paper adds components from the revenue side of the government budget to the model, including tax revenue, non-tax revenue and budget surplus or deficit variables.

The third set of regression model specifications for capturing the relationship between productive government expenditure and economic growth in the presence of three revenue-side variables in the GBC is:

$$G_{it} = a_i + b_t + \beta_3 \left(\frac{g_{pro,it}}{g_{pro,it} + g_{nonpro,it}}\right) + \gamma_4 \left(\frac{TR_{it}}{y_{it}}\right) + \gamma_5 \left(\frac{NTR_{it}}{y_{it}}\right) + \gamma_6 \left(\frac{Def\ or\ sur_{it}}{y_{it}}\right) + \sum_{l=1}^{k} \sigma_l I_{ilt} + \mu_{it} \qquad (4.10)$$

The fourth set of regression model specifications for capturing the non-productive expenditure is:

$$G_{it} = a_i + b_t + \beta_4 \left(\frac{g_{nonpro,it}}{g_{pro,it} + g_{nonpro,it}}\right) + \gamma_7 \left(\frac{TR_{it}}{y_{it}}\right) + \gamma_8 \left(\frac{NTR_{it}}{y_{it}}\right) + \gamma_9 \left(\frac{Def\ or\ sur_{it}}{y_{it}}\right) + \sum_{l=1}^{k} \sigma_l I_{ilt} + \mu_{it} \qquad (4.11)$$

where TR is tax revenue, NTR is non-tax revenue and $Def\ or\ sur$ is budget surplus or deficit to GDP ratios.

4.3 Data and Empirical Methodology

The sample of countries used in this analysis consists of a panel of 59 countries (37 high-income and 22 low to middle-income) covering the period from 1993 to 2012 (list of countries can be seen in Table 3.2). The classification of high and middle to low-income countries is based on the World Bank's classification using gross national income per capita. One important objective of this analysis is to determine the effects of productive and non-productive government expenditure components on economic growth, so the classification of expenditures into productive and non-productive plays a vital role. This analysis classifies productive government spending as the sum of expenditure on education, health, defence, housing, economic affairs and general public services expenditure, while non-productive expenditure consists of expenditure on public order, recreation and social protection. This classification is based upon those applied by Bleaney et al. (2001), Adam and Bevan (2005), Park (2006), Christine (2012), and Chu et al. (2018).

The fiscal variables for the consolidated central government and general government are collected from the IMF's Government Finance Statistics (GFS) and are subject to availability for each country. Devarajan et al. (1996) rerun their regression on a subset of countries which have data available for both central and general government and found that the results for both kinds of data are consistent. An advantage of this data source is that it also includes sectorial decompositions of total government expenditures and total revenues, which allow the separation of productive and non-productive elements of government spending, as well as tax and non-tax elements of government revenue (see Table 4.1 for the classification of fiscal data). The remaining data are attained from World Bank's Development Indicators (WDI).

Traditionally, to capture the long-run relationship of economic growth to fiscal variables and eliminate business cycle effects, the data is expressed in long-frequency periods – usually 5 years. While some previous studies applied 5-year average for all variables (see for example: Bleaney et al., 2001; Adam and Bevan, 2005; and Christie, 2012) or decade average value for all variables (see for example: Bose et al., 2007); others used 5-year forward moving averages of GDP growth on yearly fiscal variables (Devarajan et al., 1996, and Ghosh and Gregoriou, 2007). However, both of these period-averaging processes have some drawbacks which have been explained in section 3.1.5 of the Methodology chapter. Therefore, this analysis uses 5-year forward moving averages for all variable as it can remove business cycle effects, increase the number of time series observation in our panel data, minimise the reverse causality argument holding in our model and account for endogeneity. In the robustness section, this analysis will re-run the growth regression models with 5-year average period for all variables to see the difference between 5-year average periods with the analysis choice's 5-year moving average period. Also, it will re-run the growth regression models with annual data to see the different impact of government expenditure components on economic growth in the short run and long run.

Table 4.1: Theoretical aggregation of functional classifications

Classification	Functional classification
Government expenditure categories	
Productive expenditures	General public services expenditure Defence expenditure Educational expenditure Health expenditure

Non-productive expenditures	Economic affairs Housing expenditure Public order expenditure Expenditure on recreation Expenditure on social protection
Government revenue categories	
Taxation Revenue	Taxation Revenue
Non-taxation Revenue	Social Contribution (% of GDP) Grant (% of GDP) Other Revenues (% of GDP)

An issue that is encountered in panel data estimation is the presence of unobserved country-specific effects (Easterly et al., 1997). Excluding unobservable country-specific effects could lead to serious biases in the econometric estimates, especially when these effects are correlated with other covariates. The OLS fixed effects, also known as the Least Squares Dummy Variable (LSDV) are often applied to panel estimations to address this concern (Bleaney et al., 2001 and Gupta et al., 2005). Pooled OLS regression, two-way random effects and two-way fixed effects estimations are considered. Based on the log likelihood and the adjusted R^2 for the pooled OLS and a rejection of the null hypothesis in the Hausman test between fixed effects and random effects, the two-way fixed effects which control both time-invariant individual country characteristics and time fixed effect is chosen as the main method of estimation for this thesis. The results for Pooled OLS and two-way random effects are described in Appendix B.

Furthermore, a major concern when running regressions of the form in equation (4.10) and (4.11) is the potential for simultaneity between GDP per capita growth and the right-hand side variables - especially the fiscal variables, a point stressed by Ghosh and Gregoriou (2007), Afonso and Alegre (2011), Gemmell et al. (2016), and Chu et al. (2018). Estimation techniques that do not take into account this endogeneity will be biased and will lead to inconsistent parameter estimates. Ghosh and Gregoriou (2007) applied GMM technique to tackle possible endogeneity of the explanatory variables in the panel. Recently, Christie (2012) re-estimated productive public spending variable using dynamic GMM to account for endogeneity and found that the results are consistent with her main result using Fixed Effect Method. Therefore, this analysis also applies the dynamic panel one-step system GMM estimation (Arellano and Bover, 1995 and Blundell and Bond, 1998) to address those concerns. The single equation GMM panel estimator (difference GMM) normally specifies a dynamic model in first differences and is able to provide consistent coefficient estimates. However, the difference GMM estimator can experience a weak correlation between the regressors and the instruments. To overcome this problem Blundell and Bond (1998) have proposed the panel GMM system estimator, which combines a system of equations in first differences and levels, and has been shown to perform much better (less bias and more precision). The reason for using one-step GMM estimator is that this technique is efficient when the errors are homoscedastic and not correlated over time. This is often too restrictive. However, the one-step results are consistent, and robust standard errors that adjust for heteroskedasticity and autocorrelation are easily obtained. Furthermore, the estimated standard errors of the two-step GMM estimator tend to be too small when the analysis has a small sample (small number of individuals), similar to our sample. To sum up, the system GMM estimation is specifically designed to handle some of the problematic features of panel data, such as: country-specific fixed effects, heteroscedasticity and autocorrelation within countries. However, this thesis uses GMM approach as robustness analysis to assess the sensitivity of the econometric results presented by two-way fixed effects rather than the main estimation approach. There are a few reasons for this decision. First, Roodman (2009b) stated that if the number of time series observations (T) is large, dynamic panel sometimes becomes insignificant, and a more straightforward fixed-effects estimator works. Furthermore, the number of instruments in different and system GMM tend to explode with T. Second, if the number of countries (N) is small, the cluster-robust standard errors and the Arellano-Bond autocorrelation test may be unreliable (Bond et al., 2001 and Roodman, 2009b). Lastly, an underappreciated problem often arises in the application of different and system GMM is instrument proliferation (Roodman, 2009a). Tauchen (1986) demonstrated in simulations of very small samples (50–75 observations) that the bias of GMM raises as more instruments, based on deeper lags of variables, are introduced. Ziliak (1997) obtains similar results. In Monte Carlo tests of difference GMM in particular, on 8 × 100 panels, Windmeijer (2005) reports that reducing the instrument count from 28 to 13 cuts the average bias in the two-step estimate of the parameter of interest by 40%. The first and second analysis of this thesis use short panel data, as these analysis examine the relationship between government expenditure components, corruption and economic growth for a panel data of 37 high-income and 22 low to middle-income countries (N = 37 and 22) for the period 1993 to 2012 (T = 15 for applying five-year moving averages). The final analysis uses a shorter panel data as this thesis focuses on the growth effects of government expenditure on human capital and its components (education and health) for an Asia case study. Therefore, the two-way fixed effects which control both time-invariant individual country characteristics and time fixed effect is chosen as the benchmark for this thesis. Meanwhile, the GMM estimation has the advantage of using internal instruments, formulated from lags of the endogenous and pre-determined variables for each time period to tackle possible endogeneity of the explanatory variables in the panel. Hence, it is used as robustness analysis.

Table 4.2 lays out some descriptive statistics for the data set. It can be seen that high-income economies have a lower average growth rate than low and middle-income economies, at 2.6% and 3.3% respectively. It has been observed that high-income economies have bigger size of government expenditure than low to middle economies, which accounts for approximately 39% and 26% of total GDP respectively. Small government sizes tend to concentrate spending on productive government spending. Low to middle-income countries spend over 78% of government spending on productive spending such as infrastructure, health, defence and education, to help boost economic growth and catch up with the development of high-income countries who spend approximately 61% of total government expenditure on productive components. Meanwhile, countries with bigger governments tend to allocate a larger share of total government spending to social welfare and transfer payments (Gray et al., 2007). In the estimation sample, high-income countries use roughly 39% of total expenditure on non-productive spending, compared to 22% on low to middle-income countries. Moving to other fiscal variables, developing countries have a lower average budget deficit as percentage of GDP than developed countries, at -0.9% and -2.8% respectively. Meanwhile, tax revenue and non-tax revenue variables as percentage of GDP in developed countries have a higher average rate compared to developing countries, 23% compared with 15% for tax revenue and 15% compared with 8% for non-tax revenue. Looking at other macroeconomic variables in table 4.2, high income countries have a low average inflation rate during this period at 3.4%; while low to middle income countries have markedly high inflation rate with average of 13.8%. Regarding trade openness as percentage of GDP, high income economies have a higher average rate than low to middle economies, at 100% and 78% respectively. The remaining variables such as investment and labour force growth show no significant difference between the two sub-group country samples.

Table 4.3 describes the correlation matrix between variables. It can be seen that productive and non-productive government spending as a percentage of total government expenditure have a highly negative correlation with each other (-0.9983) as they are both part of total expenditure. Therefore, this analysis introduces productive and non-productive expenditure in separate regression models. This exercise can also help to solve the collinearity problem when we combine tax revenue, non-tax revenue and budget deficit or surplus variables of GBC in this analysis.

Table 4.2: Descriptive Statistics

	Full sample		High-income economies		Low to Middle-income economies	
Variable	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**
GDP p.c. growth (% p.a)	2.594	3.419	2.141	3.337	3.343	3.424
Productive government expenditure (% TGE)	67.012	14.373	60.599	10.996	78.040	12.718
Non-productive government expenditure (% TGE)	32.988	14.234	39.401	10.965	21.960	12.574
Total government expenditure (% of GDP)	34.630	12.565	39.803	11.329	25.658	9.074
Log Initial p.c. GDP (constant 2005 US$)	9.042	1.540	10.055	0.641	7.346	1.013
Investment (Gross capital formation as % of GDP)	23.460	5.935	23.376	5.761	23.600	6.219
Inflation rate (%)	7.324	30.654	3.419	4.638	13.784	48.940
Labour force growth (p.a)	1.521	2.041	1.280	2.091	1.926	1.888
Openness (Sum of exports and imports as % of GDP)	91.665	55.954	100.024	64.453	77.617	33.188
Deficit or Surplus (% of GDP)	-2.111	4.667	-2.843	4.765	-0.859	4.214
Tax Revenue (% of GDP)	20.240	8.219	23.268	8.266	15.007	4.803
Non-Tax Revenue (% of GDP)	12.215	7.122	14.818	6.409	7.716	5.959

Table 4.3: Correlation Matrix

	GRO	INF	INV	LFG	LIG	NTR	OPN	SOD	TR	PGE1	UPGE1	TGE
Growth (GRO)												
Inflation (INF)	-0.0047											
Investment (INV)	0.5046	-0.1001										
Labour force growth (LFG)	-0.1942	-0.1036	0.0069									
Log initial GDP (LIG)	-0.2835	-0.2143	-0.1783	-0.1861								
Non-tax revenue (NTR)	-0.2333	-0.0176	-0.1838	-0.1123	0.537							
Openness (OPN)	0.0001	-0.0725	0.0283	0.1266	0.2865	0.0921						
Surplus or deficit (SOD)	0.0699	-0.0465	0.0687	0.0763	0.2878	0.2293	0.2626					
Tax revenue (TR)	-0.1949	-0.1105	-0.3404	-0.3542	0.6423	0.2349	0.023	0.1622				
Productive spending (PGE1)	0.1065	0.0961	0.1704	0.449	-0.6893	-0.585	0.0034	-0.1326	-0.6315			
Non-productive spending (UPGE1)	-0.1049	-0.0923	-0.1743	-0.4491	0.6852	0.5865	-0.0058	0.1346	0.6295	-0.9983		
Total government expenditure (TGE)	-0.2636	-0.0806	-0.3036	-0.3506	0.687	0.6818	-0.008	-0.045	0.7626	-0.7396	0.7373	

The reason for using productive and non-productive government expenditure as a percentage of total government expenditure instead of as a percentage of GDP has been explained in Section 3.1.3 in the methodology chapter.

4.4 Results

Table 4.4 presents the estimated effects of productive and non-productive government expenditure on economic growth in high-income and low to middle-income economies by using a two-way fixed effects method. The main variable of interest is share of productive and non-productive expenditure on total government spending, which have a respective positive and negative statistically significant coefficient effect on economic growth for high-income economies (column [1] and [2]). For high-income economies, a one percentage point shift in the ratio of government expenditure away from non-productive areas and toward productive areas of spending will increase per capita real GDP growth by 0.05 percentage points. These results are unsurprising and consistent with previous findings for high-income economies (see for example: Devarajan et al., 1996; Gemmell et al., 2016 and Chu et al., 2018).

Meanwhile, Column [3] and [4] display the regression results of growth against the ratio of productive and non-productive expenditure in low to middle-income economies. However, no statistically significant relationship is found between composition of government expenditure and growth in this group of countries. These findings differ from those of Devarajan et al. (1996) and Ghosh and Gregoriou (2008), who in similar work found significant impacts. The reason for this may be due to the absence of the GBC variables in their studies, as criticised by other authors (Kneller et al. 1999; Bleaney et al. 2001; Adam and Bevan 2005; Afonso and Alegre 2011; Gemmell et al. 2016). Devarajan et al. (1996) did not include this feature in their model, while Ghosh and Gregoriou (2008) compared their main results with and without the presence of GBC and found there is not much difference for the main variables of interest. The vital role of GBC in main results will be seen in Table 4.5.

Regarding total government expenditure as a ratio to GDP, it can be seen that it has a negative and significant impact on economic growth for both high-income and low to middle-income group. This is the level effect of total government expenditure on per capita growth, which has been found to be positive but insignificant by Devarajan et al.

(1996) and positive significant by Ghosh and Gregoriou (2008) for developing countries. So this results of ours is somewhat different from their findings, but consistent with previous studies for developed countries (Romero-Avila and Strauch 2008; Afonso and Alegre 2011; Christie 2012). Increases in government expenditure might increase the tax burden on citizens - either now or in the future – which leads to a reduction in private spending and investment (crowding-out effect) and thus retards economic growth (Barro 1990; Bose et al. 2007). With a negative effect of total government spending on growth, it is important for governments to reallocate government expenditure in a more optimal way and thereby to increase economic growth within a given government expenditure decision.

Table 4.4: Productive and Non-productive government spending with FE technique

Estimation technique: 5-year moving average - two-way fixed effect
Dependent variable: Per capita growth

	High Income		Low and Middle Income	
	(1)	(2)	(3)	(4)
Productive expenditure	**0.0513****		**0.0289**	
	(0.0265)		(0.0354)	
Non-productive expenditure		**-0.0510***		**-0.0237**
		(0.0294)		(0.0366)
Total government expenditure	**-0.1136*****	**-0.1145*****	**-0.1344***	**-0.1390***
	(0.0403)	(0.0405)	(0.0921)	(0.0919)
Log Initial GDP	-2.4789	-2.4123	-0.3023	-0.2821
	(2.6749)	(2.6965)	(2.0513)	(2.0714)
Investment	0.1219**	0.1223**	0.1747**	0.1740**
	(0.0591)	(0.0591)	(0.0658)	(0.0655)
Inflation	-0.0304	-0.0308	-0.0028	-0.0025
	(0.0443)	(0.0444)	(0.0050)	(0.0049)
Labour force growth	0.0717	0.0689	-0.2096	-0.2129
	(0.1531)	(0.1530)	(0.2674)	(0.2700)
Openness	0.0427**	0.0420**	-0.0053	-0.0053
	(0.0163)	(0.0163)	(0.0202)	(0.0202)
Constant	22.7369	27.3148	2.8611	4.2648
	(23.547)	(25.387)	(15.669)	(13.564)
Observations	591	591	344	344
No of countries	37	37	22	22
Adjusted R-squared	0.5612	0.5605	0.5022	0.5011

Note: Robust standard error in parentheses. Country and time dummies included but not reported
*** p < 0.01, ** p < 0.05, * p < 0.1

Turning our attention to other variables, the positive coefficient attached to investment for both sets of countries follows standard economic theory, in which an increase in the investment results in increase in production, and conforms to previous studies (Adam and Bevan 2005; Bose et al. 2007; Afonso and Alegre 2011; Christie 2012). The same effect is expected to apply for the labour force growth variable, but this analysis cannot report any statistically significant effect. This may indicate that growth in endogenous growth models could be influenced by fiscal policy rather than the rate of labour force growth. Unlike Christie (2012), this thesis finds that neither log initial GDP nor inflation has a significant impact on growth (indeed the inflation coefficient is negative). Therefore, there is no conditional convergence hypothesis for this initial GDP variable. The openness variable in terms of trade is normally positive for low and middle-income countries since trade is assumed to be growth-enhancing, but this analysis observes no relationship between them for low to middle-income economies sample (similar to Ghosh and Gregoriou 2008). However, in the sample of high-income economies, international trade has a positive and significant impact on economic growth.

As an alternative procedure, this thesis estimates growth regression by including three revenue-side variables in the GBC instead of total government expenditure in equations (4.10) and (4.11). This will help to compare the new results with the benchmark specification, where total government expenditure was assumed as the only variable to represent the revenue side in Devarajan et al. (1996)'s model. An issue worth noting is if it included all the budget components in the regression it can create perfect collinearity (Gupta et al. 2005; Bose et al. 2007). This thesis avoids this by including productive and non-productive government expenditure in separate regressions.

Table 4.5 reports the results of the new set of regressions where clearly the main sources of funds are included as three separate variables. It can be seen that the economic growth effects of productive and non-productive expenditure are similar to those in table 2 for high-income economies. However, both of these expenditures show a significant impact on economic growth in low to middle-income group. The result is stronger for low to middle-income economies with per capita real GDP rising by 0.06 percentage points in response to reallocating one percentage point away from non-productive spending and toward productive expenditure. Though this result opposes the result of Devarajan et al. (1996) and Ghosh and Gregoriou (2008) for developing countries, it is similar to some previous empirical findings for developing countries (Adam and Bevan 2005; Gupta el al. 2005; Park 2006), despite quite different samples and approaches to estimation.

Table 4.5: Productive and Non-productive government spending with FE technique in the presence of three revenue-side variables in the GBC

Estimation technique: 5-year moving average - two-way fixed effect
Dependent variable: Per capita growth

	High-income		**Low and Middle-income**	
	(1)	(2)	(3)	(4)
Productive expenditure	**0.0507***		**0.0648***	
	(0.0282)		(0.0334)	
Non-productive expenditure		**-0.049***		**-0.0602***
		(0.0307)		(0.0336)
Log Initial GDP	-2.6191	-2.5341	0.4827	0.4977
	(2.4902)	(2.5067)	(1.4092)	(1.4181)
Investment	0.0936*	0.0935*	0.1956***	0.1935***
	(0.0595)	(0.0601)	(0.0607)	(0.0609)
Inflation	-0.044	-0.0442	0.0004	0.0004
	(0.0445)	(0.0449)	(0.0047)	(0.0046)
Labour force growth	0.0963	0.0935	-0.0883	-0.0862
	(0.1332)	(0.1342)	(0.2524)	(0.2575)
Openness	0.0424***	0.0415***	0.0058	0.0052
	(0.0148)	(0.0148)	(0.0186)	(0.0183)
Non-tax revenue	-0.1465***	-0.1476***	0.0069	0.0031
	(0.0529)	(0.0532)	(0.0757)	(0.0764)
Tax revenue	0.1359	0.1339	-0.2321**	-0.2315**
	(0.0978)	(0.0984)	(0.0843)	(0.0836)
Surplus or Deficit	0.2053***	0.2060***	0.2202***	0.2262***
	(0.0644)	(0.065)	(0.0696)	(0.0702)
Constant	3.524	24.1057	-6.6917	-0.2553
	(1.5661)	(22.894)	(11.6589)	(8.8435)
Observations	591	591	344	344
No of countries	37	37	22	22
Adjusted R-squared	0.6077	0.6065	0.5677	0.5655

Note: Robust standard error in parentheses. Country and time dummies included but not reported

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

As previous research focused on either high-income or low-income countries, but never both together, it is difficult to directly compare and contrast results. By using the same period of analysis and methodology, this study can for the first time directly compare countries effects. The findings show that an increase in the absolute level of total government expenditure has a crowding-out effect and thus obstructs economic growth. However, by shifting the mix of spending way from non-productive forms of expenditure and towards productive forms, countries can move closer to a more optimum growth level for both high-income and low to middle-income groups. These results are consistent with the theoretical framework and the empirical strategy used in previous studies, which predict that the coefficients estimated for government expenditure components (productive and non-productive) should be of similar size but different signs.

Concerning the GBC variables, this analysis finds that increased tax revenue in low to middle-income countries has a negative and significant impact on economic growth. The result is consistent with previous empirical studies for developing countries (Bose et al. 2007; Lee and Gordon 2005). Tax rate cuts encourage individuals, businesses and shareholders to work, save, invest, and build capital; thereby directly impacting economic growth. It is expected the same effect of tax revenue on economic growth for high-income countries (Arnold et al. 2011; Gemmell et al. 2011), but this expectation is not supported by these findings. To fully examine the impact of taxation on economic growth for high-income countries, it may need to decompose total tax revenue into different types of taxes as previous studies have done. For example; Arnold et al. (2011) found that corporate taxes are most damaging to economic growth over the long-run, followed by taxes on personal income, consumption and property. In the scope of this thesis, I do not focus on this aspect of government revenue. On the other hand, non-tax revenue is found to be negative and significant effect on growth in high-income economies, while it is not significant in low to middle-income countries.

In addition, greater budget surplus or reduced deficit estimated coefficients indicate a positive and significant effect on long-term growth for both sets of countries. Previous research on this same relationship has produced mixed results. Afonso and Alegre (2011) and Kneller et al. (1999) found a positive coefficient effect of budget surplus on economic growth for a panel of 15 EU and 22 OECD countries. Meanwhile, Bose et al. (2007) and Gupta et al. (2005) found the budget deficit adversely affects growth in their panels of developing countries. Adam and Bevan (2005) found that budget deficits could be growth-enhancing in their 45 developing sample economies. The financing assumptions may help explain these different results. If greater budget surplus or reduced deficit is a result of an increase in public investment or a decrease in tax, it should promote economic growth. However, table 4.4 and table 4.5 suggest that as the coefficients estimated for budget surplus are positive and significant while the coefficients estimated for revenue side are negative (on non-tax revenue or tax revenue from high-income and low to middle-income respectively), the level of total public expenditure may be at or beyond its optimum and increasing it further would hinder economic growth. Therefore, governments should consider reducing total government spending and focus on reallocating funds towards productive and away from non-productive spending to achieve a closer to optimum growth level.

The results in table 4.5 also suggest that not incorporating full GBC into the analysis could tend to make the coefficient estimates biased which have been warning by some researchers, e.g., Kneller et al. (1999); Bleaney et al. (2001); Bose et al. (2007); Afonso and Alegre (2011); Gemmell et al. (2016). The coefficients on the other important variables remain strikingly similar to what was obtained in table 4.4.

4.5 Robustness

In this section, this analysis assesses the robustness of the baseline results by conducting the following four exercises. First of all, a critical econometric issue arising in estimating our empirical model is that the right-hand side variables in equations (4.10) and (4.11) may not be exogenous. They can be determined by each other, by growth rate, by other variables that are not controlled for in the empirical specification. The one-step system GMM dynamic panel is used to provide more reliable and precise results as it offers more rigorous treatment of the endogeneity of fiscal variables on growth. Secondly, this analysis assesses whether the baseline results are sensitive to the choice of time period. It re-runs the regression models using five-year average of all variables to examine the consequences of the period-averaging process to capture long-term economic growth. Also, using annual data for all variables, this exercise compares the impact of government expenditure components on growth between long-run and short-run. Thirdly, this section examines the definitions and classifications of productive and non-productive government expenditure. Finally, this analysis considers the difference in the level effect of spending on long-run economic growth.

4.5.1 Robustness Test: Testing for Endogeneity

A common issue in literature for fiscal policy and growth is the likely presence of endogeneity. The validity or interpretation of aggregate growth regressions is the possibility that estimated relationships represent correlations but not causation (Gemmell et al., 2016). This thesis cannot discount the possibility that a direct impact of fiscal variables on GDP, changes in GDP may induce changes in these fiscal variables. Fiscal policy changes may also be associated with country-specific time-varying variables, such as political conditions, that influence GDP levels or growth rates. Economic downturns reduce taxable capacity and lead to increases in certain types of public expenditure such as unemployment benefits and social insurance payments. Though these may be at the expense of other types of expenditure, this is often insufficient to prevent total spending from rising in downturns (Sanz, 2010). As previously noted, social welfare expenditures might be expected to rise in response to an economic downturn yielding negative correlations with GDP. On the other hand, some productive expenditure shares may rise when faster GDP growth generates additional revenues, and demands for social welfare-related expenditures weaken. This would have contrasting effects on the shares of these different components of expenditure in total expenditure and for total expenditure as a ratio to GDP. In addition, over the longer term, the income elasticity of demand for education and health may be high, leading to upward pressure on public spending (Slemrod, 1995). Moreover, some degree of reverse causality could also be present in the relationship between growth and investment, and growth and openness (Christie, 2012; Gupta et al., 2005 and Ghosh and Gregoriou, 2007). If economic growth is a determinant of any of the right-hand side variables in thesis model, estimation techniques that do not take into account this endogeneity may yield biased and inconsistent parameter estimates.

Since the GMM technique was first improved by Arellano and Bond (1991) it has become a common method to apply and capture the endogeneity involved in the simultaneous economic growth regressions. The reason for its popularity is that GMM has the benefit of using internal instruments to deal with the problem of the main variable of interest not being strictly exogenous. The consistency of the Arellano and Bond estimator depends on the assumption that errors are not serially correlated. It is therefore crucial to test for the presence of serial correlation. Arellano and Bond’s test reports for first and second order serial correlation of the differenced residuals. Hence, there should be first order but not second order correlation (Roodman, 2009a). Furthermore, Arellano and Bover (1995) and Blundell and Bond (1998) suggested a Sargan or Hansen test for over-identifying restrictions, which tests the overall validity of the instruments when applying the GMM technique.

Bleaney et al. (2001) and Bose et al. (2007) found substantial lagged effects of growth for a set of 21 OECD countries and 40 developing countries respectively, and suggested that long-run effects of fiscal policy may take more than one interval to be effective. To account for this, this analysis applies dynamic model with lagged growth as an explanatory variable for both group samples. Fiscal, investment and openness variables entered as endogenous, whereas all other variables with time dummies are assumed to be exogenous and instrument for themselves (Bose et al., 2007, Christie, 2012 and Gupta et al., 2005). To capture the effect of lagged growth and to be consistent with the approach of Bose et al. (2007), this analysis excludes log initial GDP from the regressions.

The estimated dynamic models with lagged growth as an explanatory variable and capturing the productive expenditure:

$$G_{it} = a_i + b_t + \alpha_1 G_{it-1} + \beta_2 \left(\frac{g_{pro,it}}{g_{pro,it} + g_{nonpro,it}}\right) + \gamma_1 \left(\frac{TR_{it}}{y_{it}}\right) + \gamma_2 \left(\frac{NTR_{it}}{y_{it}}\right) + \gamma_3 \left(\frac{Def\ or\ sur_{it}}{y_{it}}\right) + \sum_{l=1}^{k} \sigma_l I_{ilt} + \mu_{it} \quad (4.12)$$

The estimated dynamic models with lagged growth as an explanatory variable and capturing the non-productive expenditure:

$$G_{it} = a_i + b_t + \alpha_1 G_{it-1} + \beta_3 \left(\frac{g_{nonpro,it}}{g_{pro,it} + g_{nonpro,it}}\right) + \gamma_1 \left(\frac{TR_{it}}{y_{it}}\right) + \gamma_2 \left(\frac{NTR_{it}}{y_{it}}\right) + \gamma_3 \left(\frac{Def\ or\ sur_{it}}{y_{it}}\right) + \sum_{l=1}^{k} \sigma_l I_{ilt} + \mu_{it} \quad (4.13)$$

where G_{it-1} is the first lag of the growth variable

The results for the dynamic panel GMM one-step system technique for productive and non-productive expenditures on both group countries sample are presented in Table 4.6.

Table 4.6: Productive and Non-productive government spending with GMM technique in the presence of three revenue-side variables in the GBC

Estimation technique: 5 years moving average - GMM one-step system Dependent variable: Per capita growth

	High-income		Low and Middle-income	
	(1)	(20	(3)	(4)
Productive expenditure	**-0.0308***		**0.0299****	
	(0.0208)		(0.0135)	
Non-productive expenditure		**0.0314**		**-0.0323****
		(0.0266)		(0.0155)
Lagged growth	0.9314***	0.9216***	0.9445***	0.9356***
	(0.0712)	(0.0757)	(0.0335)	(0.0384)
Investment	0.0406	0.0551	0.0045	0.0116
	(0.0557)	(0.0568)	(0.0179)	(0.0192)
Inflation	-0.0161	-0.0062	0.0023	0.0026
	(0.0536)	(0.0569)	(0.0023)	(0.0023)
Labour force growth	0.08483	0.1047	-0.0431	-0.0410
	(0.0824)	(0.0918)	(0.0673)	(0.0697)
Openness	0.0022	0.0028	-0.0014	0.0025
	(0.0036)	(0.0038)	(0.0050)	(0.0050)
Non-tax revenue	0.0440	0.0531	0.0146	0.0084
	(0.0434)	(0.0401)	(0.0434)	(0.0444)
Tax revenue	0.0314	0.0464	0.0253	0.0389
	(0.0602)	(0.0623)	(0.0510)	(0.0515)
Surplus or Deficit	-0.0183	-0.0122	0.0448	0.0574
	(0.0551)	(0.0549)	(0.0724)	(0.0665)
Constant	-0.1490	-4.1736	-2.773*	0.0995
	(3.6369)	(3.6784)	(1.5056)	(0.9932)
Observations	554	554	323	323
No of countries	37	37	22	22
No of instruments	44	44	37	37
AR(1) test (p-value)	0.014	0.018	0.02	0.018
AR(2) test (p-value)	0.027	0.027	0.154	0.178
Hansen test (p-value)	0.540	0.900	0.983	0.935

Note: Robust standard error in parentheses. Country and time dummies included but not reported
*** p < 0.01, ** p < 0.05, * p < 0.1

These results also report Arellano-Bond's test for autocorrelation and the Hansen J-test of over-identifying restriction. When the model is estimated only for low to middle-income economies, the results closely align with those of the fixed effects model for both productive and non-productive government spending. This implies that the main results for those economies are not purely an object of endogeneity biases. The coefficients of those main interests (productive and non-productive variables) are smaller under GMM than fixed effect model, but the standard errors are also smaller. While the coefficients on the control variables are of different magnitudes and signs. On the other hand, GMM estimation for high-income group does not appear to be valid. While the Hansen J test for over-identifying restrictions does not reject the null hypothesis that our instruments are uncorrelated with the residuals for both samples, we only fail to reject the null hypothesis of no second order serial correlation for the developed economies at the 10% level. Notably, lagged growth appears significant for both sets of samples as foreseen by Bleaney et al. (2001) and Bose et al. (2007), but with five-year moving average data this dynamic specification presents high value (approximately 0.90) of lagged growth. One of the reasons for the invalidity of GMM technique in high income countries may be common characteristics among macro data sets.

4.5.2 Robustness Test: Time-series Period and Using 5-year Average

This further robustness test was carried out by using 5-year averages instead of 5-year moving averages for all variables in both group samples. The results are reported in table 4.7 (using OLS two-way fixed effects technique). It can be seen that productive government spending has a positive and statistically significant effect on per capita growth rate, while non-productive government spending is significantly negative for high-income sample data. In particular, the higher growth effects for productive and non-productive expenditure is attached to this 5-year average period (0.08 percentage point compared with 0.05 for productive expenditure and -0.08 percentage point compared with -0.05 for non-productive expenditure). These results are consistent with the main results in part 4.4 for high-income economies and give a reliable parameter estimates for our sample. Other control variables present the same results with the main one even though some have higher estimated coefficients, such as, investment, openness and non-tax revenue. Surprisingly, there is a positive and significant effect between labour force growth and long-run economic growth in high-income sample data (Column [1] and [2]). It is common and popular practice of taking 5-year average when examining relationships between government expenditure components and long-run economic growth, as seen in Table 2.1 in Literature Review chapter (except: Devarajan et al. (1996), Ghosh and Gregoriou (2007) and Gemmell et al. (2016) used 5-year moving average for dependent variable). This approach smooths out changes due to cyclical effect and also eliminates potential econometric biases due to endogeneity problems arising from short-run cyclical simultaneity when applying static panel econometric techniques (Christie, 2012).

Table 4.7: Productive and Non-productive government spending with five-year average

Estimation technique: 5-year average – two way Fixed Effects Dependent variable: Per capita growth				
	High Income		**Low and Middle Income**	
	(1)	(2)	(3)	(4)
Productive expenditure	**0.0777*** **		**0.0393**	
	(0.0257)		(0.0381)	
Non-productive expenditure		**-0.0807*** **		**-0.0361**
		(0.0268)		(0.0372)
Log Initial GDP	-1.0991	-1.0681	-0.3173	-0.3275
	(2.0833)	(2.0943)	(1.1876)	(1.1813)
Investment	0.2014***	0.2026***	0.1921***	0.1927***
	(0.0564)	(0.0570)	(0.0585)	(0.0582)
Inflation	-0.0490	-0.0488	0.0023	0.0029
	(0.0495)	(0.0496)	(0.0061)	(0.0059)
Labour force growth	0.1990*	0.1931*	-0.1047	-0.1068
	(0.1250)	(0.1258)	(0.2470)	(0.2507)
Openness	0.0415***	0.0407***	-0.0111	-0.0112
	(0.0128)	(0.0129)	(0.0138)	(0.0137)
Non-tax revenue	-0.1874***	-0.1896***	-0.0703	-0.0722
	(0.0627)	(0.0632)	(0.0884)	(0.0883)
Tax revenue	0.1320*	0.1269	-0.1582**	-0.1616**
	(0.0860)	(0.0869)	(0.0776)	(0.0770)
Surplus or Deficit	0.1040*	0.1050*	0.1932*	0.1996*
	(0.0577)	(0.0584)	(0.1086)	(0.1067)
Constant	0.6171	8.4063	1.7861	5.8107
	(17.6205)	(19.1919)	(10.7664)	(8.2412)
Observations	147	147	84	84
No of countries	37	37	22	22
Adjusted R-squared	0.7576	0.7074	0.6299	0.6288

Note: Robust standard error in parentheses. Country and time dummies included but not reported

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

For low to middle economies group, however, the coefficient on productive (non-productive) government spending is positive (negative), but not statistically significant.

The reason for this insignificance may be due to the absence of automatic stabilisers. Developed or high-income economies have normally achieved a degree of macroeconomic stability, so changing between 5-year averages and 5-year moving average is unlikely to affect the relationship between components of government spending and growth. Meanwhile, for low to middle-income countries, 5-year average for pre-stabilisation countries may lead to bias results as their governments set up several five-year Socio-Economic Development Plans to achieve development and economic growth. Therefore, any study that uses the wrong 5-year average period between two 5-Year Plans may result in incorrect estimates. Hence, using a 5-year moving average for all variables, as in our model, is more reliable and efficient.

In addition, the research also ran the test with annual data for all variables to see the short-run effects on growth and the results are reported in Table 4.8. Productive government spending in both groups has a positive and significant impact on growth, consistent to our main results with 5-year moving average. Similar results are found for non-productive government spending for high-income and low to middle-income economies groups (negative and statistically significant effect on growth). Taking into account the role of control variables, this analysis also finds the same results as in part 4.3. Hence, the thesis model could be applied to capture the effect of both the short-run and long-run impact of government spending on growth. However, as mentioned before, fiscal performance is highly likely to be endogenous to economic growth, especially in the short-run (Adam and Bevan, 2005 and Christie, 2012). Therefore, the finding suggests that applying a 5-year moving average for all variables is the most efficient and reliable method to capture the effect of government expenditure on long-term economic growth.

Table 4.8: Productive and non-productive government spending with annual data

Estimation technique: yearly with OLS two-way fixed effect Dependent variable: Per capita growth				
	High Income		**Low to Middle Income**	
	(1)	(2)	(3)	(4)
Productive expenditure	**0.0755****		**0.0577***	
	(0.0347)		(0.0280)	
Non-productive expenditure		**-0.0774****		**-0.0542**
		(0.0368)		(0.0272)
Log Initial GDP	0.2221	0.2304	1.2327	1.2248
	(2.4403)	(2.4386)	(1.4398)	(1.4366)
Investment	0.2075***	0.2066***	0.2797***	0.2780***
	(0.0532)	(0.0532)	(0.0488)	(0.0491)
Inflation	-0.0452	-0.0457	-0.0020	-0.0020
	(0.0325)	(0.0322)	(0.0026)	(0.0026)
Labour force growth	-0.0576	-0.0565	0.0049	0.0041
	(0.0732)	(0.0731)	(0.1306)	(0.1306)
Openness	0.0441***	0.0435***	-0.0096	-0.0100
	(0.0120)	(0.0120)	(0.0162)	(0.0162)
Non-tax revenue	-0.1783***	-0.1800***	0.0643	0.0626
	(0.0648)	(0.0642)	(0.0565)	(0.0568)
Tax revenue	0.0433	0.0430	-0.2527***	-0.2529***
	(0.0955)	(0.0953)	(0.0831)	(0.0846)
Surplus or Deficit	0.1942***	0.1940***	0.1237*	0.1278*
	(0.0548)	(0.0553)	(0.0664)	(0.0657)
Constant	-10.849	-3.2296	-13.385	-7.507
	(21.221)	(23.035)	(10.708)	(9.3029)
Observations	686	686	397	397
No of countries	37	37	22	22
Adjusted R-squared	0.7576	0.7074	0.387	0.3857

Note: Robust standard error in parentheses. Country and time dummies included but not reported

*** p < 0.01, ** p < 0.05, * p < 0.1

4.5.3 Robustness Test: Classification of Fiscal Variables

The next change this analysis makes to the regression equation is to re-test the classification of productive and non-productive variables. The aggregation of the functional classification in the data source into theory-based categories in Table 4.1 has been a controversial issue. Moreover, much of the empirical literature testing for the effects of public expenditure decompositions on long-run economic growth shows inconsistent results. Regarding high-income economies, it has been found that education, health and economic affairs (transport and communication) are positively associated with long-run economic growth (Barro, 1991; Easterly and Rebelo, 1993; Kocherlakota and Yi, 1997; Kneller et al., 1999; Bassanini and Scarpetta, 2002; Afonso and Alegre, 2011; and Gemmel et al., 2016). Meanwhile, these expenditure components showed different results in the case of developing economies. Bose et al. (2007), Bayraktar and Moreno-Dodson (2012), and Acosta-Ormaechea and Morozumi (2013) found that education expenditure has a positive impact on economic growth, while health and transport & communication spending do not. In contrast, Ghosh and Gregoriou (2007) stated that education and health expenditure have a negative impact on economic growth in their 15 developing countries for the period from 1972 to 1999. The differences in applying various methodological approaches, specification models and time periods are the reason for these variable results. Also, little attention has been given to comparing the impact of government expenditure decompositions on economic growth at the different stages of country development. Devarajan et al. (1996) were one of the first to compare the different between two groups: developed and developing countries. They used panel data of 43 developing countries from 1970 through 1990 and found a positive relationship between health and transport & communication expenditure and economic growth, while reporting a negative relationship between defence and education spending and growth. They subsequently re-tested their regressions with a sample of 21 developed countries for the same period and found that the results are reversed. Recent study, Afonso and Jalles (2014) use a large panel of OECD and emerging countries (155 countries) for the period 1970 to 2008 to differentiate the effects from expenditure on education and health between each group. However, the results are not clear to compare and contrast between two sub-group sample data as they find an only positive and significant effect of education spending on economic growth in the emerging economies sub-group (insignificant impacts on other expenditure and other group). Moving to social protections (and welfare) which constitutes the main item of non-productive expenditure, it is found to have a negative impact on growth in either developed or developing countries sample in previous empirical studies (for example, Kneller et al., 1999; Afonso and Alegre, 2011; Acosta-Ormaechea and Morozumi, 2013; Afonso and Jalles, 2014; and Gemmel et al., 2016).

To highlight the concern about the classification of productive and non-productive expenditure and also the difference in comparing the impacts of public spending decompositions between two sub-group samples, this analysis now separates out productive and non-productive government spending to their components. It then re-runs the regression with each component in functional classification by applying OLS two-way fixed effects to test the relationship between them and economic growth. Expenditure on recreation, a non-productive spending, to total government spending ratio is too small and will therefore not be considered in this test. The results are displayed in Table 4.10, while the descriptive statistics of these components are presented in Table 4.9. In general, most of the components of productive government spending for each group data have a positive (either significant or insignificant) impact on growth, while expenditure on social protection (major percentage of non-productive spending) is opposed, which is consistent with the main results. Taking the education expenditure as one of the most important components in government expenditure (Barro (1990) believed that spending on education as investing in human capital), the analysis finds a significant positive relationship between expenditure on education as a ratio of total government expenditure and economic growth in high-income sub-group countries, while it also is positive but not significant in low to middle-income countries. The result is similar to previous studies.

With regards to expenditure on defence which is included in productive spending as raising the probability of receiving the marginal product of capital through supporting the protection of property rights (Barro, 1991), it is found to be significant and negative impact on growth in low to middle-income countries. This is in line with the findings of Bose et al. (2007) with 30 developing countries sample and Bojanic (2013) with a Bolivia's case study. It seems that investing more money on defence is not a good choice for economic improvement, but developing government's policy makers have to spend on it for political purposes. However, there is a positive but insignificant relationship between spending on defence and economic growth in high-income economies group.

Looking into expenditure on health, another component that has been argued to have a positive effect on growth due to its investment in human capital, this analysis finds a positive and significant impact on economic growth in low to middle-income economies (whereas insignificant effect in high-income countries). The further analysis on the growth effects of government expenditure on education and health will be represented in chapter 6.

Regarding expenditure on economics affairs, there is a positive and significant coefficient effect on economic growth for low to middle-income countries, while the coefficient is insignificant and negative for high-income countries. This component which includes agriculture, fuel and energy, manufacturing, construction, and transport & communication, plays an important role in government spending structure in developing countries (average of 18% in total of government expenditure). It also is one of the main engines in boosting economic growth in low to middle-income countries and has made a marked contribution to development in some countries over the past 20 years, such as China, India, Indonesia, Thailand and Vietnam. For high-income countries group, this expenditure may not contribute to economic growth because the infrastructure and these economies have been stabilised. General public services expenditure as a percentage of total expenditure is found to be positive and significant impact on long-run growth in high-income countries group. Meanwhile it has insignificant impact in low to middle-income countries even though this expenditure has the largest fraction on total government spending in this sub-group (nearly 28% average). This may be due to how efficient governments are in using this expenditure.

Finally, expenditure on social protections, which has the largest fraction of total government spending in high-income group (around 32% average), has a negative and significant effect on economic growth for both sub-group data. These results are consistent with the main results on non-productive government spending and previous research on social protections component. Public order expenditure, a non-productive expenditure component, has a positive impact on growth, but this share to non-productive spending is much smaller than expenditure on social protection, therefore does not change substantial effect of non-productive expenditure on growth. For other control variables, the coefficients of those variables are similar to the main results in part 4.3. The coefficient associated to investment is somehow positive and significant for low to middle-income countries only, while international trade has a positive and significant impact on economic growth in the sample of high-income countries. Regarding the budget constraint variables, budget deficit or surplus coefficients in all different estimations show a positive and significant effect on long-term growth for both sets of sub-group sample. In addition, tax-revenue coefficients find to have a positive impact on growth in some components estimation in high-income countries, while it is reversed result in low and middle-income countries.

Table 4.9: Descriptive statistics for government expenditure components

	Full Sample		High Income Countries		Low and Middle Income Countries	
Variable	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**
Education expenditure (% of TGE)	13.198	4.833	12.424	4.052	14.539	5.709
Defence expenditure (% of TGE)	6.902	6.616	6.145	7.129	8.223	5.368
Health expenditure (% of TGE)	9.764	5.114	11.928	4.790	6.023	3.100
Economic affairs (% of TGE)	13.771	7.308	11.136	4.514	18.334	8.824
General public services expenditure (% of TGE)	20.253	11.682	15.896	6.781	27.852	14.274
Housing expenditure (% of TGE)	2.796	2.638	2.543	2.526	3.253	2.773
Public order expenditure (% of TGE)	4.988	2.551	4.336	2.327	6.123	2.529
Social protections expenditure (% of TGE)	25.248	14.512	31.470	12.422	14.340	11.074

Table 4.10: Classification of fiscal variables with five-year moving average

Estimation technique: 5 years moving average - two-way FE
Dependent variable: Per capita growth

	HIC	LIC&MIC	HIC	LIC&MIC	HIC	LIC&MIC	HIC	LIC&MIC	HIC	LIC&MIC	HIC	LIC&MIC	HIC	LIC&MIC	HIC	LIC&MIC
Education exp	0.1055*	0.0036	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	(0.0615)	(0.0808)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Defence exp	-	-	0.0143	-0.2172**	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	(0.0291)	(0.0836)	-	-	-	-	-	-	-	-	-	-	-	-
Health exp	-	-	-	-	-0.0244	0.2139*	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	0.0430	0.1428	-	-	-	-	-	-	-	-	-	-
Economic affairs	-	-	-	-	-	-	-0.0021	0.0957**	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	(0.0414)	(0.0417)	-	-	-	-	-	-	-	-
General pub sev	-	-	-	-	-	-	-	-	0.1066***	-0.0013	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	(0.0341)	(0.0199)	-	-	-	-	-	-
Housing	-	-	-	-	-	-	-	-	-	-	0.1499**	0.0281	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	(0.0735)	(0.0934)	-	-	-	-
Public Order	-	-	-	-	-	-	-	-	-	-	-	-	0.2859**	0.0504	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	(0.1385)	(0.2051)	-	-
Social Pro	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.0420*	-0.0479*
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(0.0281)	(0.0330)
Log Initial GDP	-1.9586	-0.1574	-1.6595	-1.4720*	-1.5942	-0.0201	-1.6488	-1.8370**	-3.7471*	-0.1973	-1.3512	-0.2725	-1.1976	-0.0834	-2.3041	0.2742
	(2.3130)	(1.2620)	(2.2959)	(0.8462)	2.3373	1.1462	(2.2628)	(0.7074)	(2.6427)	(1.1294)	(2.2529)	(1.1723)	(2.1230)	(1.0101)	(2.3910)	(1.2950)
Investment	0.0790	0.1892***	0.0761	0.2472***	0.0746	0.2086***	0.0726	0.1900***	0.1388**	0.1889***	0.0547	0.1946***	0.1018	0.1864***	0.0903*	0.1884***
	(0.0581)	(0.0604)	(0.0621)	(0.0643)	0.0587	0.0627	(0.0613)	(0.0569)	(0.0652)	(0.0609)	(0.0568)	(0.0597)	(0.0662)	(0.0607)	(0.0571)	(0.0605)
Inflation	-0.0511	0.0019	-0.0505	0.0045	-0.0504	0.0049	-0.0518	0.0013	-0.0475	0.0019	-0.0471	0.0022	-0.0362	0.0022	-0.0432	0.0011
	(0.0462)	(0.0049)	(0.0463)	(0.0047)	0.0457	0.0061	(0.0493)	(0.0047)	(0.0488)	(0.0048)	(0.0428)	(0.0044)	(0.0463)	(0.0048)	(0.0463)	(0.0046)
Labour force gro	0.1089	-0.1470	0.1015	-0.0876	0.0883	-0.1162	0.1004	-0.1554	0.0369	-0.1482	0.0584	-0.1436	0.1208	-0.1529	0.0757	-0.0992

	(0.1257)	(0.2440)	(0.1334)	(0.2549)	0.1303	0.2218	(0.1348)	(0.2485)	(0.1268)	(0.2456)	(0.1401)	(0.2291)	(0.1157)	(0.2488)	(0.1342)	(0.2461)
Openness	0.0359**	0.0038	0.0323**	0.0008	0.0312*	0.0049	0.0321**	0.0051	0.0440***	0.0037	0.0316**	0.0057	0.0320*	0.0043	0.0398***	0.0059
	(0.0154)	(0.0179)	(0.0164)	(0.0159)	0.0166	0.0174	(0.0162)	(0.0164)	(0.0144)	(0.0177)	(0.0146)	(0.0191)	(0.0164)	(0.0180)	(0.0140)	(0.0185)
Non-tax revenue	-0.1424**	-0.0265	-0.1500**	-0.0144	-0.1503**	-0.0077	-0.1519**	-0.0108	-0.1678***	-0.0280	-0.162***	-0.0185	-0.1013*	-0.0281	-0.159***	0.0037
	(0.0573)	(0.0885)	(0.0631)	(0.0795)	0.0630	0.0740	(0.0627)	(0.0773)	(0.0598)	(0.0833)	(0.0599)	(0.0900)	(0.0615)	(0.0825)	(0.0552)	(0.0753)
Tax revenue	0.1223	-0.2098*	0.1529*	-0.1802**	0.1522*	-0.2436**	0.1529*	-0.1995**	0.1097	-0.2086**	0.1741*	-0.2423	0.1241	-0.2061**	0.1440*	-0.2305**
	(0.0981)	(0.1150)	(0.0961)	(0.0763)	0.0952	0.1005	(0.0949)	(0.0813)	(0.0893)	(0.0940)	(0.0907)	(0.1103)	(0.0976)	(0.0956)	(0.0985)	(0.0897)
Surplus or Deficit	0.1938***	0.2519***	0.2086***	0.2490***	0.2130***	0.2487***	0.2121***	0.2258***	0.2228***	0.2522***	0.2152***	0.2542***	0.1879***	0.2493***	0.1963***	0.2276***
	(0.0684)	(0.0676)	(0.0697)	(0.0582)	0.0643	0.0675	(0.0641)	(0.0647)	(0.0559)	(0.0723)	(0.0675)	(0.0771)	(0.0691)	(0.0704)	(0.0637)	(0.0688)
Constant	16.3642	3.5864	14.3721	12.9589**	14.2875	1.1190	14.5484	13.258**	31.953*	3.9698	11.2865	4.5253	7.8525	2.8271	21.4739	0.8688
	(20.2773)	(8.6106)	20.1051	(5.5098)	20.2774	8.0706	(19.835)	(4.2023)	(23.313)	(7.8722)	(19.821)	(7.393)	(18.228)	(6.3011)	(21.511)	(8.1811)
Observations	591	344	591	344	591	344	591	344	591	344	591	344	591	344	591	344
No of countries	37	22	37	22	37	22	37	22	37	22	37	22	37	22	37	22
Adjusted R-squared	0.6081	0.5501	0.5978	0.5845	0.5982	0.5613	0.5974	0.5847	0.6257	0.5501	0.6054	0.5558	0.614	0.55	0.6051	0.5601

Note: Robust standard error in parentheses. Country and time dummies included but not reported

*** p < 0.01, ** p < 0.05, * p < 0.1

4.5.4 Robustness Test: The Difference in the Level Effect

The final robustness test this analysis makes is to re-test the difference in the level effect of spending on long-run economic growth. In the theoretical and empirical model, this analysis results are on the composition effect of expenditure on growth (the ratio of productive and non-productive government expenditure on total government expenditure) and the level effect has been controlled separately in the regression analysis by the GBC variables. This analysis follows the studies of Devarajan et al. (1996), Ghosh and Gregoriou (2007), Acosta-Ormaechea and Morozumi (2013), Gemmel et al. (2016) and Chu et al. (2018) in which the compositions are as the percentage of total government expenditure, while other empirical previous studies which has been mentioned in table 2.1 examined the relationship between economic growth and government expenditure compositions as a percentage of GDP. The difference is that a unit increase in the budgetary share of education spending (productive expenditure) in term of calculating as the ratio on total government expenditure has to be matched by a unit decrease in some other spending shares (non-productive expenditure), as the size of total spending remains fixed. On the other hand, a unit increase in the share of education or productive government expenditure in GDP does not necessarily mean that other expenditure items are decreasing in other studies. This may lead to varied findings in the previous studies for different sets of sample. Therefore, this robustness test re-runs the regression equations with productive and non-productive government expenditure as a percentage of GDP to see how the results are changing compared with previous studies. Table 4.11 represents the descriptive statistics of these expenditures and table 4.12 shows the estimated of these expenditures on economic growth in high-income and low to middle-income economies with five-year moving average period. Both sub-group countries spend roughly the same on productive government expenditure (21.7% compared with 19.7%), whilst high-income economies spend higher on non-productive government expenditure than low to middle-income countries (15% and 6.6% respectively). For high-income economies group, the analysis finds that neither productive nor non-productive has a significant effect on long-run economic growth (even the sign of both expenditures are similar to the main results). Regarding low to middle-income countries, we find only non-productive expenditure variable has a negative and significant impact on growth, while productive expenditure's is insignificant. This may be a result of the period technique that this analysis picks up to re-run the equations – five-year moving average.

Table 4.13 displays the results of productive and non-productive impact on economic growth with five-year average, a common and popular time period using by previous research. It can be seen that the coefficient for productive expenditure is significant and positive in high-income sub-group, while coefficient for non-productive expenditure is opposite. This result is similar to this analysis main result and consistent with the previous studies, such as Kneller et al. (1999), Bleaney et al. (2001), Afonso and Alegre (2011). However, neither productive expenditure nor non-productive expenditure is found to have significant impact on growth in low to middle-income countries. The reason for this may be the wrong chosen 5-year time period as mentioned in robustness test part 4.5.2

Table 4.11: The descriptive statistics for the difference level effect

	Full sample data		**High Income Countries**		**Low and Middle Income Countries**	
Variable	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**
Productive government expenditure (% GDP)	**21.558**	8.312	**21.662**	5.847	**19.694**	5.329
Non-productive government expenditure (% GDP)	**11.756**	7.276	**15.101**	6.443	**6.618**	5.155

Table 4.12: The level effect with five-year moving average

Estimation technique: 5-year moving average - two-way fixed effect
Dependent variable: Per capita growth

	High Income		**Low and Middle Income**	
	(1)	(2)	(3)	(4)
Productive expenditure	**0.0995**		**0.0401**	
	(-0.0729)		(0.0721)	
Non-productive expenditure		**-0.0941**		**-0.1861****
		(0.0859)		(-0.0336)
Log Initial GDP	-1.7917	-2.2545	-0.3555	0.4181
	(2.2654)	(2.4618)	(1.1847)	(1.2681)
Investment	0.0729	0.087	0.1921**	0.1931**
	(-0.0590)	(0.0621)	(0.0603)	(0.0595)
Inflation	-0.0492	-0.0487	0.0009	-0.0003
	(0.0449)	(0.0462)	(0.0049)	(0.0048)
Labour force growth	0.1168	0.0868	-0.1368	-0.1053
	(0.1342)	(0.1363)	(0.2502)	(0.2474)
Openness	0.0316**	0.0384**	0.0041	0.0055
	(0.0153)	(0.0156)	(0.0173)	(0.0183)
Non-tax revenue	-0.2060***	-0.1225*	-0.0403	0.0325
	(0.0599)	(0.0640)	(0.0777)	(0.0764)
Tax revenue	0.0813	0.1722*	-0.2255**	-0.2141**
	(0.1060)	(0.0995)	(0.0902)	(0.0836)
Surplus or Deficit	0.2614***	0.1858**	0.2632***	0.1988***
	(0.0782)	(0.0725)	(0.0710)	(0.0702)
Constant	16.33683	19.97012	4.5377	-0.2349
	(19.983)	(21.711)	(7.2153)	(8.1178)
Observations	591	591	344	344
No of countries	37	37	22	22
Adjusted R-squared	0.6028	0.6021	0.551	0.5691

Note: Robust standard error in parentheses. Country and time dummies included but not reported

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 4.13: The level effect with five-year average

Estimation technique: 5-year average - two-way fixed effect Dependent variable: Per capita growth				
	High Income		**Low and Middle Income**	
	(1)	(2)	(3)	(4)
Productive expenditure	**0.1465****		**-0.084**	
	(0.0695)		(0.0901)	
Non-productive expenditure		**-0.1577***		**-0.0998**
		(0.0819)		(0.1260)
Log Initial GDP	0.2085	-0.704	-0.5936	-0.4114
	(1.7832)	(2.0616)	(0.9072)	(1.085)
Investment	0.1694***	0.1954***	0.1919***	0.1910***
	(0.0575)	(0.0635)	(0.0584)	(0.0570)
Inflation	-0.0558	-0.055	0.007	0.003
	(0.0441)	(0.0508)	(0.0063)	(0.0064)
Labour force growth	0.2344	0.1681	-0.1837	-0.1297
	(0.1259)	(0.1268)	(0.2388)	(0.2412)
Openness	0.0247*	0.0366**	-0.0106	-0.011
	(0.0155)	(0.0146)	(0.0137)	(0.0136)
Non-tax revenue	-0.2626***	-0.1468**	-0.0631	-0.0656
	(0.0708)	(0.0673)	(0.0757)	(0.0930)
Tax revenue	0.0453	0.1838**	-0.1058	-0.1506*
	(0.0871)	(0.0873)	(0.0799)	(0.0836)
Surplus or Deficit	0.1841***	0.0716**	0.1824*	0.1908*
	(0.0668)	(0.0673)	(0.0936)	(0.1197)
Constant	-5.0344	2.607754	7.8376	6.159422
	(15.337)	(18.018)	(6.1693)	(7.9751)
Observations	147	147	84	84
No of countries	37	37	22	22
Adjusted R-squared	0.6979	0.6966	0.6274	0.628

Note: Robust standard error in parentheses. Country and time dummies included but not reported

*** p < 0.01, ** p < 0.05, * p < 0.1

4.6 Discussion and Conclusion

This analysis characterises the impact of fiscal policy on growth within an endogenous growth framework with two government spending components, productive and non-productive. The added value of this analysis is to compare and contrast the effect of government expenditure on economic growth in high-income and low to middle-income countries over a fixed time period and a given set of measures, therefore providing consistency comparison. The empirical strategy applied OLS fixed effects methods to a panel of 59 countries during the period from 1993 to 2012. Additionally, potential biased problems in the relationship between growth and government structure were tackled using GMM system dynamic estimation techniques. A final important feature of our methodology is that we took into account both the sources and uses of government budget in assessing the effect of fiscal policy on growth.

Consistent with those existing studies using developed country data; the findings show that that a shift in government expenditure towards productive government expenditure and away from non-productive expenditure has a positive relationship with economic growth. In relation to low to middle-income countries, this study finds a similar relationship, which runs contrary to the findings of other papers that examined developing countries. The popular view in the past was that low to middle-income countries lacked the basic infrastructure and other type of public goods and therefore increased productive spending may not bring increased economic growth. The average productive government expenditure (as a ratio of total expenditure) was 21% for nine developing countries during period 1970s to 1990 in the Devarajan et al. (1996) study. Furthermore, countries that have allocated fund towards productive spending and away from non-productive spending in this period have often done so for other reasons other than productivity considerations, and this is where the role of corruption assumes importance. As Tanzi and Davoodi (1997) have noticed that private companies often get contracts for large public investment projects by paying a "commission" to government officials. However, for this samples from 1990 to 2012, low to middle-income countries spent a much larger proportion of public spending on productive expenditure components (78% in total government expenditure) which helps to develop infrastructure, create innovation and improve labour productivity. This may have boosted GDP per capital growth and achieved fruitful sustained development economics during the sample period. Non-productive expenditure (mainly on social protections) is found to have a negative impact on economic growth in our analysis, as this spending contributes to the standard of living for countries' residents instead of impacting growth directly. This is especially true for high-income countries, which spend 39% of total government spending on non-productive components. The empirical results show that low to middle-income countries have been following the approach of high-income countries in allocating government expenditure in favour of productive government spending at the expense of non-productive expenditure, with the aim to enhance economic growth. However, this approach still depends on the size of the government. While low to middle-income countries have small governments (average total spending is about 26% of GDP) and tend to concentrate spending on productive government spending, high-income countries that have a large government size (40% of GDP) tend to spend more on non-productive government compositions. Furthermore, for high-income countries, allocating more expenditure to education, housing and general public services will enhance economic growth; meanwhile spending more on health and economics affair bring the same result for low to middle-income countries. It can be indicated that investment in human capital and quality of life issues are more important in high income countries, while basic health and infrastructure issues are more important in low to middle-income countries.

In addition, as it can be seen in table 4.4 and 4.5, an increase in total government expenditure has a crowding out effect and thus has a negative impact on economic growth in both groups. Both sets of countries should not increase revenue by tax or non-tax means to have a greater government budget surplus (which enhances economic growth), as this increase would have a negative impact on economic growth. However, by reallocating the mix of existing spending away from non-productive forms of expenditure and towards productive forms, countries can move closer to a more optimum growth level. Economic growth is assuredly not the only criteria a government considers when deciding how to allocate public spending. There are other crucial elements such as employment and income equality that should also be considered. Even when social protection spending may be an obstruction to greater growth, it may help promote income equality. Even though the results suggest that a rise the ratio of productive from non-productive expenditure raises economic growth, increasing this kind of productive expenditure composition too much may be counter-productive.

The analysis also finds that the dynamic panel GMM one-step system technique shows that the baseline regression results do not experience the possible endogeneity biases, especially low to middle-income economies sample. Also, by comparing the results between using five-year moving averages to common five-year average, the analysis indicates that applying five-year moving average for all variables is the most efficient and reliable method to capture the impact of public spending components on long-run economic growth due to the macroeconomic stability in low to middle-income economies.

While this analysis provides more specific insights than previous studies, this analysis results should still be taken with some caution, especially in relations to low and middle-income economies. Without controlling for the efficiency of public spending, the results obtained above can be to some extent misleading. Chapter 5 with introduction of government effectiveness, bureaucracy quality and corruption indexes in the regression will help to expand the thesis policy recommendation. Furthermore, it is important to notice that, in order to draw generalisations regarding the composition of government spending at the country level, the analysis should be followed by additional individual country empirical studies which should consider country specific characteristics affecting the government expenditure composition as well as other determinants of growth. In chapter 6, this thesis will focus on the effects of government expenditure on human capital and its important components (education and health) on long-run economic growth in some low and middle-income case study countries to examine how the results change from country to country.

Chapter Five

The Impact of Corruption on Economic Growth in terms of Government Expenditure Compositions

5.1 Introduction

Corruption is a significant global social ethics problem. Due to the common perception that corruption is bad for economic development, both emerging market economies and developed countries have paid attention to the impact it has on economic growth and have invested resources in mitigating and controlling its effect. Over the past two decades a substantial volume of theoretical and empirical research has also been directed toward its relationship. The studies' conclusion varies and in some cases they have conflicting results. Theory suggests that corruption generates unfavourable effect on long-term economic growth and sustainable development. Among many defenders of this opinion belong much research and international organisations. For example, Mauro (1995), Knack and Keefer (1997), Wei (1997), Mo (2001), Pellegrini and Gerlagh (2004), Meon and Sekkat (2005), Podobnik et al. (2008), Ugur (2014), Huang (2016) and Abdixhiku et al. (2017). Corruption has been linked to an increase of production costs, positively related to tax evasion, reduced national and foreign investment, inefficient allocation of national resources, increased inequality and poverty in the society, and uncertainty in decision making. On the other hand, some scholars believe that corruption can have a positive impact on growth. Leff (1964), Bayley (1966), Huntington (1968), Lui (1985), Colombatto (2003), Paul (2010), Meon and Weill (2010) and Swaleheen (2011) have recommended that individuals or corporations under certain circumstances may bride policy makers to turn around unfavourable situations caused by existing laws and regulation, which in turn ends up promoting economic efficiency.

While generally accepting the impact of corruption on economic growth, the literature remains divided on the channels and magnitude of the direct and indirect effects. One channel that has received limited attention in current literature is government expenditure. Specifically, it is the corruption is connected with a misallocation and misappropriation of government expenditure components. In the previous chapter, this thesis compared and contrasted the impact of government expenditure components, productive and non-productive, on economic growth in high-income and low to middle-income economies during the period from 1993 to 2012, but has not yet considered the role of corruption in the process. Therefore, this chapter examines the effect of the composition of public spending on economic growth in the presence of corruption for a panel data of 37 high-income and 20 low to middle-income countries, hence providing insights on the role that different levels of economic development play in moderating the level of corruption impact. Again, this analysis uses a 5-year moving average for all variables, instead of the traditional 5-year average or 5-year moving average for dependent variables, to smooth over some of the cyclical features of the data. The OLS two-way fixed effects and the dynamic panel one-step system GMM estimation are also applied to address the concerns of unobservable country-specific effects and endogeneity for the model.

The remainder of this chapter is organised as follows. Section 5.2 presents measurement of corruption and an overview of the literature on the effect of corruption on growth. Section 5.3 describes the model specification and discusses the data and specifies the econometric model and methodology. Section 5.4 reports the empirical estimates and links these with the analytical results. In Section 5.5, robustness tests are carried out on some different measurement of corruption index. Finally, Section 5.6 concludes the results with some policy implications.

5.2 Corruption Definition and Literature Reviews

5.2.1 Corruption Definition and Measurements

Corruption is a complex and multifaceted phenomenon with multiple causes and effects, as it takes on various forms and functions in different contexts. The phenomenon of corruption can be identified from the choice of a single act of an illegal payment to the failure of a political and economic system. The problem of corruption can be recognised either as a structural problem of politics or economics, or as a cultural and individual moral problem (Ahmad et al., 2012). Transparency International (TI) defined corruption as “the abuse of entrusted power for private gain”. In their definition, corruption can be classified as “grand, petty and political, depending on the amounts of money lost and the sector where it occurs” (Transparency International, 2017). Meanwhile, the World Bank has defined corruption as “the abuse of public office for private gain” (World Bank, 2005).

This chapter examines the corruption impact on economic growth through government spending allocation; therefore we will focus on the definition of on political and administrative corruption. The creation and implementation of government budget goes through wide and complex decision making management. Hence, it is highly likely that the decisions relating to the scope and allocation of government expenditures are more propitious for various kinds of corruption (Jajkowicz and Drobiszova, 2015). Delavallade (2006) stated that when public decisions are made during the preparation stage of the budget, they are called political corruption; during the execution stage of the budget it is referred to as another form of corruption which is administrative or bureaucratic corruption. Both the administrative and political corruption has a direct effect on the amount and allocation of government expenditure into different areas of economy. However, due to the aim of this thesis we consider only political corruption as it has the aforementioned direct effect on government expenditure allocation and therefore has impact on economic growth. Garamfalvi (1997) demonstrated that "political corruption has particularly damaging effects on the allocation of resources because it will produce an allocation that will be different from the one that would have been arrived at through a corruption free process. In other words, political corruption occurs when political decision makers independently, or in collusion with corrupt officials, will divert public resources in a way that will reduce the welfare of society or will be contrary to public interest".

The current literature on corruption commonly uses subjective measures created by Transparency International (TI), the World Bank (WB) and Political Risk Services (PRS). The TI and WB measures are composite indices based on individual surveys of corruption. The PRS measure uses expert rankings by specialised institutions. It is commonly accepted that these measures equally reflect the frequency of corruption as well as its depth, and they are also highly correlated with each other (Swaleheen, 2011). The corruption in government index from the International Country Risk Guide (referred to as the ICRG index) is provided by PRS. The PRS Group which was established in 1979 is among the earliest institution providers of political and country risk forecasts. The ICRG index is a measure of corruption within the political system that threatens foreign investment by distorting the economic and financial environment, decreasing the efficiency of government and business by enabling people to undertake positions of power through patronage rather than ability. It includes 22 variables in three subcategories: political, financial and economic. A separate index is formed for each of subcategories. The Political Risk index is based on 100 point, Financial Risk on 50 point and Economic Risk on 50 point. The total point from 3 subcategories is divided by two to present the weights for inclusion in the composite country risk score. The score ranges from zero to 100 with a higher number (80 to 100 point) signifying very low risk. Corruption index is measured as part of Political index and ranges from zero to six with a higher number meaning lower corruption.

TI has published a Corruption Perception Index (CPI) every year since 1995. Each year TI rates up to 176 countries on how corrupted their public sectors appear to be. The measure ranks countries from zero to ten points during period 1995 to 2011, with a score of zero representing the highest corruption. Since 2012 the countries have been ranked on a scale 0 to 100. The lower-ranked countries in CPI index are plagued by untrustworthy and badly functioning public institutions like the police and judiciary. Even where anti-corruption laws are on the books, in practice they are often skirted or ignored. Whereas, higher-ranked countries tend to have higher degrees of press freedom, access to information about public expenditure, stronger standards of integrity for public officials, and independent judicial systems (International Transparency, 2017).

Lastly, the WB provides a World Governance Indicator (WGI) report. This indicator summarises a variety of individual indicators for 212 countries in a total of 6 subcategories of governance. These categories are voice and accountability, political stability, absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption. Individual sources of data based on which are the summary indexes from wide number of various researchers of private, non-profit organisations and international organisation (Hashem, 2014). The World Bank control of corruption index is based on the corruption perceptions of firms' manager and interpreted as indicating the extent to which public power is executed for private gain (D'Agostino et al., 2016). The indicator values ranges from a zero to 100, with zero being a non-corrupted country. However, these data are only available in limited timeframe (1996, 1998, 2000, and 2002 until now) and Ugur (2014) on a meta-analysis recognises that ICRG and TI corruption data used more heavily compared to WGI and other corruption data sources. Therefore, it will not be used for the purpose of this analysis as it does not provide the data continuity.

5.2.2 Corruption and Economic Growth

Empirical literature in the field has most consistently reported a negative relationship between growth and level of corruption. Since Mauro (1995), it is acknowledged that severe corruption significantly hinders investment and economic growth. In his paper, Mauro brought together indices on corruption and institutional efficiency and found that corruption decreases private investment and thereby economic growth. Tanzi (1998) and Rose-Ackerman (1999) found that corruption has a negative effect on nation's competitiveness by not only lowering financial investment and economic growth, but also causing imbalanced expenditures and poorly allocated national resources. Corruption reduces tax revenues for the government due to tax evasion and to the emergence of the underground economy by rent-seeking activities (Lambsdorff, 2006). Tax evasion causes a decrease in public investment capacity and in public sector productivity (Jain, 1998 and Tanzi, 1995). Corruption also affects international investment by inducing less FDI flows into the economy (Habib and Zurawicki, 2002). Moreover, it increases inflation (Ben Ali and Sassi, 2016), reduces investment (Habib and Zurawicki, 2002), positively associates with tax evasion (Abdixhiku et al., 2017), demotivates entrepreneurial activities (Bui et al., 2018) and diverts it away from productive activities (United Nations Development Program, 2008), deepens income inequality and poverty (Gupta et al., 2002) and weakens public sector quality (Lambsdorff, 2006). More recently, Ugur (2014) with a meta-analysis that takes into account 327 estimates of the direct impact of corruption on growth from 29 primary studies and found that those studies are likely to report negative effects on growth even though they are using different measures of corruption and growth, estimation methods, country coverage, and sample periods.

Although most empirical research agree that corruption negatively influences economic growth, there are still some researchers believe that corruption have a positive impact. Leff (1964), Bayley (1966) and Huntington (1968) believed that corruption may "grease in the wheel" by enabling economic agents to engage in beneficial activities that may be otherwise unfeasible because of high levels of bureaucratic hold-ups in highly-regulated countries. Acemoglu and Verdier (1998) used the theoretical model to suggest that while the optimal level of corruption may be relatively low, it exists due to a cost of anti-corruption efforts itself. Colombatto (2003) found that in certain developing countries or totalitarian countries, corruption helps eliminate certain factors which obstruct economic development. Meon and Weill (2010) stated that corruption has regime specific effects on growth, meaning a detrimental effect of corruption in economies with effective institutions but a positive relationship between corruption and efficiency in economies when institutions are ineffective.

While not denying that corruption may have a positive effect at particular times in specific countries, however the main findings of theoretical and empirical literatures have been that corruption leads to lower growth, weakens both private and public investment spending and inhibits the efficiency of public services. Furthermore, it is worth noting that the cost of corruption for countries is different depending on their level of development and on surges in their national incomes. At the early stages of development, income is rather limited and so is the level of corruption. As income increases, corruption increases. However, as a country reaches a certain level of development, high income levels increase corruption's costs in the way that corruption is considerably dissuaded (Saha and Gounder, 2013).

While generally accepting the negative impacts of corruption on growth, the literature still remains divided on the channels and sizes the direct and indirect effects. The impact of corruption on certain components of government expenditure is vital and this provides a link between how the effects of the composition of government expenditure on growth can be related with corruption. Mauro (1996, 1998) represented the first cross-country evidence that corruption has an effect on the composition of government spending. His studies examined the relationship between corruption and government expenditure compositions by using a sample of 100 countries in period from 1970 to 1985. His research presented evidence that government expenditure on education as a ratio to GDP has a negative and significant associated with corruption. In his conclusion, corruption misleads government spending away from high-productivity areas, such as education and health toward other areas which are less productivity promoting (large-scale infrastructure and defence). Similar to Mauro's research, Tanzi and Davoodi (1997) showed that corruption can reduce economic growth by increasing public investment while quality of this investment tends to fall. The authors came to a conclusion that corruption distorts public expenditure to where brides are easiest to collect, implying a diversion of government expenditure compositions towards low-productivity areas at the expense of growth-promoting projects. They also state that corruption can reduce economic growth by lowering government revenue needed to finance productive government expenditure.

Delavallade (2006) examined the effect of corruption on the structure of government expenditure by different sectors. The author addressed the issue of which public spending sectors are favoured by corruption and which are hindered. The paper found that corruption seems to deform the structure of public expenditure in the areas of defence, fuel and energy, culture and public service and order, at the expense of social areas (education, health and social protection). In the similar vein, Hessami (2010) analysed the impact of corruption on the composition of public spending. The research concludes that the percentages of spending on health and environment protection increases with higher levels of corruption, while the percentages of spending on social protection and recreation, culture and religion decreases with an increase in corruption. Another conclusion from this author is that a distortion in the allocation of public expenditures leads to a failure of the government in fulfilling its objective and it affects economic growth.

Hashem (2014) and Jajkowicz and Drobiszova (2015) used different sets of countries, but their conclusions have reached the same point, that higher levels of corruption distort the structure of government expenditure in favour of defence and general public service, whereas the proportion of spending on education, health, recreation, culture and religion decrease. Again, Hague and Kneller (2015) focus their study on analysing empirically the impact of public investment (productive government expenditure) on economic growth which is influenced by the presence of corruption in an economy. Their research is one of very few to combine three different literatures on corruption and growth, public investment and growth and corruption and public investment to capture the impact of one on the other. The study concludes that the countries with lower level of corruption (a score of less than 4 in ICRG) can have significant efficient return on public investment so that it raises growth. Meanwhile, for highly corrupted countries (a score of 4 or above) the returns from productive government expenditure are reduced by the presence of corrupt agents in the economy and therefore productive government expenditure fails to create higher economic growth. Furthermore, they also suggest that corruption has an indirect negative impact on growth through decreasing private investment.

Furthermore, in addressing the effects of corruption, with few exceptions, majority of the empirical studies have investigated various country case-studies and/or regions but cross-sectional comparative analysis have been lacking. Saha and Gounder (2013) examined the relationship between corruption and economic development by using data covering 100 countries and income classification for the period 1995 to 2008. They found that there is a cost involved in reducing corruption. Reducing corruption is mostly dependent on the building of a sound institutional framework of a country that can combat corruption effectively. However, a low level of income does not provide enough support to build the institutional structures in low-income countries and that makes the cost of reducing corruption very high. On the other hand, middle-income countries are more of a transitional stage that provokes a high level of corruption. As when income level is moderately high, it can enhance corrupt activities by transferring resources to the non-productive sectors. But at the mature stages of development, a very high level of income makes it possible to build the institutional foundation and thereby increases the efficacy of anticorruption reform and the cost of getting caught while corrupt and punished. This raises some questions, such as, how the levels of country's economic development affect corruption?, and do the growth effects of government expenditure compositions in the presence of corruption differ between high-income and low to middle-income economies?

Overall, in the line of research, there exists empirical evidence to suggest that corruption not only has an effect on economic growth, but also is associated with a misallocation and misappropriation of government expenditure components. However, little attention has been given to the relationship between the composition of government expenditure and economic growth in the presence of corruption and the role that differing levels of economic development play in this relationship. Therefore, this chapter will focus on examining the impact of the composition of government expenditure (productive and non-productive government spending) on long-run economic growth in the presence of corruption, with particular attention on comparing high-income and low to middle-income countries.

5.3 Model specification, Data and Methodology

5.3.1 The Analytical Framework

In this section, we modify the model of fiscal policy and growth developed in chapter 4, section 4.2 to include corruption variable, which affects government expenditure compositions. The aggregate production function (y) has three arguments: private capital k, and two types of government expenditures g_1 (productive) and g_2 (non-productive):

$$y = \left[\alpha k^{-\zeta} + \beta(1 - \delta_1)g_1^{-\zeta} + \gamma(1 - \delta_2)g_2^{-\zeta}\right]^{-1/\zeta} \tag{5.1}$$

Where $\alpha > 0$; $\beta(1 - \delta_1), \gamma(1 - \delta_2) \geq 0$; $\alpha + \beta(1 - \delta_1) + \gamma(1 - \delta_2) = 1$; $\zeta \geq -1$

In this specification, we define β and γas the "pure" productivity parameters related with two types of government expenditure. In another way, the "net" productivity of public spending is given by $\beta(1 - \delta_1)$ and $\gamma(1 - \delta_2)$ respectively when corruption distorts the effect of public spending on output. Corruption in this circumstance is like a leakage that decreases the returns to government investment and drives a wedge between the growth rate that society could have achieved in its absence, and what it actually achieves (Ghosh and Gregoriou, 2007). Higher level of corruption in g_1 or g_2 is captured by a higher value of δ_1 or δ_2, and the corruption parameter is bounded between 0 and 1. There is no difference between the pure and net productivities in an absence of corruption. The corruption parameter is $0 < \delta_1, \delta_2 < 1$, as activities like bride-taking reward costs of procurement of public goods and procurement of low-quality products, which typically decrease the productivity of the goods purchased by bureaucrats and hinder growth. However, as it has been noticed in the literature review section above that corruption may have a positive impact on economic growth through the avoidance of bureaucratic delays and red-tape in getting things done more efficiently in some situations. Despite stating the range of δ_1, δ_2as we have here, we will investigate in the empirical section whether it is possible for corruption to increase economic growth rate.

The rest of set-up for theoretical framework model is similar to section 4.2 in chapter 4. The relationship between long-run growth rate, λ, and the share of government spending devoted to $g_{1:}$

$$\frac{d\lambda}{d\phi} = \frac{\alpha(1-\tau)(1+\zeta)(\alpha\tau^{\zeta})^{-(1+\zeta)/\zeta}[\beta(1-\delta_1)\phi^{-(1+\zeta)}-\gamma(1-\delta_2)(1-\phi)^{-(1+\zeta)}]}{\sigma[\tau^{\zeta}-\beta\phi^{-\zeta}-\gamma(1-\phi)^{-\zeta}]^{-1/\zeta}} \tag{5.2}$$

Both forms of government expenditure have an impact on the rate of growth through the marginal production of capital; however their relative influence varies upon the relative productivity of g_1 and g_2, and their relative budget shares, $\emptyset$ and $(1-\emptyset)$. In the special case of Cobb-Douglas technology ($\xi = 0$ *and* $\theta = 1$), the condition for the two types of government expenditure to be at its optimum is:

$$\frac{\emptyset}{1-\emptyset} = \frac{\beta(1-\delta_1)}{\gamma(1-\delta_2)} \tag{5.3}$$

5.3.2 Data and Choices of Variables

The empirical analysis used panel data on 37 high-income and 20 low to middle-income countries covering the period from 1993 to 2012 (list of countries can be seen in Appendix C). The list of 37 high-income economies is similar to analysis in chapter 4, while we take out 2 countries (Nepal and Mauritius) in the list of low to middle-income countries as there is limited information about corruption in these countries. The classification of high and middle to low-income countries is based on the World Bank's classification using gross national income per capita. The fiscal variables for productive, non-productive government expenditure and tax, non-tax revenue are collected from IMF's GFS and are subject to availability for each country. Other variables (without corruption variables) are attained from World Bank's Development Indicators (WDI).

One variable of main interest in this empirical exercise is corruption. The data for corruption indices are obtained from ICRG. There are some critical points in using the ICRG index as a measure of corruption. First of all, the ICRG index strictly measures the risk to political stability owing to corruption, not corruption itself. Secondly, the index is gathered for foreign investors by non-resident country experts and measures only corruption that threatens foreign investment rather than corruption faced by all firms, foreign and domestic. Finally, the ICRG scores may lag the major events they seek to measure and therefore may be an inaccurate reflection of current situations (William and Siddique, 2008). However, although the ICRG index is not a direct measure on corruption, it is still a trusted proxy of corruption under the sensible assumptions that: (1) the risk of political uncertainty to foreign investor owing to corruption increases linearly with the incidence of corruption in the country, (2) corrupt bureaucrats make no difference at the margin between foreign and domestic firm when it comes to taking bribes, and (3) the experts apply the same range of information for all countries when considering country risks (Swaleheen, 2011). Moreover, the problem of inaccurate measure of current corruption by using the ICRG index is solved in this chapter if long-run averages are used (a five-year moving average of the ICRG index in place of the annual ICRG index).

In the ICRG index, higher corruption score implies that “high government officials are likely to demand special payments” and “illegal payments are generally expected throughout lower levels of government” in the forms of “brides connected with import and export licenses, exchange controls, tax assessment, police protection, or loan”. The ICRG index ranges from zero to six with a high number denoting lower corruption. As the δ in our theoretical model ranges between 0 and 1, and is a positive function of corruption, we have rescaled the index as 0 to the least corrupt category and 6 to the most corrupt category, and used a scale conversion to transform the numbers to be within the 0 to 1 range.

This analysis uses the TI’s CPI index to check for the robustness of the estimation using ICRG index. The CPI is a composite index based on individual surveys among international business people, risk analysts, local residents and expatriates. It ranges from zero to ten with a score of ten signifying the least corruption for the period 1995 to 2011. Since 2012 the countries have been ranked on a scale 0 to 100. The index is rescaled as Corr = 10 – CPI (in case of 2012, corr = 100 – CPI), so that a high score means that corruption is perceived to be high. The usefulness of the CPI index in year-to-year comparisons has been questioned by many researchers (William and Siddique, 2008) as the set of countries covered by the index has changed over time when new countries have been added. The addition of new data sources has improved the accuracy of the CPI index, but it can disturb the continuity of this index. Lambsdorff (1999) pointed out that the problem of designing the CPI index is similar to the problem of the price index for a basket of goods when the compositions of the basket has been changing. However, a study of Lambsdorff (2004) stated that the impact of a changing sample and methodology on the continuity of the CPI seems to be small, especially looking at the long-term trend. It is generally accepted that these measures equally reflect the frequency of corruption as well as its depth (Swaleheen, 2011).

Based on our data and availability of CPI index for these countries, the test examines a panel data of 50 countries (32 high-income and 18 low to middle-income countries) during period 1998 to 2012 (list of countries for this robustness test is described in Appendix D).

In contrast to Ghosh and Gregoriou (2010)'s study where they assume there is no corruption in non-productive government expenditure and whatever corruption there is in the economy can be solely attributed to productive spending, this chapter assumes that corruption applies to both productive and non-productive government expenditure as it fits rather well with reality. Since δ is the corruption index, which denotes a higher value corresponding to higher corruption, $\delta. g$ is an interaction term that presents the impact of government expenditure composition on growth with presence of corruption. Hence, the term $(1-\delta). g$ is the productivity of government expenditure composition net of corruption. In this set-up, we first examine the impact of $(1-\delta). g_{pro}$ and $(1-\delta). g_{nonpro}$ on the economic growth rate for high-income and low to middle-income economies, then compare these coefficients of the modified equations with the original coefficients of g_{pro} and g_{nonpro} in chapter 4. The idea is that if the $(1-\delta). g_{pro}$ coefficient turns out to be smaller than g_{pro} coefficient, this implies that the pure productivity effect of this productive government spending exceeds the productivity of g_{pro} net of corruption. In other words, corruption has a negative impact on economic growth in the situation of g_{pro}. The same explanation is used for g_{nonpro}.

The first set of regression model specification for capturing the relationship between productive government expenditure and economic growth in the presence of corruption is:

$$G_{it} = a_i + b_t + \alpha_1 G_{it-1} + \beta_2 \left(\frac{(1-\delta) g_{pro,it}}{g_{pro,it} + g_{nonpro,it}}\right) + \gamma_1 \left(\frac{TR_{it}}{y_{it}}\right) + \gamma_2 \left(\frac{NTR_{it}}{y_{it}}\right) + \gamma_3 \left(\frac{Def\ or\ sur_{it}}{y_{it}}\right) + \sum_{l=1}^{k} \sigma_l I_{ilt} + \mu_{it} \quad (5.4)$$

The second set of regression of model specification for capturing the non-productive expenditure:

$$G_{it} = a_i + b_t + \alpha_1 G_{it-1} + \beta_3 \left(\frac{(1-\delta) g_{nonpro,it}}{g_{pro,it} + g_{nonpro,it}}\right) + \gamma_1 \left(\frac{TR_{it}}{y_{it}}\right) + \gamma_2 \left(\frac{NTR_{it}}{y_{it}}\right) + \gamma_3 \left(\frac{Def\ or\ sur_{it}}{y_{it}}\right) + \sum_{l=1}^{k} \sigma_l I_{ilt} + \mu_{it} \quad (5.5)$$

where i and t denote the cross-sectional and time series dimensions respectively; capture the time-invariant unobserved country-specific fixed effects, and capture the unobserved individual-invariant time effects. G is the per capita real GDP growth rate, $G_{it-1}$is first lagged of growth variable is introduced for applying dynamic panel GMM techniques. g_{pro}, g_{nonpro} are productive and non-productive expenditure as a proportion of total government spending. y is GDP, TR is tax revenue, NTR is non-tax revenue and (Def or sur) is budget surplus or deficit. I_{ilt} is a vector of non-fiscal independent variables (initial of GDP per capita, inflation, labour force growth, investment and openness variables capture the inter-national dimension).

5.3.3 Methodology

Similar to methodology has been used in chapter 4, this section uses two-way OLS fixed effects which control time-invariant individual country characteristics and time fixed effect as the main method of estimation to capture the long-run relationship of economic growth to fiscal variables in the presence of corruption. This technique addresses the common concern of excluding unobservable country-specific effects in panel data estimation. Furthermore, dealing with the endogeneity and simultaneity aspects of our model, this analysis also applies the dynamic panel one-step system GMM estimation. The advantages of using this technique have been mentioned in methodology chapter and the impact of government expenditure on economic growth chapter. Also, this analysis uses five-year forward moving averages for all variable as it can remove business cycle effects, increase the number of time series observation in our panel data, minimise the reverse causality argument holding in our model and account for endogeneity.

Table 5.1 lays out the descriptive statistics about corruption and development using the World Bank’s income classification of countries together with the corruption index from ICRG for the period from 1993 to 2012 and from CPI for the period from 1998 to 2012.

Table 5.1: Corruption across countries

		Low Income	Lower-middle Income	Upper-middle Income	High Income
ICRG index	**No of countries**	2	8	10	37
	Mean	1.97	2.52	2.73	4.19
	Standard Deviation	0.65	0.72	1.09	1.16
	Range of index	0.50 - 3.46	1.00 - 4.00	1.00 - 5.00	2.00 - 6.00
CPI index	**No of countries**	2	7	9	32
	Mean	2.43	2.78	4.25	7.12
	Standard Deviation	0.44	0.444	0.803	1.925
	Range of index	1.90 - 3.50	1.70 - 3.70	2.60 - 5.70	2.70 - 10.00

It can be seen that a compelling feature of the data is the higher corruption rating of poor countries than rich countries throughout the period. This is indicative of the negative relationship between corruption and development that has been reported in many empirical researches (Mauro, 1995; Knack and Keefer, 1997; Gyimah-Brempong, 2002; Campos et al., 2010; and Ugur, 2014). Another notable feature is the much greater diversity in corruption score range among middle-income and high-income economies. For ICRG index in high-income economies classification, there are number of countries which have the corruption level score less than 3.5 average score during period from 1993 to 2012 (Bahrain, Croatia, Latvia, Oman, Czech, Estonia, Greece, Italy, South Korea, Poland, Slovak Republic and Slovenia). The reasons for higher corruption rating of these countries are that some of them have transferred from transition economies to developed economies (such as Estonia, Poland, Slovak Republic and Slovenia); or have a long history of corruption (for example, Greece, Italy and South Korea). The foregoing observations on middle-income countries' higher corruption index can be explained as following: below some critical level of capital, there is a low-development regime that displays a unique equilibrium in which the incidence of corruption is high; above some other critical level of capital, there is a high-development regime that displays a unique equilibrium in which the incidence of corruption is low; and in between the two thresholds, there is an intermediate-development regime that present both types of equilibriums (Blackburn et al., 2011). Therefore, it explains why corruption is not only higher in low-income countries than high-income countries, but also more varied among middle-income countries. From this point of view, this thesis tried to classify our countries sample based on ICRG average score index to test the relationship between government spending components and economic in term of corruption classification. The result shows that for those countries with lower corruption, the effects of government expenditure compositions on growth rate are consistent with high-income economies in the main result. Meanwhile, the result presents to be an insignificant impact of government spending components on economic growth for those countries with higher corruption index as these countries group has mixed up all three different kinds of income categories (low-income, middle-income and high-income) and therefore this section will not report these results. (The results for this test and the explanations for the insignificant impact of higher corruption index group on economic growth are described in Appendix E).

The annual average of CPI for low and middle-income country averages ranges from 1.70 to 5.70, while its high-income country varies between 2.70 to 10.00. Again, it can be seen that the descriptive statistics for CPI are similar results with descriptive statistics for ICRG. For the correlation matrix between variables with presence of corruption variable, it has been described in Appendix F.

5.4 Empirical Results

Table 5.2 represents the effect of productive and non-productive government spending on economic growth in high-income countries by using a two-way fixed effects method with two different corruption measure resources. It also shows the impact of corruption by comparing models with and without corruption included in government spending compositions (productive and non-productive). In term of using ICRG measure, the set of data is similar to the main results' analyses for high-income economies in chapter 4 when we excluded the influence of corruption on government spending compositions. A percentage point increase in the ratio of productive spending to total government expenditure will increase real GDP per capita growth by 0.051 percentage point, while one percentage point increase in the ratio of non-productive spending to total government expenditure will decrease real GDP per capita growth by 0.050 percentage point. Comparing these results with presence of corruption as a component of government expenditure, the coefficient on $(1-\delta).g_{pro}$ and $(1-\delta).g_{nonpro}$is 0.047 and -0.045 respectively. It can be seen that the corruption-adjusted coefficient of productive expenditure is still positive, but the growth benefits of its spending turn out to be lower which shows that corruption is bad in the context of the productivity of productive expenditure. In term of non-productive government spending, the corruption-adjusted coefficient of this expenditure is again negative and significant but is not as negative as when did not take into account corruption. However, the effect size of corruption on both government expenditure compositions is very small (the impact of corruption on economic growth in both cases is, $\delta g_{pro} \approx \delta g_{nonpro}$ and roughly 0.004 percentage point). Furthermore, this thesis also run a robustness test to check whether the coefficients of interested variables (productive and non-productive government expenditure) are significant different between before and after including corruption adjustment. The test name is "seemingly unrelated estimation" which was developed by Weesie (1999) to examine whether some relationship between the estimators holds either on different datasets, on overlapping datasets, or on the same dataset. Such a hypothesis is often that the coefficients estimated by one estimator are equal to the coefficients estimated by the other estimator. The results have shown that the coefficients are not significant different from each other (the results have been reported in Appendix X).

The same result is found using the CPI index in table 5.2. A unit increase in the ratio of productive government expenditure without corruption influence on total government spending increases real GDP per capita by 0.16 percentage points in high-income economies. It implies that greater weight of productive expenditure could contribute to a more positive impact on economic growth in OECD countries as five countries eliminate from the high-income sample group are Bahamas, Bahrain, Cyprus, Malta and Oman. Comparing the corruption-adjusted coefficient of productive government spending, the analysis finds that productive public spending still has a positive impact and it provides higher positive effects on economic growth than when we did not take into account corruption. The net impact of corruption in productive government expenditure (the δg_{pro} term) is 0.004. This result is opposed to ICRG's result. Meanwhile, the coefficient on non-productive government expenditure without corruption presence is negative and significant (-0.16). The corruption-adjusted coefficient of non-productive spending is again negative and it is more negative than that we did not take into account corruption for high-income countries. The test for the difference between coefficients of productive and non-productive before and after using CPI corruption index shows that they are significant different to each other (Appendix I).

Table 5.2: Contribution of productive and non-productive spending to growth in high-income countries (with and without corruption)

Estimation technique: 5 years moving average - two-way Fixed Effects - **High Income countries**
Dependent variable: Per capita growth

	ICRG Index				**CPI Index**			
	Without Corruption		**With Corruption**		**Without Corruption**		**With Corruption**	
Productive expenditure	**0.0507***		**0.0471***		**0.1551****		**0.1590****	
	(0.0282)		(0.0141)		(0.0686)		(0.0692)	
Non-Productive expenditure		**-0.0498***		**-0.0448*****		**-0.1579****		**-0.1699****
		(0.0307)		(0.0148)		(0.0690)		(0.0707)
Log Initial GDP	-2.6191	-2.5341	-1.9593	-1.9126	-5.427313	-5.412151	-5.6627	-5.2176*
	(2.4902)	(2.5067)	(2.4129)	(2.5067)	(3.4296)	(3.4497)	(3.4310)	(3.3996)
Investment	0.0936*	0.0935*	0.0973*	0.0955**	0.2756**	0.2829**	0.2738**	0.2857**
	(0.0595)	(0.0601)	(0.063)	(0.0619)	(0.1322)	(0.1313)	(0.1329)	(0.1313)
Inflation	-0.044	-0.0442	-0.0613	-0.0592	-0.2075**	-0.2139**	-0.2045**	-0.2182**
	(0.0445)	(0.0449)	(0.046)	(0.0424)	(0.1019)	(0.1010)	(0.1017)	(0.0997)
Labour force growth	0.0963	0.0935	0.1351	0.1343	0.0868	0.067497	0.0948	0.0598
	(0.1332)	(0.1342)	(0.1248)	(0.1342)	(0.3160)	(0.3162)	(0.3160)	(0.3136)
Openness	0.0424***	0.0415***	0.0409***	0.0398***	0.0545**	0.0561**	0.0539**	0.0570**
	(0.0148)	(0.0148)	(0.0149)	(0.0148)	(0.0272)	(0.0272)	(0.0270)	(0.0270)
Non-tax revenue	-0.1465***	-0.1476***	-0.1510**	-0.1536***	-0.3082**	-0.3114**	-0.3104**	-0.3237**
	(0.0529)	(0.0532)	(0.0563)	(0.0532)	(0.1413)	(0.1407)	(0.1398)	(0.1401)
Tax revenue	0.1359	0.1339	0.1244	0.1239	-0.131521	-0.1269	-0.1363	-0.1218
	(0.0978)	(0.0984)	(0.0995)	(0.0984)	(0.1899)	(0.1938)	(0.1880)	(0.1930)
Surplus or Deficit	0.2053***	0.2060***	0.2025***	0.2027***	0.2188**	0.2186**	0.2195**	0.2165**
	(0.0644)	(0.065)	(0.0148)	(0.065)	(0.0912)	(0.0910)	(0.0914)	(0.0901)

Constant	3.524	24.1057	13.734	18.0328	45.18802	60.33997	47.829	58.5966
	(1.5661)	(2.894)	(20.946)	(8.124)	(30.9871)	(33.4411)	(30.8215)	(32.9154)
Observations	591	591	583	583	351	351	351	351
No of countries	37	37	37	37	32	32	32	32
Adjusted R-squared	0.6077	0.6077	0.6104	0.6089	0.7063	0.7077	0.7063	0.7103

Note: Robust standard error in parentheses. Country and time dummies included but not reported

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

So, these empirical results for high-income economies suggest that the presence of corruption in productive and non-productive expenditure may or may not have an impact on economic growth depending on corruption index. However if it has, its impact is rather small. In term of ICRG index, a change in the expenditure mix towards productive forms of expenditure and away from non-productive forms of expenditure still enhances growth but the growth benefit is lower in presence of corruption. On the other hand, the growth benefit of a change toward productive forms of expenditure from non-productive forms is higher in associated with corruption in case of CPI index. The reason is that dissimilar ranges of corruption indexes (from zero to six for ICRG and from zero to ten for CPI), which reduce the share of total expenditure to productive and non-productive components differently, and different high-income countries group covered explain this difference result. Therefore, it implies that shifting more how much percentages on productive government expenditure from non-productive government expenditure to achieve higher economic growth is not an easy question for policymaker. It would be interesting to see how the growth effects of government expenditure compositions change with the presence of corruption in low to middle-income economies compared with high-income economies.

Table 5.3 repeats the result of table 5.2, but for low to middle-income economies. It can be seen from table 5.3 that in the bench case, productive government expenditure still has a positive and significant impact on economic growth when the effect of corruption is included (with a coefficient of 0.050) in term of using ICRG index. When its effect is netted out, the growth benefit of productive spending surprisingly turn out to be lower (the coefficient becomes 0.045, but the effect is rather small (the difference in this case, δg_{pro} = 0.005). The test for the difference between coefficients of productive when the effect of corruption is included or netted out is significant different to each other (Appendix I). A similar result finds in case of non-productive government spending for low to middle-income countries data. There is a negative and statistically significant relationship between the corruption-adjusted coefficient of non-productive spending and economic growth (-0.037), but it is not as negative as when to remove the effect of corruption in the regression (-0.038). So, netting out the effect of corruption in non-productive spending do not provide better outlook for this spending on growth even this effect is really small (δg_{nonpro} = 0.001). Also, there is no difference between two coefficients of this variable (Appendix I). It can be seen that the effect of corruption in non-productive government expenditure for high-income and low to middle-income economies sub-groups are similar where its effect reduces the negative impact of non-productive spending on economic growth. The difference with the previous (high-income countries) result for productive government expenditure is that low to middle-income countries spend roughly 78% of total government spending on productive spending, while high-income countries spend approximately 61% of total government expenditure on productive components. Remembering that with a negative effect of total government spending on growth, it is important for governments to reallocate government expenditure in a more optimal way and thereby a change in the expenditure mix towards productive forms of expenditure and away from non-productive forms of expenditure enhances economic growth rate (chapter 4). However, it has been mentioned by Devarajan et al. (1996) that a shift in favour of an objectively more productive type of expenditure may not raise the growth rate if its initial share is too high. It is correct for the case of low to middle-income sample as these countries may currently spend too much public spending on productive components, therefore with presence of corruption it implies that a decrease percentage of productive spending based on ICRG index can create greater growth benefit of this spending.

The corruption-adjusted coefficient of productive spending is still positive and it provides higher positive effects on economic growth than when the research did not take into account corruption for low to middle-income countries when using CPI index. The net impact of corruption in productive government expenditure (the δg_{pro} term) is 0.002. The result is the same when using ICRG index. Whereas, the corruption-adjusted coefficient of non-productive spending is again negative and it is more negative than that the analysis did not take into account corruption. The net impact of corruption in non-productive government expenditure for low to middle-income economies (the δg_{nonpro} term) is -0.005 respectively. Once again, the corruption-adjusted coefficients of productive and non-productive expenditures when using CPI index show that low to middle-income economies may have too high initial share on productive government spending. Although shifting the mix of spending way from non-productive forms of expenditure and towards productive forms, low to middle-income countries can achieve higher economic growth level, but reducing the share of productive spending can even have a greater economic benefit. Both ICRG and CPI indexes show the same results for low to middle-income countries.

Table 5.3: Contribution of productive and non-productive spending to growth in low to middle-income countries (with and without corruption)

Estimation technique: 5 years moving average - two way Fixed Effects - **Low to Middle Income**

Dependent variable: Per capita growth

	ICRG Index				**CPI Index**			
	Without Corruption		**With Corruption**		**Without Corruption**		**With Corruption**	
Productive expenditure	**0.0448***		**0.0499***		**0.0552***		**0.0572***	
	(0.0294)		(0.0299)		(0.0295)		(0.0312)	
Non-Productive expenditure		**-0.0383****		**-0.0375***		**-0.0519***		**-0.0571***
		(0.0195)		(0.0202)		(0.0287)		(0.0308)
Log Initial GDP	-0.2191	-0.202	-0.2121	-0.2253	1.251734	1.378371	1.2842	1.381505
	(1.4092)	(0.9759)	(1.3205)	(0.9776)	(1.4431)	(1.4408)	(1.4427)	(1.4401)
Investment	0.1988***	0.1955***	0.1979***	0.1956***	0.1739***	0.1727***	0.1718***	0.1729***
	(0.0661)	(0.0287)	(0.0661)	(0.0287)	(0.0458)	(0.0459)	(0.0460)	(0.0459)
Inflation	0.002	0.0022	0.0017	0.0024	0.1152***	0.1150***	0.1158***	0.1148***
	(0.0043)	(0.0033)	(0.0066)	(0.0033)	(0.0198)	(0.0198)	(0.0199)	(0.0198)
Labour force growth	-0.1558	-0.1581*	-0.152	-0.1602*	0.2509*	0.2619*	0.2508*	0.2657*
	(0.2576)	(0.0892)	(0.2565)	(0.0893)	(0.1471)	(0.1490)	(0.1474)	(0.1493)
Openness	-0.0048	-0.0052	-0.0048	-0.0054	-0.0643***	-0.0632***	-0.0641***	-0.0632***
	(0.0169)	(0.0078)	(0.0169)	(0.0078)	(0.0107)	(0.0108)	(0.0107)	(0.0108)
Non-tax revenue	-0.0366	-0.0413	-0.0345	-0.0427	-0.05295	-0.05453	-0.05412	-0.05338
	(0.0729)	(0.0503)	(0.0727)	(0.0503)	(0.0657)	(0.0657)	(0.0657)	(0.0657)
Tax revenue	-0.1909*	-0.1911***	-0.1912**	-0.1898***	-0.02467	-0.03361	-0.02796	-0.03256
	(0.0872)	(0.0551)	(0.0852)	(0.0552)	(0.0817)	(0.0819)	(0.0817)	(0.0818)
Surplus or Deficit	0.2462***	0.2523***	0.2435***	0.2538***	0.2477***	0.2560***	0.2498***	0.2545***
	(0.0635)	(0.0444)	(0.0642)	(0.0444)	(0.0651)	(0.0636)	(0.0649)	(0.0637)
Constant	0.5811	5.0042	0.2187	5.1487	-9.97836	-5.31861	-9.97703	-5.34162

	(10.4606)	(6.6803)	(10.4606)	(6.6911)	(10.193)	(10.059)	(10.205)	(10.052)
Observations	312	312	312	312	195	195	195	195
No of countries	20	20	20	20	18	18	18	18
Adjusted R-squared	0.6026	0.6004	0.6043	0.5997	0.6383	0.6378	0.638	0.6382

Note: Robust standard error in parentheses. Country and time dummies included but not reported

*** p < 0.01, ** p < 0.05, * p < 0.1

The test for the difference between coefficients of productive and non-productive before and after using CPI corruption index shows that they are significant different to each other (Appendix I).

Turning our attention to the other explanatory variables affecting the economic growth rate, the results are similar to the main empirical results' analyses in chapter 4. Concerning the budget constraint variables, there is a positive and significant relationship between the budget surplus or deficit variable and economic growth in all regressions. The results find that the tax revenue variable in low to middle-income countries has a negative and significant impact on economic growth for both scenarios with the effect of corruption or without. The same result is found for non-tax revenue variables in high-income countries dataset. The positive coefficient attached to investment for two groups and both scenarios follows standard economic theory, in which an increase in the investment will result in greater production. The openness variable in terms of trade is normally positive for low and middle-income countries since trade is assumed to be growth-enhancing, but it is observed that no relationship between them for low to middle-income sample (similar to Ghosh and Gregoriou, 2007). However, in the sample of high-income economies, international trade has a positive and significant impact on economic growth. Other variables with effect of corruption are insignificant and have the same results as when we remove the effect of corruption out of regressions. For other explanatory variables measuring by CPI, the coefficients of those variables are similar to the main results in part 4.3, except inflation and openness variables. Inflation has negative and significant impact on economic growth in high-income economies, while a positive and significant effect has been found in case of low to middle-income economies. Similar results have been obtained by openness variable. Also, labour force growth variable shows a positive relationship with economic growth for low to middle-income countries during the period 1998 to 2012.

In sum, by comparing the corruption-adjusted coefficient of productive and non-productive government expenditure for both low to middle-income and high-income economies, there is no evidence that corruption has a marked impact on the strength relationship between government expenditure, whether in from of productive or non-productive, and economic growth. These findings do not discount the possibility of corruption affecting growth through other means. For example, through altering the division of total government expenditure between productive and non-productive types.

It also implies that low to middle-income economies may have a high initial share on productive government spending components and a shift in favour of an objectively more productive type of expenditure may not move closer to a more optimum growth level. The difference in using ICRG and CPI has been explained by Ugur (2014) in which he mentions that corruption's adverse effect is reduced when the underlying primary-study estimates are based on ICRG corruption data. Unlike, other corruption data sources, ICRG data is market-tested as it is financed by users (mainly international investors and business managers) who would be willing to pay a fee only if they receive the data as sufficiently informative. TI data are not market-tested as they are financed through public funds or donations. Ugur (2014) in his meta-analysis suggests that there may be significant differences between alternative corruption data sources. Therefore, it is worth to conduct sensitivity checks to verify that our findings remain robust across different measures of perceived corruption.

5.5 Robustness Tests

In this section, the robustness of the empirical results will be tested with respect to endogeneity. A critical econometric issue arising in estimating our empirical model is that the right-hand side variables in equations (5.4) and (5.5) may not be exogenous. The one-step system GMM dynamic model with some advantages mentioned in methodology part is used to provide more reliable and precise results as it offers more rigorous treatment of the presence possibility of endogeneity of fiscal variables on growth.

This test deals with the endogeneity and simultaneity aspects of the model by means of the system GMM for the reasons spelled out in chapter 3. The system GMM estimator estimates as system of equations in first differences and levels (Blundell and Bond, 1998). The GMM system has the added advantage of dealing with the explanatory variables being jointly determined with the growth rate in order to reducing the poor precision of the single equation GMM and SLS estimators. The consistency of the GMM system estimator depends on the assumption that errors are not serially correlated. It is therefore crucial to test for the presence of serial correlation. Arellano and Bond's test reports for first and second order serial correlation of the differenced residuals. Hence, there should be first order but not second order correlation (Roodman, 2009a). Furthermore, Arellano and Bover (1995) and Blundell and Bond (1998) suggested a Sargan or Hansen test for over-identifying restrictions, which tests the overall validity of the instruments when applying the GMM technique.

This robustness test applies dynamic model with lagged growth as an explanatory variable for both group samples. Fiscal, investment and openness variables entered as endogenous, whereas all other variables with time dummies are assumed to be exogenous and instrument for themselves (Bose et al., 2007, Christie, 2012 and Gupta et al., 2005). To capture the effect of lagged growth and to be consistent with the approach of Bose et al. (2007), we exclude log initial GDP from our regressions. The results for the dynamic panel GMM one-step system technique for productive and non-productive expenditures which take into account the presence of corruption on both group countries sample are presented in Table 5.4. These results also report Arellano-Bond's test for autocorrelation and the Hansen J-test of over-identifying restriction.

In the low to middle-income economies, the GMM system model presents the results closely similar to those of the fixed effects model for both productive and non-productive government spending with effects of corruption on them. This implies that the main results for those economies are not purely an object of endogeneity biases. The coefficients of those main interests (productive and non-productive variables) are smaller under GMM than fixed effect model, but the standard errors are also smaller. While the coefficients on the control variables are of different magnitudes and signs. GMM system estimation for high-income countries fails to be valid. While the Hansen J test for over-identifying restrictions does not reject the null hypothesis that our instruments are uncorrelated with the residuals for both samples, it fails to reject the null hypothesis of no second order serial correlation for the developed economies at the 10% level. This result is similar to the robustness test result for endogeneity in chapter 4 for the same sample; even the thesis introduces the effect of corruption on main variables, i.e. productive and non-productive government expenditure. The reason for the invalidity of GMM technique in high-income group may be due to a common characteristic among macro data sets. The dynamic panel data models, which were applied by Arellano and Bond (1991), Blundell and Bond (1998) or Bond et al. (2001), have focused mainly on those applicable to micro data sets, which normally have a large cross-section dimension with a small time-series dimension.

Table 5.4: Productive and Non-productive government spending with GMM technique (with corruption in the system)

Estimation technique: 5 years moving average - GMM one-step system Dependent variable: Per capita growth - **Effect of corruption**				
	High-income		Low and Middle-income	
	(1)	(2)	(3)	(4)
Productive expenditure	**-0.0265***		**0.0312****	
	(0.0191)		0.0153285	
Non-productive expenditure		**0.0875****		**-0.0295***
		(0.0343)		(0.0162)
Investment	0.0116	-0.0338	-0.0086	-0.0049
	(0.0516)	(0.0648)	(0.0249)	(0.0290)
Inflation	-0.0312	-0.0732	0.0027	0.0029
	(0.0467)	(0.0594)	(0.0021)	(0.0021)
Labour force growth	0.0585	0.0764	-0.0367	-0.0250
	(0.0741)	(0.0935)	(0.0764)	(0.0680)
Openness	0.0011	0.0007	-0.0011	-0.0020
	(0.0029)	(0.0033)	(0.0046)	(0.0056)
Non-tax revenue	0.0264	-0.0321	0.0020	0.0111
	(0.0486)	(0.0726)	(0.0444)	(0.0430)
Tax revenue	0.0130	-0.0831	0.0133	0.0234
	(0.0533)	(0.0739)	(0.0467)	(0.0608)
Surplus or Deficit	0.0213	0.0771	0.0759	0.0415
	(0.0508)	(0.0723)	(0.0652)	(0.0687)
Constant	0.2541	-0.3829	-1.2510	1.3342
	(3.4472)	(4.0570)	(1.5186)	(1.0577)
Observations	550	550	293	293
No of countries	37	37	20	20
No of instruments	43	34	38	34
AR(2) test (p-value)	0.022	0.033	0.172	0.156
Hansen test (p-value)	0.307	0.338	1	1

Note: Robust standard error in parentheses. Country and time dummies included but not reported

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

5.6 Discussion and Conclusion

This chapter evaluates empirically the impacts of different components of government expenditures on economic growth that is affected by the presence of corruption in an economy. In order to take the interdependency between government expenditure compositions, corruption and economic growth this analysis has formulated a system of equations where corruption is modelled analytically as something that reduces the productivity of public spending. It is important to note in chapter 4 that by shifting the mix of spending way from non-productive forms of expenditure and towards productive forms, countries can move closer to a more optimum growth level for both high-income and low to middle-income groups. But it remain unclear whether an increase of higher portion of productive government expenditure contribute to a greater economic growth and whether with its initial share is too high, a shift in favour of an objectively more productive type of expenditure may not raise the growth rate, especially low to middle-income economies.

The empirical strategy applied OLS two-way fixed effects methods to a panel of 57 countries based on the availability of ICRG corruption index during the period from 1993 to 2012. Additionally, potential biased problems in the relationship between growth and government structure in the presence of corruption were tackled using dynamic GMM one-step system estimation techniques. By comparing the corruption-adjusted coefficient of productive and non-productive government expenditure for both low to middle-income and high-income economies, there is no evidence that corruption has a marked impact on the strength relationship between government expenditure, whether in from of productive or non-productive, and economic growth. These findings do not discount the possibility of corruption affecting growth through other means. For example, through altering the division of total government expenditure between productive and non-productive types. The different results between high-income and low to middle-income economies groups are due to the purposes of each group's government policy and the initial share of productive government expenditure on total government expenditure. High-income economies try to achieve both sustainable economic growths with high standard of living (spending only 61% of total government expenditure on productive components), while low to middle-income countries can boost their economic growth by spending more money on those productive components (around 78% of total government spending).

Therefore, high-income economies can increase their share on productive spending to boost economic growth, but low to middle-income countries may reduce its spending as Devarajan et al. (1996) stated that a shift in favour of an objectively more productive type of expenditure may not raise the growth rate if its initial share is too high. Furthermore, by introducing the CPI corruption index from TI instead of ICRG index for robustness test, the result suggests that different set of countries, period of time covering and different range of CPI score index (from zero to ten) may provide some slightly different results.

The dynamic panel GMM one-step system technique shows that the baseline regression results do not experience the possible endogeneity biases, especially low to middle-income economies sample. This result is consistent with previous study in chapter 4 when the research does not take into account the role of corruption.

Chapter Six
The Impact of Government Expenditure on Human Capital on Economic Growth: Comparison of OECD and ASEAN Countries

6.1 Introduction

Economists have long recognised that human capital is important for economic growth and it has been much researched theoretically and empirically (see e.g., Schultz, 1961; Becker, 1964; Uzawa, 1965; Romer, 1986; Barro, 1991; Levine and Renelt, 1992; Mankiw et al., 1992; Bassanini and Scarpetta, 2002; Baldacci et al., 2004; Blankenau et al., 2007; Bose et al., 2007; Afonso and Jalles, 2013; Siddiqui and Rehman, 2017). Schultz (1961) and Becker (1964) defined human capital as the set of knowledge, skills, competencies and abilities embodied in individuals and acquired through education, training, medical care and migration. The basic idea is that a more educated and healthier labour force is expected to be relatively more productive. Dissatisfied with the exogenous technological progress assumed in traditional economic growth, Romer (1986) and Lucas (1988) developed endogenous growth models in which human capital was explicitly introduced as an additional variable driving the multi-factor productivity reflected in the Solow (1956) residual. In their papers, it is essential to understand the human capital accumulation process and its impact on economic growth in different countries. For various countries, investment in human capital has been the primary and foremost objective in creating better human resources which can bring sustainable economic development of the nation in the long term. Theoretical contributions highlight different mechanisms through which human capital has impact on economic growth with health care and education being the most important indicators. First, education and health care spending improve the quality of the workforce and positively contribute to the productive capacity and thus to economic growth (Kesikoglu and Ozturk, 2013). Second, in endogenous growth theories, government expenditures on education and health play an important role in increasing the innovative capacity of the economy, knowledge of new technologies, products and processes, and therefore have a significant contribution to sustainable long-run economic growth (Hanushek and Woessmann, 2008).

There are empirical studies that show an important positive relationship between human capital and long-run economic growth (Barro, 1990; Mankiw et al., 1992; Barro and Lee, 1993; Bassanini and Scarpetta, 2002; Baldacci et al., 2004; Bose et al., 2007). However, some other studies have found that there is a negative (Prichett, 1996; Bil and Klenow, 2000; and Dalic, 2013) or in some cases insignificant effect (Benhabib and Spiegel, 1994; Perotti, 1996; Miyakoshi et al., 2010) of human capital on economic growth. Though health has been recognised as an important component of human capital (Schultz, 1961; Bloom et al., 2001 and Barro, 2013), education has often been the focus of attention in the literature on economic growth and development. Furthermore, the empirical results on the impact of these government expenditures are mixed and inconclusive. Neycheva (2010) and Afonso and Jalles (2013) find a positive impact of education government expenditure on growth, while Blankenau et al. (2007) and Ghosh and Gregoriou (2007) find opposing results. Similarly, empirical studies that investigate the growth effect of government expenditure on health provide mixed results (Easterly and Rebelo, 1993; Landau, 1997 and Cooray, 2009). In section 4.5.3, I also found a significant positive relationship between expenditure on education and economic growth in high-income countries, while it was not found to be significant in low to middle-income countries. In term of expenditure on health care, my analysis found a positive and significant impact on economic growth in low to middle-income economies, whereas an insignificant effect is found in high-income countries.

One possible explanation for the mixed effect results of human capital and its important indicators on economic growth is the matter of country heterogeneity. Studies utilising samples that include developed countries tend to find weaker results, which is consistent with diminishing returns in human capital (Baldacci et al., 2008). To properly account for heterogeneity, the solution is to estimate single-country regressions. However, while single-country estimates of the parameters of physical capital and human capital can capture the heterogeneity of the individual country structures, they ignore some useful information contained in the common structure in a regional context. It could be a common geographical terrain, similar governance structure and similarities in level of economic development and other similarities in culture and economic indicators. These commonalities are indeed found in some areas, such as, OECD countries or ASEAN countries. Furthermore, there are a number of empirical researches carried out in developed nations in order to investigating the effect of government expenditure on education and health on economic growth. However, in the case of Asian countries, especially ASEAN countries, there is limited research. ASEAN countries have enjoyed remarkable economic progress in recent years. Viewed as a single entity, the region would rank as the seventh-largest economy in the world based on GDP current price in 2013 (World Economic Forum, 2014). But much of its recent growth has been generated by an expanding labour force and the shift of workers from agriculture to manufacturing. Due to new urgency for confronting the region's low levels of productivity when those factors will eventually fade and the growing economic activities of this area, the development of education sector, health system and their contributions to the economic development is crucial. Besides, there are numbers of studies focused on OECD countries to examine the growth impacts of government expenditure on human capital, but the previous studies confined to the OECD deliver conflicting results. Also, there are great variations across countries in human capital investment and its outcomes. In term of the education and health expenditure as percentage of GDP, the low and middle-income countries lag far behind the high-income ones. Hence, it is interesting to see how government expenditure on education and health affect economic growth in OECD and ASEAN countries.

In this context, this chapter focuses on examining the association between human capital and its components and economic growth for a panel of 25 OECD countries and 5 ASEAN countries for the period 1993 to 2012, thus providing a general conclusion per development level and region. Again, this analysis uses a 5-year moving average for all variables, instead of the traditional 5-year average or 5-year moving average for dependent variables, to smooth over some of the cyclical features of the data. The OLS two-way fixed effects are also applied to address the concerns of unobservable country-specific effects. The finding shows that the impact of government expenditure upon education on economic growth remains positive for both sets of data. For the association between public expenditure upon health and growth, this analysis recognises a negative effect in OECD economies, while there is no significant impact of this component in ASEAN countries. With regards to the combined government expenditure on human capital, this analysis observes that there is a positive and significant connection between this expenditure and economic growth in ASEAN economies, but no significant effect in OECD countries. With these results, this chapter lays a foundation for and guide future studies in examining areas of particular importance in the human capital expenditure – growth literature.

Furthermore, another weakness in much of the research is the failure to control for variable that may have an effect on the effectiveness of government spending on human capital. In particular, many studies have highlighted the important role of government governance in determining the association between human capital and economic growth. Poor governance or high corruption has been identified as a key factor to ineffective public spending in human capital (Abed and Gupta, 2002; Gupta et al., 2002; Rodrik et al., 2004; Hausmann et al., 2005; Baldacci et al., 2008; Churchill et al., 2015). Besides, in chapter 5 of this thesis, the results represent that corruption reduces the productivity benefits from productive spending component in high-income economies, while the corruption is good in the context of productive government expenditure for low to middle-income countries. With the case study of 25 OECD countries and 5 ASEAN countries from 1993 to 2012, this analysis also investigates the impact of corruption in moderating the impact of government expenditure upon human capital and its indicators on economic growth.

The remainder of this chapter is organised as follows. Section 6.2 presents an overview of the literature on the effect of human capital on growth. Section 6.3 describes the model specification, discusses the data and specifies the econometric model. Section 6.4 reports the empirical estimates and links these with the analytical results. In Section 6.5, robustness tests are carried out. Finally, Section 6.6 concludes the results with some policy implications.

6.2 Literature Reviews

This section reviews the theoretical and empirical studies on the role of education and health in economic growth used in this analysis. It also provides several factors to explain why the mixed results can be found from literature on the effectiveness of education and health spending in improving economic growth.

6.2.1 Education

It is widely accepted that investment in education has been one of the most important components in human capital and critical for economic growth (Barro and Sala-i-Martin, 1995; Baldacci et al., 2008; Dauda, 2010). The relationship between economic growth and education can be demonstrated through many different mechanisms. For example, education is supposed to create the positive impact on economic growth by improving the quality of workforce, by decreasing inequality, by promoting better health and lower mortality of children, by providing better conditions for good governance, and by increasing knowledge and the innovative capacity of an economy (Jorgenson et al., 1987; Schultz, 1990; Benhabib and Spiegel, 1994; Aghion et al., 1999; Glaeser et al., 2004; Hanushek and Woessmann, 2008).

There are many theoretical studies that examine the association between government expenditure on education and economic growth. Among those studies are Mankiw et al. (1992), Glomm and Ravikumar (1992, 1997, 1998), Barro (1996), Zhang (1996), Michaelowa (2000), Benabou (2002), Wigger (2004), and Blankeanu (2005). For instance, Zhang (1996) stated that education subsidisation increases growth and decreases welfare losses caused by human capital externalities. Michaelowa (2000) showed that expenditure on education can bring into the economic system positive externalities and other indirect effects, such as higher education attainment by children, better individual health and a lower number of births. All of these together with lower population growth and better health of the population tend to positively affect higher economic growth per capita.

While there is strong theoretical support for the role of government expenditure on education in promoting economic growth, empirical evidence is not clear-cut and has been mixed. Barro and Lee (1993) investigated this relationship in a sample of 129 countries and found that government expenditure on education has a positive impact on economic growth. There are many empirical papers that find the same results, such as Barro and Sala-i-Martin (1995), Zhang and Casagrande (1998), Bose et al. (2007), Baldacci et al. (2008), Neycheva (2010), Afonso and Jalles (2013), Mallick et al. (2016), and Siddiqui and Rehman (2017). In contrast, some empirical studies find a negative relationship between education expenditure and growth (Kelly, 1997; Mo, 2007; and Ghosh and Gregoriou, 2007) or even an insignificant connect between two (Levine and Renelt, 1992; Benhabib and Spiegel, 1994; Devarajan et al., 1996; Keller, 2006; Miyakoshi et al., 2010).

There are several explanations for these mixed results. For example, Baldacci et al. (2008) stated that model specification and the inclusion or exclusion of certain control variables could explain differences in reported estimates. Bassanini and Scarpetta (2002) mentioned that the results depend on the use of better data (wherever available) on measuring education as well as in the choice of estimation techniques. The use of large panel data series with better consistency in compilation can help mitigate these problems. Another possible explanation is that of country heterogeneity that has been mentioned in the introduction. In light of this heterogeneity, Jones and Olken (2008) showed that dramatic changes in growth are common features of the growth experience for many countries and growth decelerations and accelerations are asymmetric. Therefore, they argue that the within-country dimension is important for explaining the determinants of growth.

6.2.2 Health

One direct way in which health can have an impact on economic growth is by improving labour force productivity. By adding health as a capital good in his model, Grossman (1972) showed that people's health depreciates over time but can recover with investment in health. Grossman (1972) also argued that increasing health capital reduces the time lost to illness and therefore provides a more effective performance from the labour force through increased productivity. Jack (1999) demonstrated that investment in human capital, especially in the physical and mental capabilities of the labour force improves productivity. Furthermore, Strauss and Thomas (1998) and Bloom and Canning (2000) suggested that a healthy community or population has a tendency to enhance physical abilities and mental clarity, thereby increasing productivity.

The empirical studies on the impacts of government expenditure upon health on economic growth are relatively limited compared to those empirical studies on the effects of education expenditure. In a meta-analysis, Churchill et al. (2015) examines the relationship between economic growth and human capital by using a sample of 306 estimates drawn from 31 primary studies, but only 12 studies were focused on health expenditure. They found that there is a positive association between government expenditure upon education and growth, while government expenditure on health had a negative impact on economic growth. Based on microeconomic evidence, Strauss and Thomas (1998), and Thomas and Frankenberg (2002) found that specific health sector interventions support a significant rise in recipients' earnings and general health and nutrition status are important predictors of economic success. Research at the macroeconomic level can better capture the impact of government expenditure on health on economic growth. Several studies support the positive contribution of government expenditure upon health to growth, (Barro, 1996; Bloom and Canning, 2003; Bloom et al., 2004; Gyimah-Brempong and Wilson, 2004; Jamison et al., 2004 and Cooray, 2009). Gyimah-Brempong and Wilson (2004) pointed out that improvement in health conditions equivalent to one more year of life expectancy are consistent with higher growth of up to 4 percentage points per year from the country in their sample. Jamison et al. (2004) noticed that improvement in health account for about one tenth of economic growth by using data from developing and developed countries from 1965 to 1990. However, most of empirical research that examines public expenditure on health finds a negative (Singh and Weber, 1997; Miller and Russek, 1997; Landau, 1997; Dao, 2012; Dalic, 2013) or not significant impact on growth (Easterly and Rebelo, 1993; Perotti, 1996; Kelly, 1997; Kneller et al., 1999; Ghosh and Gregoriou, 2007; Miyakoshi et al., 2010; Afonso and Jalles, 2013).

The empirical literature on the effects of government expenditure on health on growth is relatively thin, but the mixed results from literature are similar to the effectiveness of education spending in improving economic growth. The same reasons for weakness of a robust relationship between public spending on education and economic growth have been found for public spending on health. Besides, the literature has often failed to capture the interaction between the education and health sector and their combination on economic growth. As a result, this leads to an understatement of the impact of human capital spending on economic growth (Mayer-Foulkes, 2003; Miguel and Kremer, 2004). Higher levels of education improve public awareness and the capacity of families to deal with their own health needs. At the same time, better health increases the effective and sustained use of the knowledge and skills that individuals gain through education (Schultz, 1999). Ranis et al. (2000) stated that there is a statistically significant relationship in modelling the two-way relationship between human capital and economic growth in their 76 developing countries sample for 1960 – 1992. They pointed out that government should give the priority to primary education and comprehensive heath intervention, both from the perspective of improving human development in an early phase and this will increase economic growth. Also, Gyimah-Brempong and Wilson (2004) found a positive and robust association between investment in health and economic growth in both Sub-Saharan African and OECD countries. Given the heterogeneity presented in the empirical literature as discussed above, it is difficult to draw a general conclusion on the relationship of government expenditure on human capital and its component and economic growth.

Another reason to explain the weakness of the association between government expenditure on human capital and economic growth is the failure to control governance variables which can have an important impact on the effective of human capital. Baldacci et al. (2008) with a panel dataset of 118 developing countries for the period 1971 to 2000 stated that corruption has a significant direct effect on the nexus between human capital spending and economic growth. They found that countries with poor governance or high corruption have growth lower than 1.6 percentage point compared to other countries. The effect of corruption on growth is transmitted through indirect channel via reducing the productivity of government expenditure on human capital and thereby affecting economic growth. They also mentioned that the role of corruption which had not always been noticed in previous studies could help to explain the mixed results in the association between human capital and growth. Furthermore, in a meta-regression analysis of 57 empirical studies to examine the relationship between education and economic growth, Benos and Zotou (2014) indicate that the inclusion of political measures (anti-corruption programme) can increase the education growth effect by 0.01 point in their research. Similar to their study, Churchill et al. (2015) state that the inclusion or exclusion of a political instability (corruption measurement) variable affects the impact of government expenditure on human capital and its components (education and health) on economic growth.

ASEAN is a grouping of ten neighbouring nations (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam) in Southeast Asia that has existed for over half a century. Almost five decades after the organization’s founding, ASEAN is pursuing a more ambitious form of economic integration as a tool for achieving broader regional prosperity and greater global competitiveness. This aspiration is not yet a working reality on the ground, but there has been tangible progress in areas such as eliminating tariffs. If the region’s leaders succeed in dismantling other types of barriers that hinder the movement of goods, services, capital, and skilled workers across its borders, ASEAN stands to reap the benefits of increased trade, production, and investment (McKinsey Global Institute, 2014). The region has experienced two decades of robust economic growth, which has successfully lifted millions out of poverty and created a middle class with newfound spending power. If ASEAN were a single country, it would already be the seventh-largest economy in the world (World Economic Forum, 2014). Its combined GDP of $2.4 trillion was more than 25% larger than India's economy in 2013 (IMF, 2014). Since 1990, ASEAN's population of approximately 625 million people has almost doubled, and by 2025 it is expected to reach 694 million. It accounts for 8.6% of the world total, is equal to the combined populations of Latin America and the Caribbean, and is larger than that of the European Union and doubles that of the United States (IMF, 2016). ASEAN has the third largest labour force in the world, behind only China and India, and its youthful population is producing a demographic dividend.

Despite its momentum, Southeast Asia faces some drawbacks on its current route—and low productivity ranks chief among them. Although productivity has been rising in recent decades, much of this progress was driven by a broad shift of labour from agriculture into more efficient sectors, rather than improvements within sectors. Productivity remains at worryingly low levels in most Southeast Asian countries, which hampers their ability to continue to raise living standards. Unless the region builds a more competitive manufacturing sector, it could miss out on the opportunity to secure more production from multinational corporations (McKinsey Global Institute, 2014). While demographics are still favourable, the boost to economic growth from an expanding workforce will eventually begin to taper. In fact, some of the region's countries will need to more than double their historic rates of productivity gains to sustain their pace of economic growth. Beyond its productivity imperative, Southeast Asia faces urgent priorities in addressing infrastructure, housing, health system and education. It can be seen that ASEAN is one of the world's fastest-growing market, but one of the least well known and there is also limited empirical studies on the growth effects of government expenditure upon human capital.

On the other hand, education and health have been expanding relentlessly in OECD countries. Many OECD member countries have now been providing a basic primary education to all citizens for at least a century. The expansion in education has come about for many reasons. Economically, there has been pressure to provide an increasingly well-qualified workforce to meet the demands of business. Socially, changes in the structure of OECD economies have cut job opportunities in manufacturing and trade for young people. Education has, to some extent, provided a way to keep young people off the streets

(OECD Insights, 2007). Whatever the reasons for its expansion, education now eats up a large slice of spending in OECD countries – 5.2% of combined GDP for the period from 1992 to 2012, although there are big variations between countries. Analyses which examine the growth effects of government expenditure upon education focus generally on OECD countries, as the data quality for OECD countries seems to be more reliable and easy to collect. But previous studies confined to the OECD deliver conflicting results. Krueger and Lindahl (2001) with their regression for OECD countries found that there is a negative impact of education on economic growth. In contrast, OECD (2003) found a significant positive relationship between education and economic growth applying a dynamic panel approach. Furthermore, spending on health across the OECD has recently decreased in the wake of the global financial and economic crisis in 2008. Also, governments in OECD nations are facing many complicated issues in the health sector. These issues include aging of the population, high prices for medical inputs, expensive medical technology, and resource allocation within the health sector, overload of health services and shortage of workforce in the sector. In addition, there are very few researches investigate the impact of government expenditure upon health on economic growth even in OECD case. Hence, this chapter aims to revisit the question whether government expenditure upon education, health and human capital affect long term economic growth in selected 25 OECD and 5 ASEAN economies, thus providing a general conclusion per development level and region. Also, I investigate the impact of corruption from those countries on economic growth via these expenditures.

6.3 Model Specification, Data and Methodology

6.3.1 Data and Choices of Variables

The empirical analysis used panel data on 25 high-income OECD countries and 5 ASEAN countries (Indonesia, Philippines, Singapore, Thailand and Vietnam) covering the period from 1993 to 2012 (list of 25 OECD countries can be seen in Appendix G). The fiscal variables for government expenditure on education, health and tax, non-tax revenue are collected from IMF's GFS. Other variables are obtained from the World Bank's Development Indicator (WDI). This chapter also compares and contrasts the impact of corruption from those countries on economic growth via education and health government expenditure, therefore the data for corruption indices are obtained from ICRG. The ICRG index ranges from zero to six. Similar to chapter 5, "δ" denotes as corruption index in our theoretical model which ranges between 0 and 1, and is a positive function of corruption, the analysis has therefore rescaled the ICRG index accordingly.

The first set of regression model specification for capturing the relationship between the proportion of government expenditure on education as a percentage of total government spending and economic growth is:

$$G_{it} = a_i + b_t + \alpha_1 G_{it-1} + \beta_2 \left(\frac{g_{edu,it}}{g_{pro,it} + g_{nonpro,it}}\right) + \gamma_1 \left(\frac{TR_{it}}{y_{it}}\right) + \gamma_2 \left(\frac{NTR_{it}}{y_{it}}\right) + \gamma_3 \left(\frac{Def\ or\ sur_{it}}{y_{it}}\right) + \sum_{l=1}^{k} \sigma_l I_{ilt} + \mu_{it} \quad (6.1)$$

The second set of regression model specification for capturing the relationship between the proportion of government expenditure on health as a percentage of total government spending and economic growth is:

$$G_{it} = a_i + b_t + \alpha_1 G_{it-1} + \beta_2 \left(\frac{g_{hea,it}}{g_{pro,it} + g_{nonpro,it}}\right) + \gamma_1 \left(\frac{TR_{it}}{y_{it}}\right) + \gamma_2 \left(\frac{NTR_{it}}{y_{it}}\right) + \gamma_3 \left(\frac{Def\ or\ sur_{it}}{y_{it}}\right) + \sum_{l=1}^{k} \sigma_l I_{ilt} + \mu_{it} \quad (6.2)$$

The third set of regression model specification for capturing the relationship between the proportion of government expenditure on human capital (combination of education and health) as a percentage of total government spending and economic growth is:

$$G_{it} = a_i + b_t + \alpha_1 G_{it-1} + \beta_2 \left(\frac{g_{edu,it} + g_{hea,it}}{g_{pro,it} + g_{nonpro,it}}\right) + \gamma_1 \left(\frac{TR_{it}}{y_{it}}\right) + \gamma_2 \left(\frac{NTR_{it}}{y_{it}}\right) + \gamma_3 \left(\frac{Def\ or\ sur_{it}}{y_{it}}\right) + \sum_{l=1}^{k} \sigma_l I_{ilt} + \mu_{it} \quad (6.3)$$

The fourth set of regression model specification for capturing the relationship between the proportion of government expenditure on education as a percentage of total government spending and economic growth in the presence of corruption is:

$$G_{it} = a_i + b_t + \alpha_1 G_{it-1} + \beta_2 \left(\frac{(1-\delta) g_{edu,it}}{g_{pro,it} + g_{nonpro,it}}\right) + \gamma_1 \left(\frac{TR_{it}}{y_{it}}\right) + \gamma_2 \left(\frac{NTR_{it}}{y_{it}}\right) + \gamma_3 \left(\frac{Def\ or\ sur_{it}}{y_{it}}\right) + \sum_{l=1}^{k} \sigma_l I_{ilt} + \mu_{it} \quad (6.4)$$

The fifth set of regression model specification for capturing the relationship between the proportion of government expenditure on health as a percentage of total government spending and economic growth in the presence of corruption is:

$$G_{it} = a_i + b_t + \alpha_1 G_{it-1} + \beta_2 \left(\frac{(1-\delta) g_{hea,it}}{g_{pro,it} + g_{nonpro,it}} \right) + \gamma_1 \left(\frac{TR_{it}}{y_{it}} \right) + \gamma_2 \left(\frac{NTR_{it}}{y_{it}} \right) + \gamma_3 \left(\frac{Def\ or\ sur_{it}}{y_{it}} \right) + \sum_{l=1}^{k} \sigma_l I_{ilt} + \mu_{it} \quad (6.5)$$

The sixth set of regression model specification for capturing the relationship between the proportion of government expenditure on human capital (combination of education and health) as a percentage of total government spending and economic growth in the presence of corruption is:

$$G_{it} = a_i + b_t + \alpha_1 G_{it-1} + \beta_2 \left(\frac{(1-\delta)(g_{edu,it} + g_{hea,it})}{g_{pro,it} + g_{nonpro,it}} \right) + \gamma_1 \left(\frac{TR_{it}}{y_{it}} \right) + \gamma_2 \left(\frac{NTR_{it}}{y_{it}} \right) + \gamma_3 \left(\frac{Def\ or\ sur_{it}}{y_{it}} \right) + \sum_{l=1}^{k} \sigma_l I_{ilt} + \mu_{it} \quad (6.6)$$

where i and t denote the cross-sectional and time series dimensions respectively; capture the time-invariant unobserved country-specific fixed effects, and capture the unobserved individual-invariant time effects. G is the per capita real GDP growth rate, $G_{it-1}$is first lagged of growth variable is introduced for applying dynamic panel GMM techniques. g_{edu}, g_{hea} are government expenditure on education and health. g_{pro} + g_{nonpro} are represent total government spending. y is GDP, TR is tax revenue, NTR is non-tax revenue and (Def or sur) is budget surplus or deficit. I_{ilt} is a vector of non-fiscal independent variables (initial of GDP per capita, inflation, labour force growth, investment and openness variables capture the inter-national dimension). $\delta.g$ is an interaction term that presents the impact of government expenditure composition on growth with presence of corruption. In this set-up, we first examine the impact of g_{edu} and g_{hea} on economic growth rate for OECD and ASEAN countries, then compare these coefficients of the modified equations with the presence of corruption coefficients of $(1-\delta).g_{edu}$ and $(1-\delta).g_{hea}$.

6.3.2 Methodology

Similar to methodology we used in chapter 4 and chapter 5, this section uses two-way OLS fixed effects which control time-invariant individual country characteristics and time fixed effect as the main method of estimation. This technique addresses the common concern of excluding unobservable country-specific effects in panel data estimation. Furthermore, dealing with the endogeneity and simultaneity aspects of our model, this analysis tries to apply the dynamic panel one-step system GMM estimation for robustness test on both sub-sample countries. However, as the number of observations for OECD and ASEAN are quite small, at 375 and 75 respectively, the dynamic panel one-step system GMM estimation for both groups does not perform well in small samples with many regressors, making it unsuitable for estimation (Bond et al., 2001; Roodman, 2009a; Roodman, 2009b; Tauchen, 1986 and Ziliak, 1997). Therefore, this chapter will not report the result of robustness test of endogeneity. Also, this analysis uses five-year forward moving averages for all variable as it can remove business cycle effects, increase the number of time series observation in our panel data, minimise the reverse causality argument holding in our model and account for endogeneity.

Table 6.1 presents the descriptive statistics about government expenditure on education and health, development and corruption index from ICRG for the period from 1993 to 2012 for 25 OECD and 5 ASEAN countries.

Table 6.1: Descriptive Statistics

	OECD Countries		**ASEAN Countries**	
Variable	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**
Growth rate (GDP per capita)	2.17	1.977	3.27	1.935
Education expenditure (% TGE)	11.90	3.865	15.25	5.345
Health expenditure (% TGE)	13.21	4.086	4.71	2.965
Human Capital (Education + Health as % of TGE)	25.11	3.975	19.96	4.155
Education expenditure (% GDP)	5.24	1.660	3.02	1.054
Health expenditure (% GDP)	5.83	1.815	0.95	0.603
Human Capital (Education + Health as % of GDP)	11.07	1.737	3.97	0.829
Productive government expenditure (% GDP)	56.69	6.605	86.79	4.578
Non-productive government expenditure (% GDP)	43.40	6.364	13.26	4.550

Corruption index (ICRP)	4.49	1.027	2.61	1.011
Total government expenditure (% of GDP)	44.41	6.739	20.19	4.100
Deficit or Surplus (% of GDP)	-1.15	3.864	0.35	3.654
Tax Revenue (% of GDP)	26.87	6.029	14.31	2.335
Non-Tax Revevue (% of GDP)	15.68	4.982	5.04	3.113
Log Initial p.c. GDP (constant 2005 US$)	10.34	0.517	7.72	1.334
Investment (Gross capital formation as % of GDP)	22.28	3.449	26.58	5.037
Inflation rate (%)	2.93	2.140	7.23	6.295
Labour force growth (p.a)	1.10	0.955	2.17	0.867
Openness (Sum of exports and imports as % of GDP)	90.02	49.920	152.52	113.850

It can be seen that 5 ASEAN economies have a higher average growth rate than OECD countries, at 3.3% and 2.2% respectively. Figure 6.1 shows the economic growth rate for Indonesia, Philippines, Singapore, Thailand, Vietnam and OECD average from 1993 to 2012 (taking 5 year moving average from 1995 to 2010). Vietnam has the highest growth rate among 5 countries during this period as the country introduced an open economy model in the 1990s, which was accompanied by agriculture reforms and developments in the manufacturing and services sectors. All 5 ASEAN countries experienced reduced growth for the period from 1995 to 2000 as a result of the Asian financial crisis, also called “Asian Contagion”. The crisis was a series of currency devaluations and other events that spread through many Asian markets beginning in the summer of 1997. The effects of the crisis were most evident in Thailand and Indonesia. However, those countries’ economies have recovered during the period from 2001 to 2012. Meanwhile, OECD countries were hit by the global financial crisis during 2008-2009 and economic growth was adversely affected in several countries. OECD economies are on average found to have a higher level of total government expenditure (44%) than the ASEAN countries (20%). Although they have smaller government budgets, the five ASEAN countries tend to focus spending (87%) on productive government expenditure in order to boost economic growth and converge with more developed high-income countries. They spend an average of 15.3% of total government expenditure on education, but only 4.7% on health. Meanwhile, OECD countries spend just 56.7% on productive components, with 12% on education and 13% on health. Thus, while the ASEAN economies spend a larger proportion of government expenditure on productive issues, a smaller proportion of this expenditure is on human capital.

Figure 6.1: Economic growth rate (GDP per capita, %) for five ASEAN countries and OECD average (1993-2012)

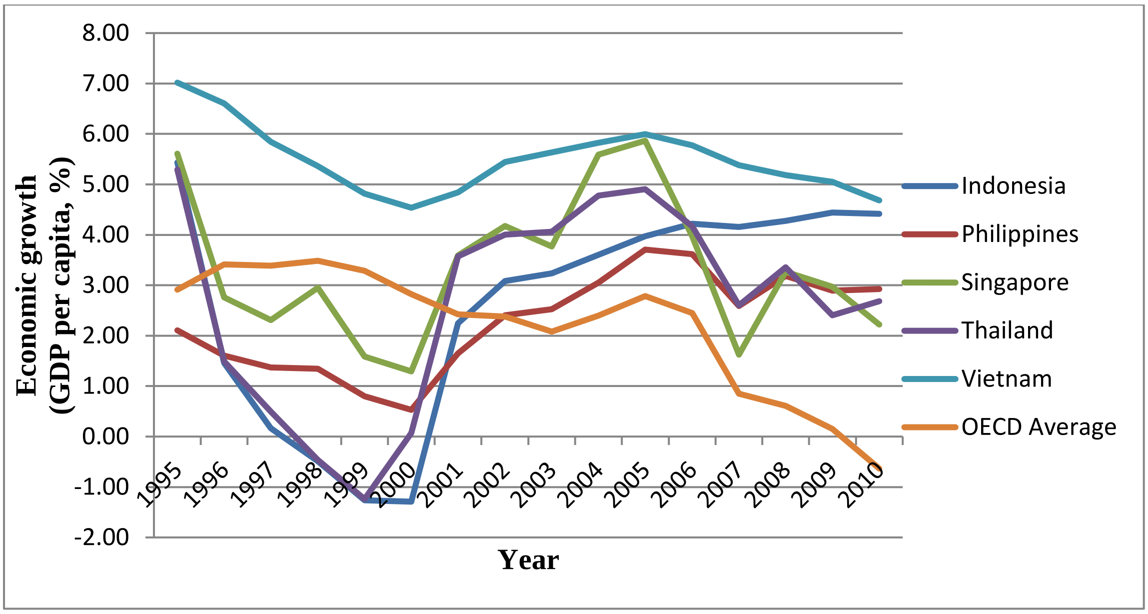


Figure 6.2: Government expenditure on education for five ASEAN countries and OECD average (1993-2012)

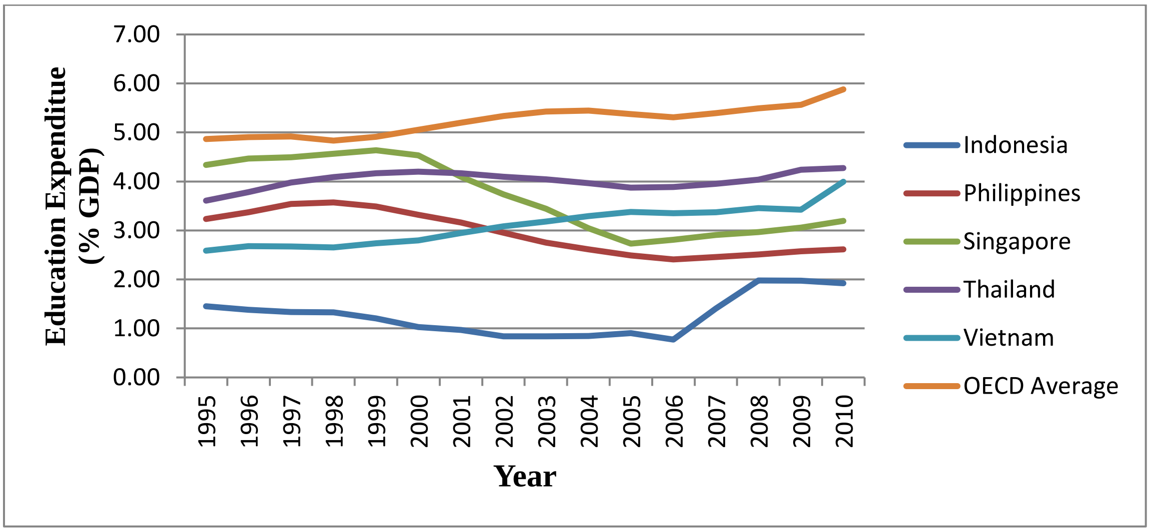


Figure 6.3: Government expenditure on health (% of GDP) for five ASEAN countries and OECD average (1993-2012)

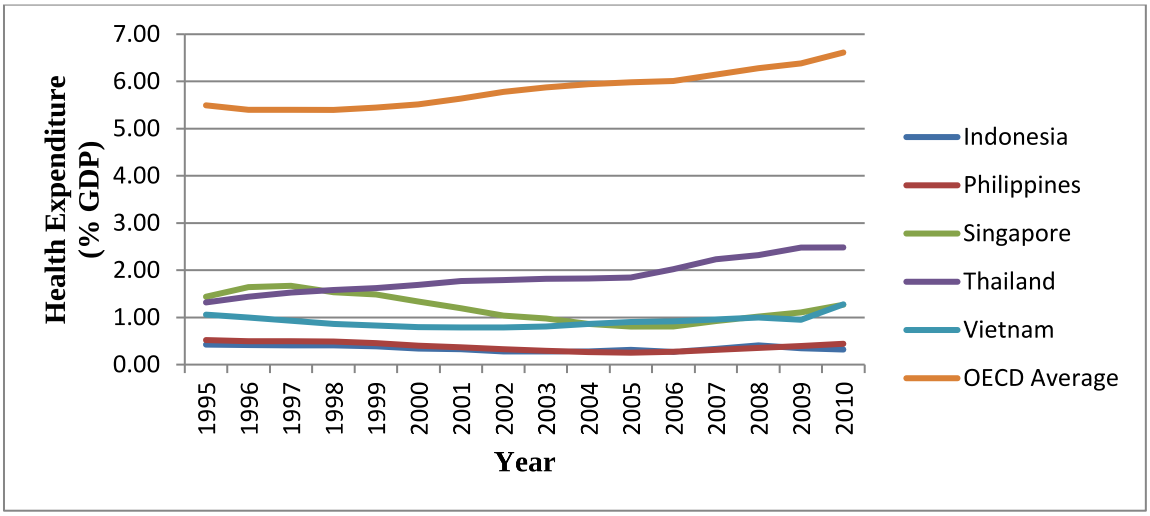


Figure 6.2 and 6.3 present government expenditure on education and health as a per cent of GDP for the five ASEAN countries and OECD average for the period 1993 to 2012. It can be seen that even though OECD countries have consistently spent less of their government spending on productive components than the ASEAN economies, they spend a larger and growing proportion on human capital. Meanwhile, government expenditure on education by the five ASEAN countries varies between countries from 1% to 4% of GDP during this period. Thailand and Vietnam are the only ones to increase their proportion of spending on education for the period from 1993 to 2012, and pick up to around 4% of GDP in 2012. Indonesia has the lowest government expenditure on education among the five ASEAN countries with the average of 1.5% of GDP.

Moving to government expenditure on health (figure 6.3), there is a significant difference between OECD average and the five ASEAN countries. OECD countries spend on average 6% of their GDP on health and they increase this spending gradually over the period from 1993 to 2012. The five ASEAN economies spend only approximately 1% of GDP on health during this period. Surprisingly, although Singapore is a high-income ASEAN economy, its spending on human capital is still very low and similar to Vietnam. The Philippines and Indonesia spend only an average of 0.5% of GDP on health. Moreover, only Thailand is trying to increase their spending on health in recently years, even this portion amount is still small compared to OECD countries. In general, it can be seen that OECD and ASEAN countries both focus on education expenditure as a key component of investing in human capital to boost economic growth, but there is a marked lack of investment in health from ASEAN governments compared to OECD countries. Thus, it leads to lower investment from ASEAN countries in human capital. It has been noted by Churchill et al. (2015) that very few studies examine the impact of government health expenditure and government expenditure on human capital as share of total government spending on economic growth. Hence, this analysis examines further in-depth the relationship between these variables on economic growth, captures country differences and lays a foundation future studies in investigating areas of particular importance of human capital expenditure – growth literature.

Moving to other fiscal variables, ASEAN countries have a lower average budget deficit as percentage of GDP than OECD countries, at 0.35% and -1.15% respectively. Meanwhile, tax revenue and non-tax revenue variables as percentage of GDP in OECD countries have a higher average rate compared to ASEAN countries, 27% compared with 14% for tax revenue and 16% compared with 5% for non-tax revenue. Looking at other macroeconomic variables in table 6.1, OECD countries have a low average inflation rate during this period at 2.9%; while ASEAN countries have markedly high inflation rate with average of 7.2%. Regarding trade openness as percentage of GDP, ASEAN economies have a higher average rate than OECD economies, at 152.5% and 90% respectively; as this variable is believed to one of main streams for significant development in those ASEAN countries. In addition, ASEAN countries have higher rate for labour force growth than OECD countries, at 2.2% compared with 1.1% respectively; and with labour force expansion and productivity improvement, ASEAN is becoming one of the most attractive areas for foreign direct investment (FDI) inflows. The remaining variable, investment as gross capital information percentage of GDP shows no significant difference between the two sub-group country samples. In term of corruption, the higher corruption rating index of ASEAN countries than OECD countries throughout the period. This is indicative of the negative relationship between corruption and development that has been reported in many empirical researches (Gyimah-Brempong, 2002; Campos et al., 2010; and Ugur, 2014) as Indonesia, Philippines, Thailand and Vietnam belong to middle-income economies while OECD countries are all high-income countries.

For the correlation matrix between variables of two sub-group country samples with presence of corruption variable, it has been described in Appendix H.

6.4 Empirical Results

Table 6.2 represents the effect of government expenditure on human capital and its indicators (education and health) on economic growth in 25 OECD and 5 ASEAN economies during the period 1993 – 2012 by using a two-way fixed effects method. The main variable of interest is the share of public spending on education to total government spending, which has a positive and statistically significant coefficient in both OECD and ASEAN countries. For OECD countries, a one percentage point increases in the ratio of education expenditure to total government spending will increase per capita real GDP growth by 0.14 percentage point. Meanwhile, the result is stronger for ASEAN economies with per capita real GDP rising by 0.16 percentage point in response to a one percentage point increase in government expenditure on education. The result is unsurprising and consistent with theoretical papers and previous empirical findings, such as Barro and Sala-i-Martin (1995), Zhang and Casagrande (1998), Bose et al. (2007), Baldacci et al. (2008), Neycheva (2010), Afonso and Jalles (2013), Mallick et al. (2016), and Siddiqui and Rehman (2017). It shows that investment in education plays an important role and is one of the key drivers of economic growth. It also shows that the impact of public education expenditures on economic growth is greater in the case of five ASEAN countries as compare to the 25 OECD countries. This might suggest the presence of "catching-up effect" in developing countries, such as ASEAN countries. ASEAN countries may replicate the production methods and technologies currently employed by the developed nations through education in the most cost effective way by undertaking research and development activities at the domestic level that best suits their local economic conditions and factor prices. The spending on education can make better human capital which can in return implement the use of modern technology in the production process by minimizing adoption costs (Mallick et al., 2016).

Regarding government expenditure on health, the coefficient of this spending is negatively significant for OECD countries, while it is positive but non-significant for ASEAN countries. A one percentage point increases in the ratio of health expenditure to total government spending will decrease per capital real GDP growth by 0.11 percentage point for OECD countries. Compared to the previous empirical research on the effect of health expenditure on growth, this result is consistent with the findings of Kelly (1997), Landau (1997), Miller and Russek (1997), Singh and Weber (1997), Dao (2012), and Dalic (2013). These studies mostly used OECD country data.

Table 6.2: Contribution of government spending on education, health and human capital to growth in OECD and ASEAN countries (without corruption)

Estimation technique: 5 years moving average - two way Fixed Effects
Dependent variable: Per capita growth

	Without Corruption					
	OECD countries			ASEAN countries		
	(1)	(2)	(3)	(4)	(5)	(6)
Education expenditure	**0.1404***			**0.1550****		
	(0.0737)			(0.0583)		
Health expenditure		**-0.1051***			**0.0688**	
		(0.0566)			(0.2825)	
Human capital expenditure			**0.0160**			**0.1217***
			(0.0715)			(0.0686)
Investment	0.0806	0.0718	0.0665	0.0287	-0.015	0.0468
	(0.1075)	(0.1025)	(0.1077)	(0.0418)	(0.0581)	(0.0486)
Inflation	0.0051	0.0571	0.0173	-0.1350*	-0.1566**	-0.1279*
	(0.0745)	(0.0878)	(0.0657)	(0.0594)	(0.0547)	(0.0634)
Labour force growth	-0.1374	-0.3007	-0.1474	-0.3181	-0.3438	-0.3089
	(0.2891)	(0.3258)	(0.2785)	(0.2442)	(0.2584)	(0.2685)
Openness	0.0309***	0.0182	0.0248	0.0076	-0.0044	0.0054
	(0.0164)	(0.0152)	(0.0196)	(0.0133)	(0.0195)	(0.0154)
Non-tax revenue	-0.1015	-0.0655	-0.1158	-0.0184	0.0292	-0.0427
	(0.0907)	(0.1059)	(0.1122)	(0.1518)	(0.2002)	(0.1559)
Tax revenue	0.1253	0.1221	0.1870	-0.084	-0.2554*	-0.0898
	(0.1815)	(0.1706)	(0.1675)	(0.0706)	(0.1339)	(0.0766)
Surplus or Deficit	0.1788*	0.2561**	0.1902*	0.4473***	0.6918**	0.3967**
	(0.1111)	(0.1179)	(0.1283)	(0.0725)	(0.1684)	(0.1209)
Constant	-3.7305	-0.1015	-3.2627	2.1358	-12.249	2.0908*
	(4.4528)	(4.9999)	(5.6539)	(0.8896)	(5.1139)	(1.0145)
Observations	399	399	399	75	75	75
No of countries	25	25	25	5	5	5
Adjusted R-squared	0.6699	0.6642	0.6552	0.8886	0.8889	0.8833

Note: Robust standard error in parentheses. Country and time dummies included but not reported
*** p < 0.01, ** p < 0.05, * p < 0.1

Possible explanations for this negative impact on growth is that government expenditure on health crowds out other factors which contribute to growth, or public resources are inefficiently and inequitably allocated in the health sector, or the quality of government expenditure on the health sector is low overall. First, the crowding out impact and the welfare losses from tax distortions in the health area have a tendency to happen in most OECD economies due to large and rising shares of total government spending dedicated to health. In fact, the share of OECD government spending allocated to the health sector increased from an average of 10% in 1992 to 15% in 2012. Similarly, this expenditure increases faster than GDP growth and total public spending for most of the period 1992 to 2012. Meanwhile most other categories of government spending (e.g., education) remained roughly constant for the same period. Public expenditure on health in the OECD countries is now the second highest government expenditure share with about 15%, after social protection with about 40% in 2012. Therefore, governments in many OECD countries may have to reduce spending in other sectors or raise taxes to sustain their healthcare systems and to reduce their budget deficit. An increase in public spending on health sector may adversely affect the public spending compositions and economic growth as it reduces the efficiency of public and private resources allocated to productive activities, such as Research and Development, investment in physical capital stock and education. In addition, distortionary taxes tend to distort saving decisions and lower growth when taxes are sufficiently large (see e.g., Barro, 1990). Thus, sufficiently high government health expenditures financed by distortionary taxes in developed countries tend to aggravate distortions, reduce the efficiency of resource allocation, crowd out productive activities, and retard long-run economic growth.

Furthermore, due to rapid population ageing in OECD countries, a large fraction of public health expenditure is devoted to the elderly population over 65. A larger population of elderly in a developed country implies a greater demand for public health care, and thus higher government expenditure on health because elderly people often require costly medical treatment due to multi morbidities and chronic illnesses. Therefore, this expenditure may lead to improvements in life expectancy without being accompanied by improvements in health status and human capital formation. Also, although it has been established that health allows for a more effective performance that increases productivity (Grossman, 1972), considering the elderly population who are not part of the active work force, investment into health does not necessarily promote productivity.

Finally, another possible explanation for a negative growth impact of government health expenditure in developed countries is that governments may not be paying enough attention to improve the efficiency and quality of public health expenditure. Increasing expenditure alone is insufficient to produce good health outcome and lead to an increase in human capital stock. For example, if public investments in medical science help people live longer, but with poor mobility, there will be less chance for these people to work, and therefore there could be a fall in labour force participation rate and economic growth. Thus, high quality and effective public health care are essential to achieve substantial improvement in average health status so as to improve the value for money used in the provision of health services. According to Anderson and Frogner (2008), there is scant evidence that the United States gets better value for its higher health care spending.

In conclusion, governments in OECD nations are facing many complicated issues in the health sector. These issues include administrative complexity, aging of the population, high prices for medical inputs such as drugs and the services of specialist physicians, expensive medical technology, waiting lists, chronic disease burden, supply and utilization rates, access to care, resource allocation within the health sector, among many others. Thus, increasing public resources to health sector alone may be insufficient for governments to improve health status of a population and achieve faster accumulation of human capital and thus, economic growth. Meanwhile, governments in developing countries, especially ASEAN area, can take advantages of young population, cheap labour cost and replicating the production methods and technologies currently employed by the developed economies in the most effective way to improve their healthcare system. In this chapter, the analysis finds the positive relationship between public spending on health and economic growth on 5 ASEAN countries, but this relationship is insignificant. It may be due to the lack of concentration from these governments on health system as they spend only average 1% of GDP on health during this period. Healthy communities and populations tend to have not only enhanced physical abilities and mental clarity, but also can be associated with increase high education performance; thus, in turn increase productivity, accumulation of human capital and enhance economic growth.

From the effects of government expenditure on human capital (education and health combined) on growth, this analysis shows there is no significant effect for OECD countries, while we find a positive and significant effect for this variable in ASEAN countries. With a positive result for the effect of government expenditure upon education and a negative result from impact of government expenditure upon health in OECD countries, it may be no surprise to find expenditure on human capital is insignificant, as the effects of two components cancel out each other. Whereas, one percentage point increase in the ratio of government expenditure on human capital as a share of total government spending will increase per capital real GDP growth by 0.12 percentage point for the ASEAN countries. With a higher percentage of total government investment on education compared with health sector and a significant positive impact on economic growth of this expenditure in ASEAN economies, it helps to explain why government expenditure on human capital has a positive and significant effect on economic growth in these economies. It can be advised that developing countries (in this case: ASEAN countries) are catching up the developed economies through increasing government expenditure on human capital. Developing countries replicate the production methods and technologies currently employed by the developed nations in the most cost effective way by undertaking research and development activities at the domestic level that best suits their local economic conditions and factor prices (Idrees and Siddiqi, 2013).

Concerning the budget constraint variables, budget surplus estimated coefficients indicate a positive and significant effect on long-term growth for both sets of countries, especially for ASEAN countries with one percentage point increase in budget surplus will boost per capital real GDP growth by roughly 0.40 percentage point. Meanwhile, the thesis does not find any significant impact of tax revenue and non-tax revenues variables on economic growth for both sets data. As mentioned in previous chapters, to accurately measure the impact of tax on economic growth for these countries, it may necessary to decompose total tax revenue into different types of taxes as previous studies have done.

Moving to other macro variables, the analysis finds that inflation has a negative and significant effect on economic growth in ASEAN countries, while we observer no relationship between them for OECD economies. With a high inflation rate (approximately average of 7%) in ASEAN economies, it is expected to have an adverse effect on growth rates as high inflation is associated with increased price variability and an uncertainty about future profitability of investment projects, which results in lower levels of investment and economic growth (Christie, 2012 and Pushak et al., 2007). However, this analysis does not find any significant relationship between other variables (investment, labour force growth and openness) and economic growth for both sets of countries.

6.5 The Impact of Corruption on Economic Growth via Government Expenditure on Human Capital

In this section the benchmark empirical results will be re-investigated with the presence of corruption. Corruption generally generates unfavourable effect on long-term economic growth and sustainable development as it is connected with a misallocation and misappropriation of government expenditure components. Mauro (1998) found evidence that corruption distorts government spending away from growth promoting components (education and health) towards other components (such as, large-scale infrastructure investment) which are less productivity-enhancing. From this point of view, this analysis adds the corruption index (ICRG index) provided by PRS to examine the growth effects of government expenditure on human capital with the presence of corruption (regression model specification equation 6.4, 6.5, and 6.6).

Table 6.3 represents the effects of government expenditure on education, health and human capital on economic growth with the presence of corruption in OECD and ASEAN economies. In case of OECD economies, the coefficient on $(1-\delta).g_{edu}$ and $(1-\delta).g_{hea}$ is 0.139 and -0.112 respectively. It can be seen that the corruption-adjusted coefficient of government expenditure on education is still positive, but the productivity benefits of its spending turn out to be lower (δg_{edu} = - 0.0011). The coefficients of education variable before and after corruption adjustment are not significant different from each other for OECD countries (Appendix I). In term of government health spending, the corruption-adjusted coefficient of this expenditure is again negative and significant, and it is more negative (δg_{hea} = - 0.0066) than when this variable did not take into account corruption. The coefficients of health variable before and after corruption adjustment are significantly different from each other. However, the effect size of corruption on both government expenditure compositions is very small. Therefore, there may be no significant impact of corruption on economic growth in these OECD countries and it is the fact that these countries have a lower levels of corruption, thus policymakers may not need to pay attention on the effects of corruption present on government expenditure on human capital.

For ASEAN economies, government expenditure on education still has a positive and significant impact on economic growth when the effect of corruption is included (with a coefficient of 0.1564). When its effect is netted out, the productivity benefits of this spending surprisingly turn out to be lower (the coefficient becomes 0.1550), but the coefficients of education variable before and after corruption adjustment are not significantly different from each other and the effect is rather small (the difference in this case, δg_{edu} = 0.0014). A similar result finds in case of government expenditure on human capital for ASEAN countries. There is a positive and statistically significant relationship between the corruption-adjusted coefficient of government spending on human capital and economic growth (0.1252). Meanwhile, the coefficients of health variable before and after corruption adjustment are significantly different from each other but government health expenditure with the presence of corruption shows no significant impact on the growth rate in ASEAN countries. These results from government expenditure on education, health, human capital after corruption adjustment show that corrupted practices actually do not have a significant impact on economic growth for ASEAN countries. The reason for these results is because of corruption is modelled analytically as something that reduces the productivity of these spending on economic growth rather than examines direct the impact of corruption on these spending and economic growth.

Table 6.3: Contribution of government spending on education, health and human capital to growth in OECD and ASEAN countries with presence of corruption

Estimation technique: 5 years moving average - two way Fixed Effects - ICRG index
Dependent variable: Per capita growth

	With Corruption Index					
	OECD countries			ASEAN countries		
	(1)	(2)	(3)	(4)	(5)	(6)
Education expenditure	**0.1393***			**0.1564****		
	(0.0770)			(0.0617)		
Health expenditure		**-0.1117***			**0.0641**	
		(0.0587)			(0.2822)	
Human capital expenditure			**0.0113**			**0.1252***
			(0.0742)			(0.0697)
Investment	0.0811	0.071	0.0662	0.0291	-0.0149	0.0453
	(0.1074)	(0.1026)	(0.1074)	(0.0424)	(0.0583)	(0.0486)
Inflation	0.0031	0.0566	0.0198	-0.1346*	-0.1571**	-0.1279*
	(0.0730)	(0.0878)	(0.0668)	(0.0598)	(0.0550)	(0.0631)
Labour force growth	-0.1319	-0.2964	-0.1552	-0.3208	-0.342	-0.3056
	(0.2837)	(0.3234)	(0.2837)	(0.2437)	(0.2592)	(0.2696)
Openness	0.0308*	0.0186	0.0243	0.0079	-0.0048	0.0051
	(0.0162)	(0.0154)	(0.0199)	(0.0134)	(0.0192)	(0.0154)
Non-tax revenue	-0.1007	-0.0689	-0.1142	-0.019	0.029	-0.0404
	(0.0908)	(0.1063)	(0.1122)	(0.1501)	(0.2004)	(0.1576)
Tax revenue	0.1245	0.1259	0.1862	-0.085	-0.2571*	-0.0888
	(0.1817)	(0.1701)	(0.1672)	(0.0703)	(0.1351)	(0.0763)
Surplus or Deficit	0.1796*	0.2588**	0.1935*	0.4517***	0.6948**	0.4014**
	(0.1110)	(0.1181)	(0.1283)	(0.0739)	(0.1683)	(0.1160)
Constant	-3.7494	-0.2388	-3.2627	2.1771*	-12.341	2.1211*
	(4.4422)	(5.0182)	(5.6539)	(0.8854)	(5.1136)	(1.0150)
Observations	399	399	399	75	75	75
No of countries	25	25	25	5	5	5
Adjusted R-squared	0.6692	0.6651	0.6551	0.8889	0.889	0.8833

Note: Robust standard error in parentheses. Country and time dummies included but not reported
*** p < 0.01, ** p < 0.05, * p < 0.1

Turning to the other explanatory variables, the results are similar to the main empirical results' analyses in section 6.4. There is a positive and significant relationship between budget surplus or deficit variable and economic growth in all regressions. It also finds that inflation rate has an adverse impact on economic growth in ASEAN economies, while it has no effect in OECD countries. In addition, the analysis cannot find a significant impact for other variables (e.g.: tax revenue, non-tax revenue, openness, investment and labour force growth) on economic growth for both sets of data.

6.6 Discussion and Conclusion

Based on 25 OECD and 5 ASEAN economies for the period from 1993 to 2012, this analysis investigates the impact of government expenditure upon education, health and human capital on economic growth. The empirical strategy applied OLS fixed effects two-way method to capture this relationship. Furthermore, this chapter also evaluates empirically the effects of those government expenditure components on economic growth in the presence of corruption. Therefore, it provides insights on the role of different levels of economic development and geographical terrain play in explaining the interdependency between human capital compositions, corruption and economic growth.

Consistent with previous studies on the relationship between government expenditure on education and growth, the finding shows that this public spending enhances economic growth for both sets of subsample data. For the association between public expenditure on health and growth, the analysis finds a negative effect in 25 OECD economies, while there is no significant impact of this component in 5 ASEAN countries. Regarding government expenditure on human capital (combination of education and health), this analysis observes that there is a positive and significant connection between this expenditure and economic growth in ASEAN economies, but not significant effect in OECD countries. These results provide some important implications. First, investment in the education sector is an essential element of long-term economic growth in all countries. The public spending on education create skilled workforce and their productivity which will improve output levels of the economy. Investment in education not only contributes to human capital but also helps the application of modern technology in a lower adoption costs. Thus, the countries should make such policies for economic development in which prioritise high quality education along with ensuring education for all. Government could make education become more affordable for all by subsidising education, which would raise the cost of providing education but would decrease the cost of education attainment. Therefore, it will increase demand for education and increase the stock of human capital. It would be only successful when the governments increase public spending on the education sector in an effective way.

Secondly, an increase proportion of government expenditure on health tends to obstruct economic growth in OECD nations. There are some reasons for this adverse effect of public health spending on growth in these economies. The crowding out impact and the welfare losses from tax distortions in the health area have occurred in many OECD economies due to the large and rising share of government spending on health. An increase in government expenditure on health may adversely affect the public spending compositions and economic growth as it reduces the efficiency of public and private resources allocated to productive activities, such as Research and Development, investment in physical capital stock. Furthermore, due to rapid population ageing in OECD countries, higher government expenditure on health may lead to improvements in life expectancy without being accompanied by improvements in health status, increases in the active labour force and human capital formation. Also, governments in OECD countries may not pay enough attention to improve the efficiency and quality of public healthcare system. They may also be facing a shortage of workforce in the health industry and an overload of health services. Increasing expenditure alone is insufficient to produce good health outcome and lead to an increase in human capital stock. ASEAN countries however are lack of concentration on the important role of health system. They spend only average 1% of GDP on health during the period 1993 to 2012. This analysis also finds that government expenditure on health has positive but insignificant impact on economic growth in the ASEAN countries. Therefore, in order to taking advantages of a young population, cheap labour and opportunities to replicate the production methods and technologies currently employed by developed economies, to achieve a sustainable and long-term economic growth, ASEAN governments should strive to achieve efficiency and quality of public health system which in turn increase productivity, accumulation of human capital and enhance economic growth.

Finally, the analysis indicates that the effect of government expenditure upon education and human capital on economic growth in ASEAN economies is greater than OECD countries. These countries can take advantage of replicating the teaching courses, methodologies, medical technology currently employed by the developed economies on education and health sectors in the most cost-effective way. It can be suggested that developing economies are catching-up the developed countries through increase in education and human capital. As investment in education and health is a key to economic development, developing country's policy should strive to achieve high quality education and health along with ensuring these services for all people. The quality of education and health can be improved by building up an effective and modern education system and health system that could meet the challenges of modern society and create a premise of economic development.

The empirical evidence provided in this chapter shows that corruption. By comparing the corruption-adjusted coefficient of education, health, human capital expenditure for both OECD and ASEAN economies, it is not clear that corruption has an impact on the growth effects of those government expenditure components. Furthermore, if corruption has an effect on economic growth through government expenditure components, this impact is not strong enough. Again, the different results between OECD and ASEAN countries are due to the purposes of each group's government policy. Dzhumashev (2014) states that for low-income economies with a high incidence of corruption, the size of government spending should be less than for an economy with a higher income and a lower incidence of corruption. That is, to achieve higher growth potential, low-income economies cannot mechanically rely on increasing public spending, as its effects depend on the incidence of corruption and the level of economic development in the economy. OECD economies, which have a big size of government spending, can achieve both sustainable economic growths and high standard of living by increasing their share on productive spending. Also, with a bigger size of government spending, it can help these high-income economies to control the inefficiencies of corruption. Meanwhile, ASEAN (low to middle-income) countries with a smaller size of government expenditure can boost their economic growth by focusing their spending on human capital and productive government expenditure. Furthermore, the presence of corruption in these economies may heighten the administrative efficiency of government agencies, decrease the transaction cost and turn around unfavourable situations, which ultimately positively influences economic growth. Besides, anti-corruption efforts represent a cost itself in these economies. It suggests a better approach by examining the direct relationship between corruption and government expenditure components, and between corruption and economic growth rather than an indirect relationship between corruption and economic growth though impact of government expenditure components.

PART C: PERSPECTIVE

Chapter Seven

Conclusion

7.1 Introduction

This chapter presents the conclusion of this research thesis. This is progressed as follows. First, the summary of main empirical evidence of the research will be discussed. Second, the contributions of the research will be presented. Third, possible policy implication deducted from the thesis will be discussed. Fourth, possible limitations and potential future research topics will be identified.

7.2 Summary of Main Empirical Evidence

The thesis has presented three distinct empirical works on the subjects of government expenditure and economic growth. The first analysis chapter studies the impact of government expenditure compositions on economic growth. The main added value of the analysis is to compare and contrast the effect of government expenditure on economic growth in high-income and low to middle-income countries over a fixed time period and a given set of measures, therefore providing a consistent comparison. Consistent with those existing studies using developed country data, the findings show that a shift in government expenditure towards productive government expenditure and away from non-productive expenditure has a positive relationship with economic growth. In relation to low to middle-income countries, the thesis finds a similar relationship, which runs contrary to the findings of other papers that examined developing countries. It also finds that an increase in level of government expenditure has a crowding out effect and thus negative effect on long run economic growth. However, by shifting from non-productive to productive forms of public spending, countries can move closer to a more optimum growth level. These results support the conclusion that the low to middle-income countries sample has followed the fiscal policy approach of high-income countries, in allocating government expenditure in favour of productive government spending at the expense of non-productive expenditure to enhance economic growth. However, the results are very sensitive to changes in the estimation methodology. This analysis also takes into account both the sources and uses of government budget in assessing the effect of fiscal policy on growth. The analysis finds that greater budget surplus or reduced deficit variable encourages growth for both sets of countries, while tax revenue and non-tax revenue variables have different effects on growth. Tax revenue has a negative impact on economic growth for low to middle-income economies as an increase in tax rate could discourage individuals, businesses and shareholders to work, invest and build capital. Meanwhile, there is an insignificant relationship between tax revenue and economic growth in case of high-income economies. On the other hand, non-tax revenue is found to be negative and significant effect on growth in high-income economies, while it is not significant in low to middle-income countries. The potential for problems with bias such as, possible endogeneity of fiscal variables and unobservable country-specific effects in the relationship between economic growth and government expenditure composition are tackled by using dynamic panel GMM one-step system. This technique shows that the baseline regression results do not experience the possible endogeneity biases, especially in the low to middle-income economies sample. Also, by comparing the results between using five-year moving averages to common five-year average, the analysis indicates that applying five-year moving average for all variables is the most efficient and reliable method to capture the impact of public spending components on long-run economic growth due to the macroeconomic stability in low to middle-income economies.

The second analysis chapter studies the effect of government expenditure compositions on economic growth in the presence of corruption based on ICRG corruption index during the period from 1993 to 2012. In order to examine the interdependency between government expenditure compositions, corruption and economic growth this analysis has formulated a system of equations where corruption is modelled analytically as something that reduces the productivity of public spending. The empirical evidence provided in this chapter suggests comparing the corruption-adjusted coefficient of productive and non-productive government expenditure for both low to middle-income and high-income economies, there is no evidence that corruption has a marked impact on the strength relationship between government expenditure, whether in from of productive or non-productive, and economic growth. These findings do not discount the possibility of corruption affecting growth through other means. For example, through altering the division of total government expenditure between productive and non-productive types. Furthermore, by introducing the CPI corruption index (range of score index from 0 to 10) instead of ICRG index (range of score index from 0 to 6) in the high-income countries sample, the result suggests that corruption has changed the percentage of productive and non-productive government spending; thereby have different impact on economic growth, even this impact is small. Meanwhile, for low to middle-income economies and similar to ICRG index, using the CPI index suggests that corruption could reduce the share of productive spending to total government expenditure and thereby contribute to a greater economic growth effect. It also implies that low to middle-income economies may have a high initial share of productive government spending components and a shift in favour of an objectively more productive type of expenditure may not move such countries closer to a more optimum growth level. Nevertheless, it should be noted that these results may be different for a different set of countries, a different period of time or different range of CPI score index (from zero to ten). The second analysis also reruns the baseline regression with the dynamic GMM one-step system technique and it shows that the main results do not experience the possible endogeneity biases, especially in the low to middle-income economies sample.

Finally, the third analysis chapter explores the relationship between government expenditure on human capital, its important components (education and health) and economic growth for a panel data of case study countries (e.g. 25 OECD countries and 5 ASEAN countries) during period 1993 – 2012. Consistent with previous studies on the relationship between government expenditure on education and growth, the results in this chapter find that this public spending boost economic growth for both sets of sub-sample data. For the link between public expenditure on health and growth, the results show a negative effect in 25 OECD economies, while there is no significant impact of this component in 5 ASEAN countries. Regarding to government expenditure on human capital (combination of education and health), this analysis observes that there is a positive and significant connection between this expenditure and economic growth in ASEAN economies, but not significant effect in OECD countries. With the case study of 25 OECD countries and 5 ASEAN countries from 1993 to 2012, this analysis also investigates the impact of corruption from those countries on economic growth via government expenditure on human capital and its indicators. The empirical evidence provided in this chapter shows that corruption does not affect the impact of government expenditure upon human capital on economic growth.

7.3 Research Contributions

This research makes an important contribution to the literature on government expenditure allocation, corruption, human capital, government spending on education, government spending on health and economic growth. Most of the conclusions drawn regarding the growth effects of government spending compositions, corruption and human capital are based either on the experiences of a set of high-income countries or on the basis of large samples consisting of a mixture of low to middle and high-income economies. There remains limited evidence on the way of understanding the process by which government spending policies shape the growth prospect for low to middle-income economies. This trend has continued regardless of the long-standing view among development experts not only that there exists a significant difference in the allocation of government spending between low to middle-income and high-income economies, but also that the difference is reflective in the way in which government spending shape the outcome in these two sets of economies (Bose et al., 2007). Therefore, these contributions are not just for high-income countries but also low to middle-income economies.

Regarding the impacts of government expenditure compositions on economic growth, this research is well motivated and includes an interesting review of previous comparable results. While the theory linking the growth effects of government expenditure compositions, productive and non-productive government expenditure, appears reasonably clear, the results from related empirical research are not, especially when distinguishing between the effects of changes in the absolute level of government expenditure and changes in relative amount of these categories. In term of absolute levels of expenditure compositions (as a share in GDP), empirical results have consistently reported a positive relationship between productive government expenditure and economic growth, and either a negative or no-impact relationship between non-productive expenditure and economic growth for high-income economies. Meanwhile, findings on the relationship between the level of public spending and economic growth in low to middle-income economies are mixed. However, there are limited studies to investigate the impact of the relative division of total expenditure between productive and non-productive uses on economic growth in countries at different stages of development. Although there are several studies that are very similar in terms of the model estimated and the dataset used, previous studies are extremely heterogeneous in terms of results.

Chapter 4 extends the work of Devarajan et al. (1996), which studies the impact of the relative division of total expenditure between productive and non-productive uses on economic growth. The rationale for expressing productive expenditure as a ratio of total government expenditure is that under this measure a unit increase in the budgetary share of productive expenditure has to be matched by a unit decrease in non-productive expenditure, as the size of total spending remains fixed. Under the alternative approach of measurement (i.e. expenditure as a ratio of GDP), a unit increase in the share of productive government expenditure in GDP does not necessarily mean that other expenditure items are decreasing. This may lead to varied findings for different sets of data. Also, the popular view is that low to middle-income countries lack infrastructure and other type of public goods and therefore their productive spending hinders economic growth. This may have been correct for the data sample period from 1970s to 1990, as the average productive government expenditure (as a ratio of total expenditure) was 21% for nine developing countries during period 1971-1990 in the Devarajan et al. (1996) study. However, for this research samples from 1990 to 2012, low to middle-income countries spent a much larger proportion of public spending on productive expenditure components (78% in total government expenditure) which helps to develop infrastructure, create innovation and improve labour productivity. This may have boosted GDP per capital growth and achieved fruitful sustained development economics during our sample period. For these reasons, the contribution of the first analysis chapter is useful in terms of shedding some light on the fragility of the results to alterations of the model in the government expenditure and economic growth literature. Having used this research to fill some of the gaps in the public spending policies, it is important to know the following: 1). although countries and regions may differ in their economic development levels, their government spending compositions as a proportion of total government expenditure have similar effect on long run economic growth; 2). an increase in absolute levels of government expenditure has a negative impact on growth in both groups of countries; 3). a change in the expenditure mix towards productive forms of expenditure and away from non-productive forms of expenditure enhances economic growth rate in both groups of countries.

In evaluating fiscal policy effects on economic growth, the previous empirical studies have suggested that it should ideally take into account both the sources and the uses of funds. Also, the growth effect of public expenditure compositions depends not only on the volume and structure of these spending, but also on how these expenditures are financed. An empirical analysis that does not incorporate the government budget constraint in full into the analysis could have biased results in their parameter estimates (Kneller et al., 1999; and Ghosh and Gregoriou, 2007). From this empirical standpoint, this thesis contributes to a growing debate on effects of government spending compositions on growth by including variables on the revenue side of the government budget more fully, e.g., tax revenue, non-tax revenue and budget surplus or deficit variables. This enables the thesis to compare with the previous studies which are heterogeneous in terms of results when considering the overall budget constraint. The thesis finds that a budget surplus has a positive and significant impact on economic growth for both groups, while the coefficients estimated for revenue side are negative (on non-tax revenue or tax revenue from high-income and low to middle-income respectively), the level of total public expenditure may be at or beyond its optimum and increasing it further would hinder economic growth. Therefore, governments should consider reducing total government spending and focus on reallocating funds towards productive and away from non-productive spending to achieve a closer to optimum growth level.

Regarding the effects of corruption on economic growth, a number of contributions to literature are also made. Generally, the direct impact of corruption on economic growth has been accepted, but the literature on the channels and magnitude of the indirect effect has remained divided. One channel that has received limited attention in current literature is government expenditure. Tanzi and Davoodi (1997), and Ghosh and Gregoriou (2008) suggest that a possible reason for misallocating government funds towards non-productive spending was attributed to the possible presence of corruption that generally affects government expenditure compositions. The literature finds that corruption either may facilitate economic growth by helping firms circumvent the burden of the public sector or may hinder it by increasing this burden and reducing the efficiency of government expenditure that contributes to productivity and growth (Huntington, 1968; Lui, 1985; Mauro, 1995; Knack and Keefer, 1997; Colombatto, 2003; Paul, 2010; Ugur, 2014 and Huang, 2016). The literature highlights that whether the positive or negative impact dominates rely on the size of the public sector, the structure of government expenditure, and the level of economic development; as these factors play an important role in corruption outcomes (Dzhumashev, 2014). However, there are some inconsistencies and gaps in the literature in explaining the dependence of the corruption growth nexus on these factors, which need a further research. This thesis addressed these gaps by capturing corruption in terms of a parameter that potentially reduces the productivity of government spending compositions in the analytical model. The empirical results in chapter 5 find that there is no evidence that corruption has a marked impact on the strength relationship between government expenditure, whether in from of productive or non-productive, and economic growth. These findings do not discount the possibility of corruption affecting growth through other means. For example, through altering the division of total government expenditure between productive and non-productive types. Therefore, this thesis has contributed further the understanding of corruption effect on government spending allocation then has impact on economic growth. The thesis is also the only one to compare and contrast the impact of government expenditure compositions on economic growth in presence of corruption between low to middle-income and high-income economies which used both (ICRG and CPI) corruption indexes for investigation. The difference in economic development levels, period of time covering and range of corruption score indexes between countries may affect the specification results, but these effects are very small.

The contribution to literature on the relationship between economic growth and government expenditure on human capital components (education and health) lies in 2 case study areas, OECD and ASEAN. The matters of country heterogeneity is normally present on examining the link between government expenditure on human capital and economic growth. To properly account for heterogeneity, the solution is to estimate single-country regressions. However, while single-country estimates of the parameters of human capital can capture the heterogeneity of the individual country structures, they ignore some useful information contained in the common structure in a regional context. OECD countries or ASEAN countries share a common geographical terrain, similar governance structure and similarities in level of economic development and other similarities in culture and economic indicators. If OECD economies include a group of developed nations with long term experience in investment in human capital, ASEAN economies consist of mostly low to middle-income emerging economies that look to the development of their education sector and health system in order to achieve sustainable economic growth. This research provides a different point of view on how government expenditure on education and health affect economic growth in OECD and ASEAN countries, especially ASEAN countries, there is a limited research that has been focused on them so far. This thesis found that an increase in government spending upon education could enhance economic growth for both sets of subsample data and this result is similar to the previous studies. Investment in the education sector is an essential element of long-term economic growth in all countries. The public spending on education create skilled workforce and their productivity which will improve output levels of the economy. Meanwhile, although government spending on health has been recognised as a vital component of human capital, it has paid less attention in the literature on economic growth and development compared to government expenditure on education. The thesis found a negative relationship between public expenditure on health and growth in OECD countries and there is no significant impact of this component in ASEAN countries. An increase in government expenditure on health may adversely affect the public spending compositions and economic growth as it reduces the efficiency of public and private resources allocated to productive activities. Furthermore, due to rapid population ageing in OECD countries, higher government expenditure on health may lead to improvements in life expectancy without being accompanied by improvements in health status, increases in the active labour force and human capital formation. Also, governments in OECD countries may not pay enough attention to improve the efficiency and quality of public healthcare system. ASEAN countries however lack concentration on the important role of their health system. Regarding government expenditure on human capital (combination of education and health), this analysis observes that there is a positive and significant connection between this expenditure and economic growth in ASEAN economies, but not significant effect in OECD countries. With a positive result for the effect of government expenditure upon education and a negative result from impact of government expenditure upon health in OECD countries, it may be no surprise to find expenditure on human capital is insignificant, as the effects of two components cancel out each other. Whereas, with a higher percentage of government investment on education compared with health sector in ASEAN economies, this may explain why government expenditure on human capital has a positive and significant effect on economic growth. Therefore, investing in human capital and its components has an important role to play as an engine for economic growth thus, understanding what components influence the economic growth can lead to the efficient allocation resources.

Previous efforts to examine the relationship between government expenditure compositions, corruption, human capital and economic growth have been affected by limitations in data availability and sensitiveness of the results to small variations in the model specification. Recently, data quality has improved and the large numbers of empirical research have provided valuable information about the variables that should be included in economic growth model. However, there remains a need for more research to address two specific limitations that persist in current economic growth regressions: the selection of estimation method and the consequences of relying on the period-averaging process to capture long-term growth rates. The effects of government expenditure can be adequately captured by the OLS fixed effects method. Nonetheless, with the introduction of GMM technique by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998), it has become popular in recent empirical studies to examine the growth effects of government expenditure compositions as it captures the endogeneity aspects of the model better given the cross-country heterogeneity in the data. However, this thesis found that GMM approach does not appear to be valid in some cases of our estimation. One of the reasons for the invalidity of GMM technique may be common characteristics among macro data sets. Besides, the association of economic growth to fiscal variables has been traditionally estimated under the form of static model in which the use of variables expressed in long-frequency periods accounts for the long-term relationship. However, some studies found the sensitivity of the results due to averaging process of variables (Levine and Renelt, 1992; Kneller et al., 1999; Afonso and Alegre, 2011). The reason for these sensitive results may be due to the absence of automatic stabilisers in different levels of economic developments and the impact of some categories of public expenditure on growth distributed across several periods. This thesis decided to use 5-year forward moving averages for all variables, as it can remove business cycle effects, increase the number of time series observation in our panel data, minimise the reverse causality argument in the models and account for endogeneity. This thesis also tested the model specification with traditional 5-year average and annual data to examining the difference in choice of time period and found that applying a 5-year moving average for all variables is the most efficient and reliable method to capture the effect of government expenditure on long-term economic growth. For these reasons, the contribution of this thesis is useful is terms of shedding some light on the fragility of the results to alterations of the model and the methodology used.

The outcome of this research is believed to be of strong interest to the world researchers in fiscal policy and economic development areas. Policy makers especially those from developing countries who are looking for an ideal fiscal policy model to ensure sustainable economic growth are definitely benefited.

7.4 Policy Implications

Based on the findings and contributions of the study, a number of policy implications have been derived from the work contained in chapter 4 to 6. The results from this thesis suggest that there are significant gains (and losses) to be made from adjusting the government expenditure composition within a country. Although it should be cautious about using the parameter estimates from any study to give precise measures of the effect on economic growth from changes in government expenditure compositions, this thesis chooses to consider such changes in order to compare of the relative sizes of government spending and different levels of economic development between economies. Due to the nature of the research, some of the policy implications can overlap. First, the thesis finds that an increase in the levels of government expenditure has a negative impact on growth, while a change in the expenditure mix towards productive forms of expenditure and away from non-productive forms of expenditure enhances economic growth rate for both high-income and low to middle-income economies. Therefore, governments can recognise which government expenditure components can have a better contribution on economic growth and consider reallocating public spending toward these spending. Second, a greater budget surplus or reduced deficit can enhance economic growth in different levels of economic development between economies. However, if a greater budget surplus or a reduced deficit is a result of an increase in non-tax revenue from high-income economies or tax revenues from low to middle-income, it could obstruct economic growth. Also, the level of total public expenditure may be at or beyond its optimum and increasing it further would hinder economic growth. Therefore, governments should consider reducing total government spending and focus on reallocating funds towards productive and away from non-productive spending to achieve a closer to optimum growth level.

Third, the empirical results in chapter 4 show that low to middle-income countries have been following the approach of high-income countries in allocating government expenditure in favour of productive government spending at the expense of non-productive expenditure, with the aim to enhance economic growth. However, this approach still depends on the size of the government. While low to middle-income countries have small governments (average total spending is about 26% of GDP) and tend to concentrate spending on productive government spending, high-income countries that have a large government size (40% of GDP) tend to spend more on non-productive government compositions. Economic growth is assuredly not the only criteria a government considers when deciding how to allocate public spending. There are other crucial elements such as employment and income equality that should also be considered. Even when social protection spending may be an obstruction to greater growth, it may help promote income equality. Even though the results suggest that a rise in productive expenditure raises economic growth, and the opposite happens when non-productive expenditure increase, increasing this kind of productive expenditure compositions too much may be counter-productive. Hence, developing countries should pursue policies targeted at achieving not only higher economic growth rate by investing more money on infrastructure, defence, roads, communications, etc., but also improve the residence life quality and income equality.

Fourth, due to the common perception that corruption is bad for economic development, both developing and developed countries have paid attention to the impact it has on economic growth and have invested resources in mitigating and controlling its effect. However, this analysis finds that corruption does affect the growth impact of different components of government expenditures, but this effect is rather small. This thesis gains some insights into the effectiveness of anticorruption policies in terms of reducing the incidence of corruption and enhancing growth simultaneously. The anti-corruption policies should be devised by taking into account the disparity between the actual and the optimal government spending levels. As Dzhumashev (2014) mentioned that the quality of institutions and the government size and structure are not easy to change. Hence, change can only be implemented gradually. Nevertheless, to be more effective, the efforts to reduce corruption should be intrinsically woven into polices to develop institutional capacity and optimise the size of government spending. The policies should account not only for their direct effect on corruption outcomes, but also for their effect on the public sector burden and the productivity-enhancing government spending.

Besides, this analysis has formulated a system of equations where corruption is modelled analytically as something that reduces the productivity of public spending. The results suggest that as corruption could reduce the share of productive spending to total government expenditure and this decrease can contribute to a greater economic growth effect for low to middle-income economies, these countries may have a high initial share on productive government expenditure components. Therefore, policymakers in these economies should pay attention on a shift in favour of an objectively more productive type of expenditure because a higher share on this type may not move closer to a more optimum growth level. On the other hand, corruption reduces the growth benefits from productive spending component in high-income economies, while it helps to improve the negative effect of non-productive expenditure. High-income governments can still increase the initial share on productive government expenditure to boost economic growth.

Regarding to the growth effects of government expenditure on human capital and its important components, the analysis results in chapter 6 provide some important policy implications. First, investment in the education sector is an essential element of long-term economic growth in all countries. The impact of public education expenditures on economic growth is greater in the low to middle-income countries as compared to the high-income nations. This is because low to middle-income countries have greater marginal productivity in human capital formation even though high-income countries invest heavily in human capital is at the advance stages of development with high skilled manpower. Idress and Siddiqi (2013)'s study reveals that, in case of developed countries, 1 dollar increase in public education expenditures brings 21.85 dollars increase in GDP. Whereas, in developing nations, 1 dollar increase in public expenditures in education brings an increase of 27.29 dollars in GDP. Thus, it can be suggested that developing countries are catching-up the developed nations through increased investment in human capital. This verifies the "inverted-V hypothesis" or the "flying geese theory". Developing countries replicate the teaching courses and methodologies currently employed by the developed nations in the most cost effective way. Thus, investment in education is a key to economic progress. It not only builds up human capital but also help in the implementation of new technologies by lowering its adoption costs. So, a country's policy for economic development has to focus on educational institutions. Countries should strive to achieve high quality education along with ensuring education for all. This could be done through increased public expenditures in the education sector. The quality of education be improved by building up an effective and modern education system that could meet the challenges of modern society and the high demand for innovative products. Education should be made affordable for all i.e. subsidizing education that would increase the government cost of providing education but would lower the cost of education attainment; thereby raising the demand for education and this in turn would increase the stock of human capital.

Secondly, government expenditure on health tends to obstruct economic growth in OECD nations. They are facing complicated issues, such as, aging of the population, high prices for medical inputs, expensive medical technology, waiting list, access to care, shortage of workforce, resource allocation within the health sector and burden of huge and rising shares in the government spending on health. Thus, increasing public resources to health sector alone may be insufficient for governments to improve health status of a population and achieve faster accumulation of human capital and thus, economic growth. Governments in developed economies need to improve the efficiency and quality of the public healthcare system. Meanwhile, the lack of a strong link from public spending on health to economic growth in ASEAN countries is not necessarily a reason to reallocate health investment away from the health sector. The policy implications of this thesis is that countries that desire a high levels of per capita income, they can achieve it by increasing and improving the stock of health human capital, especially if current stocks are at lower end. In other words, the findings indicated that income is an important factor across low to middle-income countries in the level and growth of public spending on health in long-run. As well, the health-led growth hypothesis in ASEAN is not confirmed. These countries will also need to make a number of valuable decisions before determining what course of action is appropriate for their population health goals. Policymakers need to decide the extent to which they see health as an end in itself, or as a means to economic growth. This will inform their willingness to sacrifice economic goals for health goals. The governments need to decide how much weight they give to the health of their poorest people. This will then direct a relevant amount of their health and growth policies towards reducing poverty and disease burden amongst these groups, even at the expense of average health and growth. Furthermore, policymakers in developing countries need to research the inequalities in their own country. This will assist them in creating poverty reducing growth policies, and inform their population health aims. Finally, and perhaps most importantly, they need to renew strong public commitment to widespread distribution of health knowledge and services. This includes state political support and also the facilitation of public participation in demanding better health. This may, in the end, be of more importance than growth itself. Utilization of allocated resources in the health sector may depend largely on good governance and efficient institutions, and skilled manpower of the country. In order to reap all the benefits of such spending, the authority should ensure a supportive and efficient socioeconomic structure for efficient utilization of resources. Particularly, in the case of ASEAN, it may be a difficult task to utilize such resources in the face of some practical constraints, such as inappropriate planning faltering monitoring and skilled manpower, widespread corruption and administrative bottlenecks. In such a situation, inclusion of some potential variables, such as good governance and democracy, may provide insights about the efficacy of such spending on economic growth.

7.5 Limitations of the Research

Although the thesis has contributed to knowledge and arrived at important findings and recommendations for policy makers, there are however, limitations to the study. First, due to data availability, the sample sizes capture of 22 low to middle-income economies only compared to 37 high-income countries. Therefore, the sample used for the analyses are not representative. This means different sample sizes and time periods, especially in chapter 5 with corruption indexes, are used to answer the research questions and achieve the research objectives. Second, this thesis applies the one-step system GMM to retest the robustness of the thesis baseline results, but GMM estimations do not always appear to be valid for all cases of this research. One possible reason for the invalidity of GMM technique is due to common characteristics among macro data sets. The dynamic panel data models, which were applied by Arellano and Bond (1991), Blundell and Bond (1998) or Bond et al. (2001), have focused mainly on those applicable to micro data sets, which normally have a large cross-section dimension with a small time-series dimension. Third, the research extends the works of Devarajan et al. (1996) and Ghosh and Gregoriou (2007) by including government budget constraint variables (tax revenues, non-tax revenues and surplus or deficit variables). However, the scope of this research focused on comparing and contrasting the government expenditure component effects on growth between high-income and low to middle-income economies. Therefore, the thesis has not captured the effects of structure of taxation (such as, distortionary and non-distortionary taxation) and different forms of deficit finance (by printing money, and by issuing domestic or external debt). Fourth, this research shows that a linear relationship between government spending compositions and economic growth fits the data reasonable well for the sub-samples of low to middle-income and high-income economies. Nonetheless, Barro (1990) suggested a non-linear hypothesis on the relationship between government spending and economic growth. In the Barro model, when the non-linear hypothesis is valid and the effect of public spending on long run economic growth does fluctuate with its size, this would not only help to explain the vague findings in the empirical growth literature, but also offer clearer recommendations for a country with a particular government size. Some recent studies in the economic growth and fiscal policy literature have employed the non-linear hypothesis on their relationship. However due to the direction the research in the field of government spending compositions literature, this study has not fully attached to this current wave. Fifth, the research is not able to investigate all compositions of functional classifications of government expenditures, except government expenditure on education and health to explain economic growth in comparing OECD and ASEAN countries. Such other components of government spending analyses would have added immense knowledge to this research as such findings would provide better judgements for policy makers in order to relocating public resources efficiently. Finally, since this research simply look at the quantity of government spending compositions without explicitly considering their quality; the findings should be taken with some cautions.

7.6 Further Research

Based on the limitations of this thesis, a number of possible directions for future research have been identified. First, future research should be access to an extended panel dataset with a longer time dimension than current research has permitted application of the more flexible Pooled Mean Group estimator proposed by Pasaran et al. (1999). Pooled Mean Group technique enables research to explore both short run dynamic and long run equilibrium relationships between the variables and capture the heterogeneity across countries in their short run relationships. Second, the study on the effects of structure of taxation and different forms of deficit finance as other side of fiscal policy on economic growth would arrive at a more precise policy guidelines and this remains an essential area for further study. Third, similar to Devarajan et al. (1996) work, this thesis exercise government's expenditure decision in which is taken as a given rather than deriving from some optimising framework. Whereas, Ghosh and Gregoriou (2007) stated that an attempt to study optimal fiscal policy instead of taking the government's decisions as given could be a 'fruitful extension', thus it is worth noting to attempt to do in the further research in order to examine the different impact of government expenditure compositions on economic growth. Fourth, this thesis found that corruption affects the growth impact from productive and non-productive government expenditure. However, the effect of corruption was not large enough to warrant a switch between these government spending components in the interest of long-run economic growth. Hence, it is worth to investigate, in future research, the factors other than corruption that reduce the productivity of government spending, something that was beyond the scope of this thesis. Fifth, with regards to some of important components of the government expenditure compositions, such as, infrastructure, defence and social protection that this research have not used, future research can employ such variables to investigate their impacts on economic growth. A challenge in term of finding adequate proxies to control for the quality of government spending among the different expenditure components considered in this thesis, which would be interesting for further research. Furthermore, despite its undeniable importance, economic growth is surely not the only criteria a government wants to take into account when deciding how to allocate public spending. While this thesis focuses on economic growth, there are other vital elements such as employment and income equality that should also be consider. Investigating the effects of the government expenditure compositions on these other key variables is also an important dimension for future work.

Finally, Vietnam, a one-party communist country, initiated a vast economic reform program in 1986 to transform its planned economy into a socialist-oriented market economy. Since then, Vietnamese economy has been recognised as one of the most dynamic emerging economy in the world. Due to sustained high economic growth rates, Vietnam has escaped from being a low-income country to become a middle-income country. Public sector reform in Vietnam, which was initiated from the 1990s, has aimed to improve the quality of public governance. The main goal of the reform is to build a democratic, strong, clean, effective and efficient public administrative system, which contribute to economic development. Nonetheless, there remain challenges that limit the effectiveness and efficiency of government activities in the process of economic restructuring. Government revenue as a share of GDP is the highest in Southeast Asia and it is difficult to increase further in the context of a persistent economic recession. It averaged 25% of GDP over the period of 1993 to 2012. Meanwhile, Vietnam is at the high end with average 27% total government expenditure as a share of GDP over the period 1993 to 2012 compared to those of countries in the region. With the high government spending ratio, Vietnam has chosen to devote a relatively large share of its national income to public purposes. This reflects a desire for a larger government role in society and the economy. There is very limited research have attempted to examine the relationship between government expenditure components and economic growth in Vietnam. Therefore, it is worth to investigate, in future research, the impact of government expenditure compositions on economic growth in Vietnam, a country has been transitioning from a command to market economy orientation, fully integrated into the global economy.

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Appendix

Appendix A: The Solow-Swan growth equation

The process of economic growth depends on the shape on the production function. It can be said that a production function, F (K, L, A) (where K is capital stock; L is labour force and A refer to labour-augmenting technology or knowledge (Todaro and Smith, 2009)), is neoclassical if the following properties are satisfied:

1. **Constant returns to scale.** The function F (.) displays constant returns to scale when the function multiply capital and labour by the same positive constant, λ, the output of function should get λ amount:

   $$F(\lambda K, \lambda L, A) = \lambda \times F(K, L, A) \text{ for all } \lambda > 0 \quad (1.1)$$

   It is important to note that the definition of scale includes only the two rival inputs, capital and labour. The reason is that, while capital and labour are rival goods, technology is a non-rival input; so by using the replication argument, the definition of returns to scale makes sense (Barro and Sala-i-Martin, 2004).

2. **Positive and diminishing returns to private inputs**. For all K and L > 0, the function displays positive and diminishing marginal product with respect to each input as follow:

   $$\frac{\partial F}{\partial K} > 0; \frac{\partial^2 F}{\partial K^2} < 0 \quad (1.2)$$

   $$\frac{\partial F}{\partial L} > 0; \frac{\partial^2 F}{\partial L^2} < 0$$

   The neoclassical assumes that adding an additional unit of an input provides positive additions to output but by less than the previous unit of input in case holding constant the levels of other inputs.

3. **Inada conditions.** The neoclassical production function has to satisfies the Inada conditions, following Inada (1963):

   $$\lim_{K\to 0}\left(\frac{\partial F}{\partial K}\right) = \lim_{L\to 0}\left(\frac{\partial F}{\partial L}\right) = \infty \quad (1.3)$$

   $$\lim_{K\to \infty}\left(\frac{\partial F}{\partial K}\right) = \lim_{L\to \infty}\left(\frac{\partial F}{\partial L}\right) = 0$$

4. **Essentiality.** It has been discussed that the assumption of essentiality to the definition of a neoclassical production function is necessary. An input is important if strictly positive amount is needed to produce a positive function. The three neoclassical properties in equation 2.1, 2.2 and 2.3 indicate that each input is essential for production, which is F(0, L) = F(K, 0) = 0 (Barro and Sala-i-Martin, 2004).

The Fundamental Equation of the Solow-Swan Model

The Solow-Swan model is assumed in continuous-time world with no government and closed to international trade. The aggregate production function Y (t) = F (Kt, Lt), where Y (t) is the flow of output produced at time t, is satisfied all four neoclassical properties above. In a closed economy with no public expenditure and international trade, all output is dedicated to consumption, C (t) or gross investment, I (t); so Y (t) = C (t) + I (t). In this simple economy, the amount saved, S (t) ≡ Y (t) – C (t), equals the amount invested, I (t). Denote s (.) be the fraction of output that is saved, the saving rate, so that 1 – s (.) is the fraction of output that is consumed. In Solow (1956) and Swan (1956) articles, they assumed that the saving rate is a constant, 0 ≤ s (.) = s ≤ 1. Giving that saving must equal investment, so that the saving rate equals the investment rate. The evolution of the capital stock at a point is determined by gross investment less depreciation:

$$\dot{K}(t) = I(t) - \delta K(t) = s.F[K(t), L(t), A(t)] - \delta K(t) \tag{1.4}$$

Where a dot over a variable means differentiation with respect to time, $\dot{K}(t) = \partial K(t)/\partial t$ and$0 \leq s \leq 1$.

One simple production function that is often thought to provide a reasonable description of actual economies is the Cobb-Douglas function:

$$Y(t) = F(Kt, Lt) = K(t)^{\alpha}(A(t)L(t))^{1-\alpha} \tag{1.5}$$

$$0 < \alpha < 1$$

The α and 1- α are relative income shares of capital and labour respectively

All factors of production are fully employed, and initial values of A (0), K (0) and L (0) are given. In this chapter, it is simplified by assuming that population grow at a constant, exogenous rate, $\dot{L}(t)/L = n \geq 0$ as well as technology grow exogenously at rate, $\dot{A}(t)/A = g \ \geq 0$, respectively:

$$L(t) = L(0)e^{nt} \tag{1.6}$$

$$A(t) = A(0)e^{gt} \tag{1.7}$$

The number of effective units of labour, A (t)L (t), therefore grow at rate (n + g). Since the production function has constant return to scale, it can be written as output per effective unit of labour:

$$y(t) = \frac{Y(t)}{A(t)L(t)} = \ k(t)^{\alpha} \tag{1.8}$$

The main concern of Solow-Swan model is the dynamic of capital intensity, k, the capital stock per unit of effective labour. Its behaviour over time is given by the key equation of the Solow-Swan model:

$$\dot{k}(t) = sk(t)^{\alpha} - (n + g + \ \delta)k(t) \tag{1.9}$$

The first term,$sk(t)^{\alpha} = sy(t)$ is the actual investment per unit of effective labour. The second term,$(n + g + \ \delta)k(t)$ is the break-even investment; the amount of investment that must be invested to prevent k from falling.

Steady State

Steady state is defined as a situation in which the various quantities grow at constant rates. In the Solow-Swan model, the steady state means that $\dot{k} = 0$ in equation 2.9. The equation implies that $k(t)$ converges to a steady-state value of k^{*}, define by $sk(t)^{\alpha} = (n + g + \ \delta)k(t)$ at which there is neither an increase nor a decrease of capital intensity:

$$\mathrm{k}^{*} = (\frac{\mathrm{s}}{\mathrm{n+g+\ \delta}})^{\frac{1}{1-\ \alpha}}$$

(1.10)

At which the stock of capital K and effective labour AL are growing at rate$(n + g)$. Since k is constant in the steady state, y and c are also constant at the value $y^{*} = f(k^{*})$ and

$c^* = (1 - s). f(k^*)$, respectively. Thus, once and for all changes in the level of the technology will be displayed by shifts of the production function, f (.). Shifts in the production function, in the saving rates$s$, in the rate of population growth n and in the depreciation rate δ all have impacts on the per capita levels of the various quantities in the steady state. It is crucial to note that one time change in all four factors above do not affect the steady state growth rates of per capita output, capital and consumption which are all still equal to zero.

The Ramsey-Cass-Koopmans growth key equations

The representative household is infinitely-lived and choose consumption and saving to maximise its dynastic utility. The preferences of the representative household are given by the following function,

$$u = \int_0^{\infty} e^{-pt} u(c) \delta t \quad (1.11)$$

Wherec_t: consumption per person (C/L), p is the constant rate of time preference ($p > 0$)and $u(c)$ is given by the following CIES utility function'

$$u(c) = \frac{c^{1-\sigma} - 1}{1 - \sigma} \quad (1.12)$$

Which σ: a constant rate of inter-temporal substitution. Household utility is maximised subject to a budget constraint

$$\dot{a} = ra + w - c \quad (1.13)$$

Where the assets of the household,a, rise with income, $ra + w$, and decrease with consumption, c. If we also assume that agents do not leave assets at the end of time, then the transversality condition is given that:

$$\lim_{t \to \infty} \left\{ a(t) exp \left[- \int_0^t (r(v) - n) dv \right] \right\} = 0 \quad (1.14)$$

Household utility equation (2.12) is substituted into equation (2.11) for u(c) and maximised subject to the household budget constraint equation (2.13). The growth path of consumption, known as a Euler equation, can be derived:

$$\gamma_c = \frac{\dot{c}}{c} = \frac{1}{\sigma} (r - \rho) \quad (1.15)$$

Hence, the growth of consumption is given by the return to saving, r, less the rate of time preference, ρ, divided by the rate at which household are willing to substitute consumption across time, σ.

Like the Solow-Swan model, the RCK model sets out the model with an aggregate production function that satisfies all four properties conditions of neoclassical growth theory. The aggregate production function F (K, LA) has the amount of labour is equal to the population in the economy and grows at a constant$n$. The level of technology grows at a constant rate $g$similar in Solow-Swan model. The first key equation of the RCK model is the law of motion for capital accumulation:

$$\dot{k} = f(k) - c - (n + g + \delta)k \qquad (1.16)$$

Where$f(k)$: output per worker. Under the assumption that there is no increase in either population growth or technology level, this equation shows that capital per worker is the result of output which is not consumed minus the rate of depreciation of capital (Acemoglu, 2012; Barro and Sala-i-Martin, 2004).

Steady state occurs in the RSK model when consumption and capital grow at a constant rate. The growth path of consumption for behaviour of firms is quite similar to household. It can be found in the Euler equation for the interest rate.

$$\gamma_c = \frac{\dot{c}}{c} = \frac{1}{\sigma}[f'(k) - \delta - g - n - \rho] \qquad (1.17)$$

The growth path for capital is given by equation (2.16). Both equation (2.16) and (2.17) along with the initial capital stock and the transversality condition, $\lim_{t\to\infty}\left\{kexp\left[-\int_0^t [f'(k) - \delta - g - n]dt\right]\right\} = 0$, provide a system of equations which describe the time paths of consumption and capital. The capital/effective labour ratio is constant when the growth of the capital stock is exactly equal to the growth rate of labour and technology. It can be seen that $\frac{\dot{k}}{k} = \frac{\dot{K}}{K} - \frac{\dot{L}}{L} - \frac{\dot{A}}{A} = 0$ when differentiating $k = \frac{K}{AL}$with respect to time to yield. With$\frac{\dot{L}}{L} = n$, $\frac{\dot{A}}{A} = g$ we have the capital stock grows at the rate $\frac{\dot{K}}{K} = n + g$. The growth rate of output can be calculated by differentiating the production function with respect of time when we assume in Cobb-Douglas technology, as followed:

$$\frac{\dot{Y}}{Y} = \alpha\frac{\dot{K}}{K} + (1-\alpha)(\frac{\dot{L}}{L} + \frac{\dot{A}}{A}) \tag{1.18}$$

The growth of output is equal to, $\frac{\dot{Y}}{Y} = n + g$ by substituting for the growth rate of capital, technology and labour. If there is no growth in technology or labour force, $\frac{\dot{L}}{L} - \frac{\dot{A}}{A} = 0$, then the growth rate of capital and output are both equal to zero because of diminishing returns to capital (Acemoglu, 2012; Barro and Sala-i-Martin, 2004; Savvides and Stengos, 2008).

Appendix B: The results for Pooled OLS and two-way random effects

Table B1: Productive and Non-productive government spending with Pooled OLS technique

Estimation technique: 5 years moving average Dependent variable: Per capita growth				
	High Income		Low to Middle Income	
Technique	Pooled OLS		Pooled OLS	
Productive expenditure	-0.0101		-0.0410*	
	(0.0150)		(0.0249)	
Non-productive expenditure		0.0114		0.0423*
		(0.0153)		(0.0246)
Log Initial GDP	-1.6082***	-1.6078***	-0.4203	-0.4267*
	(0.3009)	(0.3009)	(0.2885)	(0.2832)
Investment	0.0845**	0.0845**	0.2167***	0.2181***
	(0.0338)	(0.0339)	(0.0321)	(0.0316)
Inflation	0.0828*	0.0827*	-0.0047	-0.0047
	(0.0502)	(0.0504)	(0.0047)	(0.0046)
Labour force growth	-0.2359**	-0.2332**	-0.3565***	-0.3578***
	(0.1103)	(0.1105)	(0.1038)	(0.1021)
Openness	0.0063***	0.0063***	-0.0032	-0.0033
	(0.0019)	(0.0019)	(0.0060)	(0.0059)
Non-tax revenue	-0.0333	-0.0340	-0.0610	-0.0629
	(0.0286)	(0.0283)	(0.0602)	(0.0601)
Tax revenue	0.0591*	0.0585*	-0.0158	-0.0131
	(0.0319)	(0.0317)	(0.0661)	(0.0647)
Surplus or Deficit	0.1057***	0.1060**	0.0413	0.0402
	(0.0404)	(0.0403)	(0.0483)	(0.0475)
Constant	15.8414	14.7945	6.125*	1.9757
	(3.8121)	(3.0318)	(3.6352)	(2.1425)
Observations	591	591	344	344
No of countries	37	37	22	22
Adjusted R-squared	0.3784	0.3787	0.5057	0.5069

Note: Robust standard error in parentheses. Country and time dummies included but not reported
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table B2: Productive and Non-productive government spending with two-way Random Effect

Estimation technique: 5 years moving average Dependent variable: Per capita growth				
	High Income		Low to Middle Income	
Technique	Random Effect		Random Effect	
Productive expenditure	-0.0099		0.0361*	
	(0.0153)		(0.0212)	
Non-productive expenditure		0.0119		-0.0312
		(0.0167)		(0.0219)
Log Initial GDP	-2.0084***	-2.0091*	0.3355	0.3050
	(0.4785)	(0.4767)	(0.3297)	(0.3208)
Investment	0.0505	0.0503	0.1791***	0.1781***
	(0.0562)	(0.0564)	(0.0458)	(0.0452)
Inflation	-0.0373	-0.0379	-0.0007	-0.0005
	(0.0512)	(0.0510)	(0.0041)	(0.0041)
Labour force growth	0.0478	0.0486	-0.1850	-0.1875
	(0.1257)	(0.1254)	(0.1930)	(0.1921)
Openness	0.0102**	0.0102*	0.0013	0.0008
	(0.0040)	(0.0040)	(0.0122)	(0.0119)
Non-tax revenue	-0.0713*	-0.0717*	-0.0105	-0.0146
	(0.0391)	(0.0393)	(0.0694)	(0.0704)
Tax revenue	0.0889*	0.0880*	-0.1337*	-0.1308*
	(0.0480)	(0.0480)	(0.0852)	(0.0856)
Surplus or Deficit	0.1607***	0.1612***	0.1802***	0.1806***
	(0.0517)	(0.0513)	(0.0577)	(0.0570)
Constant	21.2936	20.2669	-3.7972	-0.0020
	(4.3078)	(4.1532)	(4.0692)	(2.6603)
Observations	591	591	344	344
No of countries	37	37	22	22
Adjusted R-squared	0.5629	0.5629	0.5576	0.5548

Note: Robust standard error in parentheses. Country and time dummies included but not reported

*** p < 0.01, ** p < 0.05, * p < 0.1

Table B3: Hausman results for Random Effect vs Fixed Effect in High Income countries

```
. hausman fixed ., sigmamore

Note: the rank of the differenced variance matrix (10) does not equal the number of coefficients being tested (24);
        be sure this is what you expect, or there may be problems computing the test.  Examine the output of your
        estimators for anything unexpected and possibly consider scaling your variables so that the coefficients are
        on a similar scale.
```

	Coefficients (b) fixed	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
PGE1	.0507315	-.00991	.0606415	.0103286
INF	-.0439671	-.0373045	-.0066627	.0083999
INV	.0936399	.0505265	.0431134	.0174506
LFG	.0962945	.0478114	.048483	.0354924
LIG	-2.61911	-2.008395	-.6107149	.8331795
NTR	-.1464641	-.0713021	-.0751619	.0212131
TR	.1359075	.0888831	.0470244	.0326466
SOD	.2052591	.1606661	.0445931	.017452
OPN	.0424342	.0101488	.0322854	.0058663
year				
1996	.0038008	.0688431	-.0650424	.023928
1997	-.1784996	-.1024815	-.0760181	.0473036
1998	-.3206174	-.1668161	-.1538013	.0776299
1999	-.6544001	-.4839702	-.1704299	.1015472
2000	-.9964727	-.8500087	-.146464	.1211004
2001	-1.109223	-1.008613	-.1006095	.1425912
2002	-1.059574	-.9489756	-.1105983	.1608367
2003	-1.289403	-1.187369	-.1020336	.1755452
2004	-1.036116	-.8436936	-.1924225	.1932945
2005	-.9013528	-.5662695	-.3350833	.214002
2006	-1.406365	-.9347955	-.4715695	.2326233
2007	-2.664782	-2.294339	-.3704433	.2366858
2008	-2.612674	-2.327176	-.2854985	.2393263
2009	-2.83945	-2.635055	-.2043947	.2412237
2010	-3.396433	-3.25808	-.1383528	.2407597

```
                    b = consistent under Ho and Ha; obtained from xtreg
     B = inconsistent under Ha, efficient under Ho; obtained from xtreg

  Test:  Ho:  difference in coefficients not systematic

              chi2(10) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                       =       85.97
             Prob>chi2 =      0.0000
             (V_b-V_B is not positive definite)
```

```
. hausman fixed ., sigmamore

Note: the rank of the differenced variance matrix (10) does not equal the number of coefficients being tested (24);
        be sure this is what you expect, or there may be problems computing the test.  Examine the output of your
        estimators for anything unexpected and possibly consider scaling your variables so that the coefficients are
        on a similar scale.
```

	Coefficients (b) fixed	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
PGE1	.0507315	-.00991	.0606415	.0103286
INF	-.0439671	-.0373045	-.0066627	.0083999
INV	.0936399	.0505265	.0431134	.0174506
LFG	.0962945	.0478114	.048483	.0354924
LIG	-2.61911	-2.008395	-.6107149	.8331795
NTR	-.1464641	-.0713021	-.0751619	.0212131
TR	.1359075	.0888831	.0470244	.0326466
SOD	.2052591	.1606661	.0445931	.017452
OPN	.0424342	.0101488	.0322854	.0058663
year				
1996	.0038008	.0688431	-.0650424	.023928
1997	-.1784996	-.1024815	-.0760181	.0473036
1998	-.3206174	-.1668161	-.1538013	.0776299
1999	-.6544001	-.4839702	-.1704299	.1015472
2000	-.9964727	-.8500087	-.146464	.1211004
2001	-1.109223	-1.008613	-.1006095	.1425912
2002	-1.059574	-.9489756	-.1105983	.1608367
2003	-1.289403	-1.187369	-.1020336	.1755452
2004	-1.036116	-.8436936	-.1924225	.1932945
2005	-.9013528	-.5662695	-.3350833	.214002
2006	-1.406365	-.9347955	-.4715695	.2326233
2007	-2.664782	-2.294339	-.3704433	.2366858
2008	-2.612674	-2.327176	-.2854985	.2393263
2009	-2.83945	-2.635055	-.2043947	.2412237
2010	-3.396433	-3.25808	-.1383528	.2407597

```
                      b = consistent under Ho and Ha; obtained from xtreg
       B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                 chi2(10) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       85.97
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)
```

Table B4: Hausman results for Random Effect vs Fixed Effect in Low to Middle Income countries

```
Note: the rank of the differenced variance matrix (12) does not equal the number of coefficients being tested (24);
        be sure this is what you expect, or there may be problems computing the test.  Examine the output of your
        estimators for anything unexpected and possibly consider scaling your variables so that the coefficients are
        on a similar scale.
```

	Coefficients (b) fixed	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
PGE1	.0648235	.036062	.0287615	.0102725
INF	.0000356	-.0006942	.0007297	.0010152
INV	.1955586	.1791226	.016436	.0162521
LFG	-.0883089	-.1849694	.0966605	.0402427
LIG	.4826835	.3355478	.1471356	.9020552
NTR	.0068721	-.0105239	.017396	.0332024
TR	-.232111	-.1336907	-.0984204	.0303355
SOD	.2201747	.1801845	.0399903	.0225367
OPN	.0058054	.0012552	.0045502	.0040143
year				
1996	-.3951921	-.4231847	.0279926	.0278224
1997	-.4420722	-.4908475	.0487753	.0516256
1998	-.4606595	-.4947728	.0341133	.0702093
1999	-.5719014	-.6432253	.071324	.0856995
2000	-.3018004	-.4187835	.116983	.1015333
2001	.2725002	.1482697	.1242305	.1201267
2002	.7454223	.6301758	.1152465	.141833
2003	.8915606	.7810753	.1104853	.1702925
2004	1.185297	1.083824	.1014734	.2055748
2005	1.635501	1.561332	.0741687	.2451381
2006	1.637906	1.560392	.0775141	.2834385
2007	1.057556	.9453521	.1122042	.3166667
2008	1.092277	.9719409	.1203357	.3482676
2009	.7315166	.5868282	.1446884	.3771385
2010	.2339388	.0560128	.177926	.4033996

```
                          b = consistent under Ho and Ha; obtained from xtreg
           B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(12) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                           =       28.20
                Prob>chi2 =      0.0052
                (V_b-V_B is not positive definite)
```

Note: the rank of the differenced variance matrix (12) does not equal the number of coefficients being tested (24); be sure this is what you expect, or there may be problems computing the test. Examine the output of your estimators for anything unexpected and possibly consider scaling your variables so that the coefficients are on a similar scale.

	Coefficients (b) fixed	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
PGE1	.0648235	.036062	.0287615	.0102725
INF	.0000356	-.0006942	.0007297	.0010152
INV	.1955586	.1791226	.016436	.0162521
LFG	-.0883089	-.1849694	.0966605	.0402427
LIG	.4826835	.3355478	.1471356	.9020552
NTR	.0068721	-.0105239	.017396	.0332024
TR	-.232111	-.1336907	-.0984204	.0303355
SOD	.2201747	.1801845	.0399903	.0225367
OPN	.0058054	.0012552	.0045502	.0040143
year				
1996	-.3951921	-.4231847	.0279926	.0278224
1997	-.4420722	-.4908475	.0487753	.0516256
1998	-.4606595	-.4947728	.0341133	.0702093
1999	-.5719014	-.6432253	.071324	.0856995
2000	-.3018004	-.4187835	.116983	.1015333
2001	.2725002	.1482697	.1242305	.1201267
2002	.7454223	.6301758	.1152465	.141833
2003	.8915606	.7810753	.1104853	.1702925
2004	1.185297	1.083824	.1014734	.2055748
2005	1.635501	1.561332	.0741687	.2451381
2006	1.637906	1.560392	.0775141	.2834385
2007	1.057556	.9453521	.1122042	.3166667
2008	1.092277	.9719409	.1203357	.3482676
2009	.7315166	.5868282	.1446884	.3771385
2010	.2339388	.0560128	.177926	.4033996

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

```
Test:  Ho:  difference in coefficients not systematic

             chi2(12) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                      =       28.20
            Prob>chi2 =      0.0052
            (V_b-V_B is not positive definite)
```

Appendix C: List of countries covered for chapter 5 by using ICRG corruption index.

High-income Economies		Low to Middle-income Economies	
Country	**Classification**	**Country**	**Classification**
Bahamas	High Income	Ethiopia	Low Income
Bahrain	High Income	Kenya	Low Income
Croatia	High Income	Bolivia	Lower Middle Income
Cyprus	High Income	Egypt	Lower Middle Income
Latvia	High Income	India	Lower Middle Income
Malta	High Income	Indonesia	Lower Middle Income
Oman	High Income	Philippines	Lower Middle Income
Singapore	High Income	Sri Lanka	Lower Middle Income
Australia	High Income OECD	Vietnam	Lower Middle Income
Austria	High Income OECD	Zambia	Lower Middle Income
Belgium	High Income OECD	Bulgaria	Upper Middle Income
Canada	High Income OECD	China	Upper Middle Income
Chile	High Income OECD	Costa Rica	Upper Middle Income
Czech Republic	High Income OECD	Hungary	Upper Middle Income
Denmark	High Income OECD	Iran	Upper Middle Income
Estonia	High Income OECD	Jordan	Upper Middle Income
Finland	High Income OECD	Lebanon	Upper Middle Income
France	High Income OECD	Romania	Upper Middle Income
Germany	High Income OECD	Thailand	Upper Middle Income
Greece	High Income OECD	Tunisia	Upper Middle Income
Iceland	High Income OECD		
Ireland	High Income OECD		
Israel	High Income OECD		
Italy	High Income OECD		
South Korea	High Income OECD		
Luxembourg	High Income OECD		
Netherlands	High Income OECD		
New Zealand	High Income OECD		
Norway	High Income OECD		
Poland	High Income OECD		
Portugal	High Income OECD		
Slovak Republic	High Income OECD		
Slovenia	High Income OECD		
Spain	High Income OECD		
Sweden	High Income OECD		
Switzerland	High Income OECD		
United Kingdom	High Income OECD		

Appendix D: List of countries covered for chapter 5 by using CPI corruption index.

High-income Economies		Low to Middle-income Economies	
Country	**Classification**	**Country**	**Classification**
Croatia	High Income	Ethiopia	Low Income
Latvia	High Income	Kenya	Low Income
Singapore	High Income	Bolivia	Lower Middle Income
Australia	High Income OECD	Egypt	Lower Middle Income
Austria	High Income OECD	India	Lower Middle Income
Belgium	High Income OECD	Indonesia	Lower Middle Income
Canada	High Income OECD	Philippines	Lower Middle Income
Chile	High Income OECD	Vietnam	Lower Middle Income
Czech Republic	High Income OECD	Zambia	Lower Middle Income
Denmark	High Income OECD	Bulgaria	Upper Middle Income
Estonia	High Income OECD	China	Upper Middle Income
Finland	High Income OECD	Costa Rica	Upper Middle Income
France	High Income OECD	Hungary	Upper Middle Income
Germany	High Income OECD	Jordan	Upper Middle Income
Greece	High Income OECD	Romania	Upper Middle Income
Iceland	High Income OECD	Thailand	Upper Middle Income
Ireland	High Income OECD	Tunisia	Upper Middle Income
Israel	High Income OECD	Mauritius	Upper Middle Income
Italy	High Income OECD		
South Korea	High Income OECD		
Luxembourg	High Income OECD		
Netherlands	High Income OECD		
New Zealand	High Income OECD		
Norway	High Income OECD		
Poland	High Income OECD		
Portugal	High Income OECD		
Slovak Republic	High Income OECD		
Slovenia	High Income OECD		
Spain	High Income OECD		
Sweden	High Income OECD		
Switzerland	High Income OECD		
United Kingdom	High Income OECD		

Appendix E: Robustness test with new classification based on ICRG index in chapter 5

This further robustness test was carried out by using new classification based on ICRG index. As table 18 makes clear that higher corruption index is available not only in low-income countries but also in high-income countries, while this index varies among middle-income countries. Hague and Kneller (2015) also recognise the same distribution of the corruption score for their sample data for the period from 1980 to 2003. They decide to use this information for their subsequent empirical analysis with two groups of countries within the corruption data, those with low corruption (an average score of 4 or above) and those with medium to high corruption (an average score of less than 4). Similar to their study, this robustness test reruns the regression with two new groups of countries, those with ICRG average score >= 4 (20 countries) and those with ICRG average score <4 (37 countries), to see the relationship between government expenditure compositions and long-term economic growth and examine results with the presence of corruption in government expenditure components. The list of countries based on new classification can be seen in Appendix C. It can be seen that those countries with ICRG greater than 4 have only two countries from outside of OECD countries (Cyprus and Singapore), while those countries with ICRG lower than 4 have the mix countries from all 3 categories of income: low-income, middle-income and high-income economies. This classification has changed our descriptive statistics compared to the original set of data.

Table E1 provides the summary descriptive statistics for the new groups of country classification. Economies with ICRG greater than 4 have a lower average growth rate than those with ICRG lower than 4, at 1.8% and 3.2% respectively. These countries (with ICRG greater than 4) also have a lower average growth rate than our high-income countries in original data, at 1.8% compared with 2.6% respectively. Meanwhile, these countries have bigger size of government expenditure than counterpart group, which account for approximately 44% and 30% of total GDP respectively. Similar to low and middle-income economies, those economies (with ICRG lower than 4) have small government sizes tend to spend government expenditure on productive government spending. They spend over 75% of total public spending on productive spending, while counterpart group just spends 58% of their total public spending on productive spending and allocates a larger share of total expenditure to non-productive spending (42%).

Moving to other fiscal and explanatory variables, the descriptive statistics results are similar to original set of data.

Table E1: Descriptive statistics

	Countries with ICRG >4		Countries with ICRG <4	
Variable	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**
Growth rate	**1.857**	1.325	**3.212**	2.578
Productive government expenditure (% TGE)	**57.933**	9.978	**71.489**	13.557
Non-productive government expenditure (% TGE)	**42.183**	9.768	**28.657**	13.511
Total government expenditure (% of GDP)	**43.736**	9.007	**29.757**	10.349
Deficit or Surplus (% of GDP)	**-0.155**	4.057	**-2.669**	3.863
Tax Revenue (% of GDP)	**27.402**	6.677	**16.644**	6.207
Non-Tax Revevue (% of GDP)	**15.132**	5.596	**11.034**	7.079
Log Initial p.c. GDP (constant 2005 US$)	10.489	0.347	8.369	1.352
Investment (Gross capital formation as % of GDP)	21.692	3.165	24.583	5.768
Inflation rate (%)	2.328	1.335	9.705	22.428
Labour force growth (p.a)	1.291	0.979	1.693	1.840
Openness (Sum of exports and imports as % of GDP)	102.479	80.003	86.267	35.415

Table E2 reports the effects of productive and non-productive government expenditure without presence of corruption on economic growth in new classification country groups. For those countries with ICRG average score greater than 4, productive government spending has a positive and statistically significant effect on per capita growth rate, while non-productive government spending is significant negative, at 5.5% and -6.8%

respectively. Even the number of high-income countries in the group set has changed, the effects of government expenditure compositions on growth rate are consistent and it proves that high-income countries tend to be optimum in relocating their public spending in order to achieve both sustained development economics and standard of living. On the other hand, the productive expenditure has a negative but insignificant impact on economic growth, while non-productive is positive and again insignificant for those countries with ICRG score lower than 4. The reason for this insignificance may be due to the different share of productive and non-productive expenditure components on total government expenditure inside the group, as this group included all three different kinds of income categories. This makes the group sample data have large skewness and kurtosis. These results are similar to the results of full sample data set in our baseline set of equations in chapter 4. For other control variables, the coefficients of those variables are similar to the main results in part 5.4. The coefficient associated to investment is somehow positive and significant for those countries with ICRG lower than 4 only, while international trade has a positive and significant impact on economic growth in our sample of countries with ICRG bigger than 4. Regarding the budget constraint variables, tax-revenue coefficients find to have a negative impact on growth for both sets of sub-group sample and this is opposite to our main results. Surprisingly, we find labour force growth coefficient show negative and significant effects on long-term growth for those countries with ICRG lower than 4 only.

Table E2: Contribution of productive and non-productive spending to growth in countries with ICRG greater than 4 and countries with ICRG lower than 4 (without corruption)

Estimation technique: 5 years moving average - two way Fixed Effects Dependent variable: Per capita growth **(without corruption)**				
	Country with ICRG greater than 4		Countries with ICRG lower than 4	
	(1)	(2)	(3)	(4)
Productive expenditure	**0.0554***		**-0.0149**	
	(0.0268)		(0.0335)	
Non-productive expenditure		**-0.0675****		**0.0176**
		(0.0253)		(0.0332)
Log Initial GDP	1.2276	1.2332	-0.1209	-0.1276
	(2.8292)	(2.8766)	(1.8450)	(1.8463)
Investment	-0.0320	-0.0201	0.1737***	0.1735***
	(0.06311)	(0.0630)	(0.0535)	(0.0533)

Inflation	-0.1045	-0.1095	-0.0019	-0.0019
	(0.1217)	(0.1214)	(0.0052)	(0.0052)
Labour force growth	0.1889	0.1621	-0.4379***	-0.4394***
	(0.1755)	(0.1726)	(0.1543)	(0.1543)
Openness	0.0176*	0.0199*	0.0053	0.0051
	(0.0190)	(0.0104)	(0.0144)	(0.0144)
Non-tax revenue	-0.1191*	-0.1298**	-0.2607**	-0.2621**
	(0.0613)	(0.0605)	(0.0975)	(0.0973)
Tax revenue	0.0874	0.0815	0.0630	0.0648
	(0.0925)	(0.0924)	(0.1252)	(0.1259)
Surplus or Deficit	0.0539	0.0521	0.3991***	0.3997***
	(0.0617)	(0.0620)	(0.0676)	(0.0673)
Constant	-14.8748	-9.0761	4.9589	3.4585
	(29.239)	(29.101)	(14.461)	(13.727)
Observations	319	319	576	576
No of countries	20	20	37	37
Adjusted R-squared	0.7466	0.7492	0.4269	0.4272

Note: Robust standard error in parentheses. Country and time dummies included but not reported
*** p < 0.01, ** p < 0.05, * p < 0.1

Table E3 repeats result of table E2, but this table considers the role of corruption in government expenditure compositions to examine the effect of corruption on economic growth. For those countries with ICRG greater than 4, the finding shows that the coefficient on $(1-\delta).g_{pro}$ is 0.054. The corruption-adjusted coefficient of productive expenditure in this group is still positive and significant, but the productivity benefits of its spending turn out to be lower. The impact of corruption on economic growth in this case is bad, but the effect is rather small, δg_{pro} = -0.001. In term of non-productive government spending, the corruption-adjusted coefficient of this expenditure for this group is again negative and significant (-0.066), but is not as negative as when did not take into account corruption. Therefore, with the impact of corruption on non-productive spending, it provides a better outlook for non-productive government spending on economic growth. These results are similar to our main results in table 18 with the case of high-income economies. However, the effect of corruption on economic growth rate is rather small for both productive and non-productive components, as the portion of corruption index contributed into these spending varies from 1% to 2% only. Regarding those countries with ICRG lower than 4, the results show a similar insignificant impact of both productive and non-productive spending on economic growth. Corruption in this group does not change the results in table E2 to be significance. Other control variables coefficients are similar to the results before we take into account the impact of corruption.

Table E3: Contribution of productive and non-productive spending to growth in countries with ICRG greater than 4 and countries with ICRG lower than 4 (with presence of corruption)

Estimation technique: 5 years moving average - two way Fixed Effects
Dependent variable: Per capita growth (**Corruption captured**)

	Country with ICRG greater than 4		Countries with ICRG lower than 4	
	(1)	(2)	(3)	(4)
Productive expenditure	**0.0542***		**-0.0170**	
	(0.0268)		(0.0373)	
Non-productive expenditure		**-0.0661****		**0.0247**
		(0.0251)		(0.0346)
Log Initial GDP	1.2156	1.2332	0.1933	0.1911
	(2.8218)	(2.8847)	(1.767)	(1.7600)
Investment	-0.0297	-0.0201	0.1892***	0.1876***
	(0.0631)	(0.0630)	(0.0546)	(0.0540)
Inflation	-0.1061	-0.1095	-0.0007	-0.0007
	(0.1221)	(0.1219)	(0.0051)	(0.0051)
Labour force growth	0.1846	0.1621	-0.4174***	-0.4212***
	(0.1746)	(0.1712)	(0.1486)	(0.1489)
Openness	0.0178*	0.0199*	0.0078	0.0075
	(0.0117)	(0.0103)	(0.0144)	(0.0145)
Non-tax revenue	-0.1203**	-0.1298**	-0.2548**	-0.2581**
	(0.0607)	(0.0598)	(0.1024)	(0.1281)
Tax revenue	0.0878	0.0815	0.0536	0.0568
	(0.0934)	(0.0934)	(0.1281)	(0.1281)
Surplus or Deficit	0.0530	0.0521	0.3823***	0.3840***
	(0.0616)	(0.0618)	(0.0693)	(0.0690)
Constant	-14.8541	-9.0761	1.6632	-0.1180
	(29.128)	(29.188)	(13.958)	(13.050)
Observations	319	319	576	576
No of countries	20	20	37	37
Adjusted R-squared	0.7475	0.7503	0.4329	0.4339

Note: Robust standard error in parentheses. Country and time dummies included but not reported
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Appendix F: The correlation matrix between variables with presence of corruption variable

	GRO	INF	INV	LFG	LIG	NTR	OPN	SOD	TR	PGE1	UPGE1
Growth (GRO)											
Inflation (INF)	-0.0083										
Investment (INV)	0.5182	-0.1026									
Labour force growth (LFG)	-0.1661	-0.1029	0.0044								
Log initial GDP (LIG)	-0.3017	-0.2242	-0.176	-0.192							
Non-tax revenue (NTR)	-0.2432	-0.0201	-0.1824	-0.1151	0.5186						
Openness (OPN)	-0.0058	-0.0725	0.0298	0.1366	0.2764	0.0905					
Surplus or deficit (SOD)	0.065	-0.0479	0.0699	0.0845	0.297	0.2246	0.2704				
Tax revenue (TR)	-0.2027	-0.1132	-0.3466	-0.3681	0.6268	0.2051	0.0099	0.1602			
Productive spending (PGE1)	0.1258	0.1001	0.1692	0.4505	-0.6785	-0.5839	0.0255	-0.1339	-0.6269		
Non-productive spending (UPGE1)	-0.1242	-0.0963	-0.1746	-0.4504	0.6747	0.5856	-0.0273	0.1356	0.6247	-0.9984	
Corruption index (ICRG)	-0.2061	-0.0665	-0.2546	-0.2013	0.6847	0.2721	0.1132	0.3054	0.6616	-0.5148	0.5202

Appendix G: List of countries covered for chapter 6

High-income Economies		ASEAN Economies	
Country	**Classification**	**Country**	**Classification**
Australia	High Income OECD	Indonesia	Lower Middle Income
Austria	High Income OECD	Philippines	Lower Middle Income
Belgium	High Income OECD	Vietnam	Lower Middle Income
Canada	High Income OECD	Thailand	Upper Middle Income
Denmark	High Income OECD	Singapore	High Income
Estonia	High Income OECD		
Finland	High Income OECD		
France	High Income OECD		
Germany	High Income OECD		
Greece	High Income OECD		
Iceland	High Income OECD		
Ireland	High Income OECD		
Israel	High Income OECD		
Italy	High Income OECD		
Luxembourg	High Income OECD		
Netherlands	High Income OECD		
New Zealand	High Income OECD		
Norway	High Income OECD		
Portugal	High Income OECD		
Slovak	High Income OECD		
Slovenia	High Income OECD		
Spain	High Income OECD		
Sweden	High Income OECD		
Switzerland	High Income OECD		
United Kingdom	High Income OECD		

Appendix H: The correlation matrix between variables with presence of human capital and its components (education and health)

Appendix H1: The correlation matrix between variables with presence of human capital and its components (education and health) for ASEAN countries

	GRO	INF	INV	LFG	LIG	NTR	OPN	SOD	TR	HMC	EDU
Growth (GRO)											
Inflation (INF)	-0.2481										
Investment (INV)	0.4188	-0.0126									
Labour force growth (LFG)	-0.1073	-0.014	-0.1317								
Log initial GDP (LIG)	-0.0185	-0.5753	-0.0399	0.3634							
Non-tax revenue (NTR)	0.4204	-0.2306	0.5521	0.1296	0.4461						
Openness (OPN)	0.138	-0.5506	0.0465	0.4786	0.9287	0.5828					
Surplus or deficit (SOD)	0.1808	-0.4234	0.1129	0.4631	0.8966	0.546	0.8739				
Tax revenue (TR)	-0.0786	0.009	0.4175	-0.2761	-0.0112	0.1269	-0.0424	-0.0651			
Human capital spending (HMC)	-0.0178	-0.7287	0.1013	-0.0377	0.6048	0.0632	0.5454	0.4112	0.3915		
Education spending (EDU)	-0.0348	-0.7477	0.0267	0.0551	0.5914	0.0166	0.5585	0.4136	0.2901	0.9629	
Health spending (HEA)	0.0156	-0.5589	0.2142	-0.195	0.5155	0.1339	0.4203	0.33	0.4977	0.8787	0.7174

Appendix H2: The correlation matrix between variables with presence of human capital and its components (education and health) for OECD countries

	GRO	INF	INV	LFG	LIG	NTR	OPN	SOD	TR	HMC	EDU
Growth (GRO)											
Inflation (INF)	0.4783										
Investment (INV)	0.4226	0.5183									
Labour force growth (LFG)	0.0552	0.0323	0.1241								
Log initial GDP (LIG)	-0.4313	-0.4856	-0.5422	0.2343							
Non-tax revenue (NTR)	-0.0694	-0.077	-0.0614	-0.3186	-0.0668						
Openness (OPN)	0.1455	0.0407	0.1027	0.1719	0.1942	0.0504					
Surplus or deficit (SOD)	0.1809	0.1441	0.1048	0.1748	0.4069	-0.0396	0.1527				
Tax revenue (TR)	-0.1101	-0.1107	-0.3634	-0.0033	0.4686	-0.3335	-0.1134	0.4225			
Human capital spending (HMC)	0.0785	0.2537	0.191	-0.0709	-0.1786	-0.195	-0.0692	0.0912	0.0417		
Education spending (EDU)	0.1648	0.2844	0.1464	0.0379	-0.1028	-0.2219	0.2344	0.205	0.1499	0.7745	
Health spending (HEA)	-0.0356	0.12	0.1545	-0.1446	-0.1768	-0.0891	-0.3278	-0.0541	-0.0779	0.8012	0.242

Appendix I: The results for testing whether the coefficients of interested variables (productive, non-productive, education, health and human capital government expenditure) before and after corruption adjustment are significant different from each other under "suest" command in Stata

This thesis run the "suest" (Seemingly Unrelated Estimation) command on Stata to test the significant difference of interested variable coefficients before and after corruption adjustment. The test name is "seemingly unrelated estimation" which was developed by Weesie (1999) to examine whether some relationship between the estimators holds either on different datasets, on overlapping datasets, or on the same dataset. Such a hypothesis is often that the coefficients estimated by one estimator are equal to the coefficients estimated by the other estimator.

System Hypothesis:

H_0: Coefficient of interested variable before corruption adjustment = coefficient of interested variable after corruption adjustment

H_1: Coefficient of interested variable before corruption adjustment $\neq$ coefficient of interested variable after corruption adjustment

Table I1: Result for testing the coefficient of productive government expenditure in high-income economies before and after ICRG adjustment

	Robust					
	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
eqn1_mean						
PGE1	0.0507315	0.0152179	3.33	0.001	0.0209051	0.080558
INF	-0.0439671	0.0263885	-1.67	0.096	-0.0956877	0.0077534
INV	0.0936399	0.0301292	3.11	0.002	0.0345876	0.1526921
LFG	0.0962945	0.0652647	1.48	0.14	-0.031622	0.224211
LIG	-2.61911	1.158271	-2.26	0.024	-4.88928	-0.3489405
NTR	-0.1464641	0.0298297	-4.91	0	-0.2049293	-0.0879989
TR	0.1359075	0.0419785	3.24	0.001	0.0536312	0.2181838
SOD	0.2052591	0.0303854	6.76	0	0.1457048	0.2648135
OPN	0.0424342	0.0066984	6.33	0	0.0293055	0.0555629
_Iyear_1996	0.0038008	0.240337	0.02	0.987	-0.4672511	0.4748526
_Iyear_1997	-0.1784996	0.2414544	-0.74	0.46	-0.6517416	0.2947424
_Iyear_1998	-0.3206174	0.2526956	-1.27	0.205	-0.8158916	0.1746569
_Iyear_1999	-0.6544001	0.2692088	-2.43	0.015	-1.18204	-0.1267606
_Iyear_2000	-0.9964727	0.2661915	-3.74	0	-1.518198	-0.474747
_Iyear_2001	-1.109223	0.2828353	-3.92	0	-1.66357	-0.5548759
_Iyear_2002	-1.059574	0.3010331	-3.52	0	-1.649588	-0.4695599
_Iyear_2003	-1.289403	0.3275807	-3.94	0	-1.931449	-0.6473561
_Iyear_2004	-1.036116	0.3438744	-3.01	0.003	-1.710098	-0.3621347

_Iyear_2005	-0.9013528	0.3533627	-2.55	0.011	-1.593931	-0.2087746
_Iyear_2006	-1.406365	0.3676953	-3.82	0	-2.127035	-0.6856954
_Iyear_2007	-2.664782	0.3799874	-7.01	0	-3.409544	-1.92002
_Iyear_2008	-2.612674	0.3674955	-7.11	0	-3.332952	-1.892397
_Iyear_2009	-2.83945	0.3688869	-7.7	0	-3.562455	-2.116445
_Iyear_2010	-3.396433	0.397305	-8.55	0	-4.175136	-2.617729
_Iid_2	1.761679	0.5538058	3.18	0.001	0.6762398	2.847119
_Iid_3	-4.064948	1.063752	-3.82	0	-6.149863	-1.980034
_Iid_4	-2.795454	1.703571	-1.64	0.101	-6.134392	0.5434848
_Iid_5	-1.688337	0.6962882	-2.42	0.015	-3.053037	-0.3236373
_Iid_6	0.3077672	0.3618805	0.85	0.395	-0.4015057	1.01704
_Iid_7	-2.760301	1.835931	-1.5	0.133	-6.358659	0.8380577
_Iid_8	-1.041489	1.655115	-0.63	0.529	-4.285455	2.202476
_Iid_9	-2.468202	0.8532011	-2.89	0.004	-4.140446	-0.7959586
_Iid_10	-0.7121999	1.561421	-0.46	0.648	-3.772529	2.348129
_Iid_11	-2.801866	0.8495043	-3.3	0.001	-4.466864	-1.136868
_Iid_12	-0.5651357	2.201916	-0.26	0.797	-4.880812	3.75054
_Iid_13	2.076164	0.5628043	3.69	0	0.9730875	3.17924
_Iid_14	3.432494	0.6043606	5.68	0	2.247969	4.617019
_Iid_15	3.37548	0.6345184	5.32	0	2.131846	4.619113
_Iid_16	3.052714	0.8251319	3.7	0	1.435485	4.669943
_Iid_17	0.2012623	0.5744364	0.35	0.726	-0.9246124	1.327137
_Iid_18	-0.7760501	0.831313	-0.93	0.351	-2.405394	0.8532934
_Iid_19	-0.0662182	0.8409212	-0.08	0.937	-1.714393	1.581957
_Iid_20	1.396871	0.3961783	3.53	0	0.6203757	2.173366
_Iid_21	-0.6081955	1.193175	-0.51	0.61	-2.946775	1.730384
_Iid_22	1.499925	2.487631	0.6	0.547	-3.375741	6.375591
_Iid_23	-6.080386	1.314896	-4.62	0	-8.657536	-3.503237
_Iid_24	-4.26442	1.523747	-2.8	0.005	-7.250909	-1.277931
_Iid_25	0.950311	0.7084007	1.34	0.18	-0.4381288	2.338751
_Iid_26	-1.82	0.4298935	-4.23	0	-2.662576	-0.9774242
_Iid_27	0.3390525	1.009414	0.34	0.737	-1.639363	2.317468
_Iid_28	0.0104554	1.691182	0.01	0.995	-3.3042	3.325111
_Iid_29	2.327462	1.773431	1.31	0.189	-1.148398	5.803322
_Iid_30	0.3622765	0.8855571	0.41	0.682	-1.373384	2.097936
_Iid_31	-13.96783	2.626991	-5.32	0	-19.11664	-8.81902
_Iid_32	-0.5609575	1.834381	-0.31	0.76	-4.156278	3.034363
_Iid_33	-0.0353256	1.151358	-0.03	0.976	-2.291946	2.221295
_Iid_34	1.56349	0.5851105	2.67	0.008	0.4166941	2.710285
_Iid_35	0.9804005	0.6147168	1.59	0.111	-0.2244223	2.185223
_Iid_36	1.393408	0.7540082	1.85	0.065	-0.0844207	2.871237
_Iid_37	2.179606	0.422955	5.15	0	1.35063	3.008583
_cons	20.28159	11.30658	1.79	0.073	-1.878896	42.44208
eqn1_lnvar						

_cons	0.1857056	0.0658844	2.82	0.005	0.0565745	0.3148367
eqn2_mean						
PGEICRG	0.0471113	0.0160524	2.93	0.003	0.0156492	0.0785733
INF	-0.0612725	0.0254485	-2.41	0.016	-0.1111506	-0.0113943
INV	0.097376	0.0314708	3.09	0.002	0.0356944	0.1590576
LFG	0.1350866	0.0616515	2.19	0.028	0.0142518	0.2559214
LIG	-1.959309	1.11571	-1.76	0.079	-4.146059	0.2274423
NTR	-0.1509553	0.030902	-4.88	0	-0.2115221	-0.0903884
TR	0.1244194	0.0418178	2.98	0.003	0.0424581	0.2063807
SOD	0.2024592	0.0314804	6.43	0	0.1407587	0.2641597
OPN	0.0408953	0.0067468	6.06	0	0.0276718	0.0541189
_Iyear_1996	0.0960515	0.2333927	0.41	0.681	-0.3613897	0.5534927
_Iyear_1997	-0.0413199	0.2347905	-0.18	0.86	-0.5015008	0.418861
_Iyear_1998	-0.2057669	0.2518192	-0.82	0.414	-0.6993235	0.2877897
_Iyear_1999	-0.5646121	0.2688159	-2.1	0.036	-1.091482	-0.0377426
_Iyear_2000	-0.9303656	0.2650832	-3.51	0	-1.449919	-0.4108122
_Iyear_2001	-1.056914	0.2822872	-3.74	0	-1.610187	-0.5036416
_Iyear_2002	-1.020421	0.3009093	-3.39	0.001	-1.610192	-0.4306494
_Iyear_2003	-1.271288	0.3255563	-3.9	0	-1.909367	-0.6332094
_Iyear_2004	-1.03184	0.340218	-3.03	0.002	-1.698655	-0.3650252
_Iyear_2005	-0.9109895	0.3480685	-2.62	0.009	-1.593191	-0.2287879
_Iyear_2006	-1.428757	0.3614638	-3.95	0	-2.137213	-0.7203012
_Iyear_2007	-2.705536	0.3745258	-7.22	0	-3.439593	-1.971479
_Iyear_2008	-2.661155	0.3609777	-7.37	0	-3.368659	-1.953652
_Iyear_2009	-2.887456	0.3624386	-7.97	0	-3.597822	-2.177089
_Iyear_2010	-3.446107	0.390563	-8.82	0	-4.211596	-2.680617
_Iid_2	1.746969	0.5598084	3.12	0.002	0.6497646	2.844173
_Iid_3	-3.865196	1.068941	-3.62	0	-5.960282	-1.77011
_Iid_4	-2.428299	1.732299	-1.4	0.161	-5.823544	0.9669449
_Iid_5	-1.520795	0.7128488	-2.13	0.033	-2.917953	-0.1236368
_Iid_6	0.2901277	0.3570802	0.81	0.417	-0.4097367	0.9899921
_Iid_7	-1.791945	1.782926	-1.01	0.315	-5.286417	1.702527
_Iid_8	-0.1891727	1.598373	-0.12	0.906	-3.321927	2.943581
_Iid_9	-2.114762	0.8640592	-2.45	0.014	-3.808287	-0.4212375
_Iid_10	0.0292017	1.533803	0.02	0.985	-2.976997	3.035401
_Iid_11	-2.772926	0.8489747	-3.27	0.001	-4.436886	-1.108967
_Iid_12	0.0668504	2.136461	0.03	0.975	-4.120537	4.254237
_Iid_13	2.118477	0.5686183	3.73	0	1.004005	3.232948
_Iid_14	3.464231	0.6051477	5.72	0	2.278163	4.650299
_Iid_15	3.32739	0.6319823	5.27	0	2.088728	4.566053
_Iid_16	3.396576	0.8230567	4.13	0	1.783414	5.009737
_Iid_17	0.0533899	0.5640841	0.09	0.925	-1.052195	1.158975
_Iid_18	-0.8128209	0.8563544	-0.95	0.343	-2.491245	0.8656028
_Iid_19	0.3546236	0.8372616	0.42	0.672	-1.286379	1.995626

_Iid_20	1.53126	0.3994605	3.83	0	0.7483315	2.314188
_Iid_21	-0.1583224	1.183259	-0.13	0.894	-2.477467	2.160823
_Iid_22	2.66672	2.418956	1.1	0.27	-2.074346	7.407786
_Iid_23	-6.272033	1.334063	-4.7	0	-8.886749	-3.657317
_Iid_24	-3.537299	1.504994	-2.35	0.019	-6.487034	-0.587564
_Iid_25	0.8909777	0.7213511	1.24	0.217	-0.5228444	2.3048
_Iid_26	-1.653773	0.4390183	-3.77	0	-2.514233	-0.7933133
_Iid_27	0.1113995	0.9709363	0.11	0.909	-1.791601	2.0144
_Iid_28	0.65931	1.722078	0.38	0.702	-2.715901	4.034521
_Iid_29	3.404591	1.705816	2	0.046	0.0612529	6.74793
_Iid_30	0.7718831	0.8811382	0.88	0.381	-0.955116	2.498882
_Iid_31	-13.44897	2.681175	-5.02	0	-18.70398	-8.193964
_Iid_32	0.3460185	1.80073	0.19	0.848	-3.183348	3.875385
_Iid_33	0.6171163	1.153045	0.54	0.593	-1.64281	2.877043
_Iid_34	1.675812	0.5915516	2.83	0.005	0.516392	2.835232
_Iid_35	1.017456	0.6154746	1.65	0.098	-0.188852	2.223764
_Iid_36	1.036939	0.724089	1.43	0.152	-0.3822493	2.456128
_Iid_37	2.132751	0.41581	5.13	0	1.317779	2.947724
_cons	13.98839	10.97082	1.28	0.202	-7.514021	35.4908
eqn2_lnvar						
_cons	0.1545161	0.063758	2.42	0.015	0.0295527	0.2794796

. test [eqn1_mean]PGE1=[eqn2_mean]PGEICRG

[eqn1_mean]PGE1 - [eqn2_mean]PGEICRG = 0

chi2(1) = 0.86
Prob > chi2 = 0.3530

Table I2: Result for testing the coefficient of non-productive government expenditure in high-income economies before and after ICRG adjustment

		Robust				
	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
eqn1_mean						
UPGE1	-0.0498319	0.0165403	-3.01	0.003	-0.0822503	-0.0174135
INF	-0.0442001	0.0264779	-1.67	0.095	-0.0960958	0.0076956
INV	0.0935323	0.0303796	3.08	0.002	0.0339894	0.1530752
LFG	0.0934735	0.0655998	1.42	0.154	-0.0350998	0.2220468
LIG	-2.534145	1.159963	-2.18	0.029	-4.80763	-0.2606601
NTR	-0.1475618	0.0299193	-4.93	0	-0.2062026	-0.088921
TR	0.1338604	0.0421178	3.18	0.001	0.0513111	0.2164098
SOD	0.2060042	0.0305091	6.75	0	0.1462076	0.2658009

OPN	0.041532	0.0066749	6.22	0	0.0284494	0.0546146
_Iyear_1996	0.0077231	0.2414873	0.03	0.974	-0.4655833	0.4810295
_Iyear_1997	-0.1782894	0.2432429	-0.73	0.464	-0.6550368	0.2984579
_Iyear_1998	-0.3272528	0.2534168	-1.29	0.197	-0.8239407	0.169435
_Iyear_1999	-0.6643553	0.2704084	-2.46	0.014	-1.194346	-0.1343647
_Iyear_2000	-1.008226	0.2668289	-3.78	0	-1.531201	-0.4852513
_Iyear_2001	-1.123553	0.2836954	-3.96	0	-1.679586	-0.5675203
_Iyear_2002	-1.076392	0.301639	-3.57	0	-1.667594	-0.4851903
_Iyear_2003	-1.30854	0.3280298	-3.99	0	-1.951466	-0.6656131
_Iyear_2004	-1.05945	0.3441133	-3.08	0.002	-1.733899	-0.3850001
_Iyear_2005	-0.9251245	0.3542243	-2.61	0.009	-1.619391	-0.2308576
_Iyear_2006	-1.430682	0.36881	-3.88	0	-2.153536	-0.7078278
_Iyear_2007	-2.687162	0.3808549	-7.06	0	-3.433624	-1.9407
_Iyear_2008	-2.63508	0.3686212	-7.15	0	-3.357564	-1.912595
_Iyear_2009	-2.857066	0.3700825	-7.72	0	-3.582414	-2.131717
_Iyear_2010	-3.414699	0.3988738	-8.56	0	-4.196477	-2.63292
_Iid_2	1.791675	0.5553921	3.23	0.001	0.7031262	2.880223
_Iid_3	-4.055365	1.095157	-3.7	0	-6.201832	-1.908897
_Iid_4	-2.657884	1.72379	-1.54	0.123	-6.03645	0.7206822
_Iid_5	-1.601876	0.6910626	-2.32	0.02	-2.956334	-0.2474184
_Iid_6	0.3251546	0.370019	0.88	0.38	-0.4000693	1.050379
_Iid_7	-2.587664	1.834647	-1.41	0.158	-6.183505	1.008178
_Iid_8	-0.9027941	1.656661	-0.54	0.586	-4.14979	2.344201
_Iid_9	-2.36666	0.853134	-2.77	0.006	-4.038772	-0.6945477
_Iid_10	-0.5882545	1.564828	-0.38	0.707	-3.655261	2.478752
_Iid_11	-2.78716	0.8587348	-3.25	0.001	-4.470249	-1.10407
_Iid_12	-0.3902099	2.203364	-0.18	0.859	-4.708725	3.928305
_Iid_13	2.085513	0.5663059	3.68	0	0.9755739	3.195452
_Iid_14	3.439767	0.6075008	5.66	0	2.249087	4.630447
_Iid_15	3.376708	0.6388257	5.29	0	2.124632	4.628783
_Iid_16	3.095248	0.826398	3.75	0	1.475538	4.714959
_Iid_17	0.2035712	0.5750084	0.35	0.723	-0.9234246	1.330567
_Iid_18	-0.7166217	0.8309975	-0.86	0.388	-2.345347	0.9121034
_Iid_19	0.0178955	0.8411497	0.02	0.983	-1.630728	1.666519
_Iid_20	1.408222	0.3980846	3.54	0	0.6279908	2.188454
_Iid_21	-0.5367792	1.211165	-0.44	0.658	-2.910619	1.837061
_Iid_22	1.643098	2.490359	0.66	0.509	-3.237915	6.524111
_Iid_23	-5.885223	1.294134	-4.55	0	-8.42168	-3.348766
_Iid_24	-4.0915	1.520046	-2.69	0.007	-7.070734	-1.112265
_Iid_25	0.9999501	0.7067202	1.41	0.157	-0.3851961	2.385096
_Iid_26	-1.785574	0.4319814	-4.13	0	-2.632242	-0.9389065
_Iid_27	0.3484829	1.018704	0.34	0.732	-1.64814	2.345105
_Iid_28	0.1150859	1.712724	0.07	0.946	-3.241792	3.471963
_Iid_29	2.455053	1.77236	1.39	0.166	-1.018708	5.928815
_Iid_30	0.4713209	0.8808272	0.54	0.593	-1.255069	2.197711

_Iid_31	-13.65302	2.645652	-5.16	0	-18.8384	-8.467638
_Iid_32	-0.3872769	1.836531	-0.21	0.833	-3.986812	3.212258
_Iid_33	0.0825725	1.148255	0.07	0.943	-2.167967	2.333112
_Iid_34	1.589058	0.5845127	2.72	0.007	0.4434337	2.734682
_Iid_35	1.014108	0.620739	1.63	0.102	-0.202518	2.230734
_Iid_36	1.379109	0.7567214	1.82	0.068	-0.1040377	2.862256
_Iid_37	2.192622	0.4312405	5.08	0	1.347406	3.037838
_cons	24.5654	11.65212	2.11	0.035	1.727667	47.40313
eqn1_lnvar						
_cons	0.1887405	0.0659553	2.86	0.004	0.0594704	0.3180106
eqn2_mean						
UPGEICRG	-0.0448344	0.0176177	-2.54	0.011	-0.0793645	-0.0103042
INF	-0.0591845	0.0257157	-2.3	0.021	-0.1095863	-0.0087828
INV	0.0955488	0.0315148	3.03	0.002	0.0337809	0.1573168
LFG	0.1342694	0.0617985	2.17	0.03	0.0131466	0.2553923
LIG	-1.912551	1.123093	-1.7	0.089	-4.113772	0.2886701
NTR	-0.1536203	0.0311108	-4.94	0	-0.2145962	-0.0926443
TR	0.1238645	0.0418661	2.96	0.003	0.0418084	0.2059205
SOD	0.2027449	0.0316182	6.41	0	0.1407744	0.2647154
OPN	0.0398025	0.0067345	5.91	0	0.0266031	0.0530018
_Iyear_1996	0.0984205	0.2340333	0.42	0.674	-0.3602763	0.5571173
_Iyear_1997	-0.0489112	0.2365883	-0.21	0.836	-0.5126158	0.4147934
_Iyear_1998	-0.222314	0.2521904	-0.88	0.378	-0.716598	0.27197
_Iyear_1999	-0.587648	0.2694146	-2.18	0.029	-1.115691	-0.059605
_Iyear_2000	-0.9612298	0.2645115	-3.63	0	-1.479663	-0.4427967
_Iyear_2001	-1.09621	0.2814383	-3.9	0	-1.647819	-0.5446009
_Iyear_2002	-1.066351	0.2992288	-3.56	0	-1.652829	-0.4798731
_Iyear_2003	-1.321517	0.3233601	-4.09	0	-1.955291	-0.6877427
_Iyear_2004	-1.087499	0.3375212	-3.22	0.001	-1.749028	-0.4259691
_Iyear_2005	-0.964257	0.3463846	-2.78	0.005	-1.643158	-0.2853557
_Iyear_2006	-1.479654	0.3607119	-4.1	0	-2.186636	-0.7726713
_Iyear_2007	-2.75208	0.3741443	-7.36	0	-3.485389	-2.018771
_Iyear_2008	-2.706501	0.3613594	-7.49	0	-3.414752	-1.998249
_Iyear_2009	-2.92758	0.3641302	-8.04	0	-3.641262	-2.213898
_Iyear_2010	-3.485587	0.3936771	-8.85	0	-4.25718	-2.713994
_Iid_2	1.796355	0.5612072	3.2	0.001	0.6964086	2.8963
_Iid_3	-3.856113	1.108996	-3.48	0.001	-6.029706	-1.682521
_Iid_4	-2.332313	1.782384	-1.31	0.191	-5.825722	1.161096
_Iid_5	-1.445122	0.7145559	-2.02	0.043	-2.845625	-0.0446178
_Iid_6	0.3255965	0.3684251	0.88	0.377	-0.3965034	1.047696
_Iid_7	-1.715905	1.796138	-0.96	0.339	-5.236271	1.804461
_Iid_8	-0.1661764	1.617325	-0.1	0.918	-3.336075	3.003722
_Iid_9	-2.027556	0.879028	-2.31	0.021	-3.750419	-0.3046927

_Iid_10	0.084772	1.554811	0.05	0.957	-2.962601	3.132145
_Iid_11	-2.735859	0.8603676	-3.18	0.001	-4.422148	-1.049569
_Iid_12	0.1813951	2.152124	0.08	0.933	-4.036691	4.399481
_Iid_13	2.195924	0.5719211	3.84	0	1.07498	3.316869
_Iid_14	3.440331	0.609722	5.64	0	2.245298	4.635364
_Iid_15	3.347489	0.6378582	5.25	0	2.09731	4.597668
_Iid_16	3.377477	0.8338559	4.05	0	1.74315	5.011805
_Iid_17	0.1116143	0.5628354	0.2	0.843	-0.9915229	1.214751
_Iid_18	-0.7831073	0.8650316	-0.91	0.365	-2.478538	0.9123234
_Iid_19	0.3689146	0.8561779	0.43	0.667	-1.309163	2.046992
_Iid_20	1.45227	0.4008468	3.62	0	0.6666245	2.237915
_Iid_21	-0.1296742	1.218572	-0.11	0.915	-2.518032	2.258683
_Iid_22	2.67041	2.439434	1.09	0.274	-2.110792	7.451612
_Iid_23	-5.982387	1.306891	-4.58	0	-8.543846	-3.420927
_Iid_24	-3.423664	1.519294	-2.25	0.024	-6.401425	-0.4459029
_Iid_25	1.007387	0.7161891	1.41	0.16	-0.3963176	2.411092
_Iid_26	-1.606922	0.445408	-3.61	0	-2.479905	-0.7339382
_Iid_27	0.1707172	0.9808527	0.17	0.862	-1.751719	2.093153
_Iid_28	0.7167618	1.773132	0.4	0.686	-2.758514	4.192037
_Iid_29	3.397237	1.720926	1.97	0.048	0.0242844	6.77019
_Iid_30	0.855464	0.8840547	0.97	0.333	-0.8772513	2.588179
_Iid_31	-13.03564	2.707109	-4.82	0	-18.34148	-7.729807
_Iid_32	0.443692	1.825408	0.24	0.808	-3.134042	4.021426
_Iid_33	0.6769796	1.163633	0.58	0.561	-1.6037	2.957659
_Iid_34	1.674619	0.5949414	2.81	0.005	0.5085554	2.840683
_Iid_35	1.085242	0.6224527	1.74	0.081	-0.1347426	2.305227
_Iid_36	1.065924	0.7285676	1.46	0.143	-0.3620419	2.493891
_Iid_37	2.124116	0.422171	5.03	0	1.296676	2.951556
_cons	18.22789	11.37442	1.6	0.109	-4.065572	40.52134
eqn2_lnvar						
_cons	0.1583639	0.0640219	2.47	0.013	0.0328833	0.2838445

. test [eqn1_mean]UPGE1=[eqn2_mean]UPGEICRG

[eqn1_mean]UPGE1 -
[eqn2_mean]UPGEICRG = 0

chi2(1) = 1.38
Prob > chi2 = 0.2403

Table I3: Result for testing the coefficient of productive government expenditure in low to middle-income economies before and after ICRG adjustment

	Robust					
	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
eqn1_mean						
PGE1	0.0447862	0.01645	2.72	0.006	0.012545	0.077028
INF	0.0019932	0.003262	0.61	0.541	-0.0044	0.008386
INV	0.1988606	0.02813	7.07	0	0.143727	0.253994
LFG	-0.155817	0.100463	-1.55	0.121	-0.35272	0.041086
LIG	-0.2191268	0.668842	-0.33	0.743	-1.53003	1.09178
NTR	-0.036643	0.040103	-0.91	0.361	-0.11524	0.041957
TR	-0.1908802	0.045255	-4.22	0	-0.27958	-0.10218
SOD	0.2462485	0.039554	6.23	0	0.168724	0.323773
OPN	-0.0048104	0.008402	-0.57	0.567	-0.02128	0.011657
_Iyear_1996	-0.4347397	0.360807	-1.2	0.228	-1.14191	0.272429
_Iyear_1997	-0.4428086	0.347031	-1.28	0.202	-1.12298	0.23736
_Iyear_1998	-0.5382082	0.3656	-1.47	0.141	-1.25477	0.178354
_Iyear_1999	-0.6210163	0.353449	-1.76	0.079	-1.31376	0.071731
_Iyear_2000	-0.2433563	0.342207	-0.71	0.477	-0.91407	0.427357
_Iyear_2001	0.4178792	0.37752	1.11	0.268	-0.32205	1.157804
_Iyear_2002	0.9392635	0.391374	2.4	0.016	0.172185	1.706343
_Iyear_2003	1.23163	0.376273	3.27	0.001	0.494148	1.969111
_Iyear_2004	1.592749	0.393455	4.05	0	0.821591	2.363906
_Iyear_2005	2.082858	0.376354	5.53	0	1.345218	2.820498
_Iyear_2006	2.083154	0.429873	4.85	0	1.240618	2.92569
_Iyear_2007	1.471619	0.431075	3.41	0.001	0.626729	2.31651
_Iyear_2008	1.493399	0.436473	3.42	0.001	0.637927	2.348871
_Iyear_2009	1.113241	0.458061	2.43	0.015	0.215459	2.011023
_Iyear_2010	0.5888119	0.493895	1.19	0.233	-0.3792	1.556828
_Iid_2	1.558691	0.842724	1.85	0.064	-0.09302	3.210399
_Iid_3	-0.6154696	0.860184	-0.72	0.474	-2.3014	1.070459
_Iid_4	-0.8616242	1.100765	-0.78	0.434	-3.01908	1.295835
_Iid_5	0.5955583	0.322835	1.84	0.065	-0.03719	1.228304
_Iid_6	-1.420846	1.173487	-1.21	0.226	-3.72084	0.879145
_Iid_7	2.43001	1.313361	1.85	0.064	-0.14413	5.004151
_Iid_8	-1.15946	0.667853	-1.74	0.083	-2.46843	0.149507
_Iid_9	-3.636121	0.663022	-5.48	0	-4.93562	-2.33662
_Iid_10	-4.449589	1.063194	-4.19	0	-6.53341	-2.36577
_Iid_11	0.2424226	0.698531	0.35	0.729	-1.12667	1.611519
_Iid_12	-2.686774	0.563595	-4.77	0	-3.7914	-1.58215
_Iid_13	-0.1480001	1.494622	-0.1	0.921	-3.07741	2.781406
_Iid_14	-2.686149	0.710572	-3.78	0	-4.07884	-1.29346
_Iid_15	0.7276409	0.959914	0.76	0.448	-1.15376	2.609037
_Iid_16	0.1979187	0.622578	0.32	0.751	-1.02231	1.418149
_Iid_17	-2.679321	1.008728	-2.66	0.008	-4.65639	-0.70225

_Iid_18	0.4079934	0.692372	0.59	0.556	-0.94903	1.765018
_Iid_19	-1.458048	0.944221	-1.54	0.123	-3.30869	0.392591
_Iid_20	-1.902556	0.549832	-3.46	0.001	-2.98021	-0.8249
_cons	1.431657	5.096051	0.28	0.779	-8.55642	11.41973
eqn1_lnvar						
_cons	0.2991986	0.069904	4.28	0	0.16219	0.436207
eqn2_mean						
PGEICRG	0.0499142	0.016511	3.02	0.003	0.017554	0.082274
INF	0.0016965	0.003238	0.52	0.6	-0.00465	0.008044
INV	0.1978741	0.028118	7.04	0	0.142765	0.252983
LFG	-0.1519651	0.099806	-1.52	0.128	-0.34758	0.043651
LIG	-0.2120464	0.659664	-0.32	0.748	-1.50496	1.080872
NTR	-0.0344901	0.039889	-0.86	0.387	-0.11267	0.043692
TR	-0.1912281	0.044615	-4.29	0	-0.27867	-0.10378
SOD	0.2435098	0.03962	6.15	0	0.165856	0.321164
OPN	-0.0047601	0.008353	-0.57	0.569	-0.02113	0.011611
_Iyear_1996	-0.4300712	0.360934	-1.19	0.233	-1.13749	0.277346
_Iyear_1997	-0.4328046	0.348135	-1.24	0.214	-1.11514	0.249528
_Iyear_1998	-0.5188899	0.367127	-1.41	0.158	-1.23845	0.200665
_Iyear_1999	-0.5970539	0.354728	-1.68	0.092	-1.29231	0.098199
_Iyear_2000	-0.2100697	0.344999	-0.61	0.543	-0.88626	0.466116
_Iyear_2001	0.4589134	0.382251	1.2	0.23	-0.29028	1.208112
_Iyear_2002	0.9892842	0.396252	2.5	0.013	0.212646	1.765923
_Iyear_2003	1.288755	0.381111	3.38	0.001	0.541792	2.035718
_Iyear_2004	1.654989	0.398177	4.16	0	0.874578	2.435401
_Iyear_2005	2.145578	0.380763	5.63	0	1.399295	2.89186
_Iyear_2006	2.146925	0.433394	4.95	0	1.297489	2.996361
_Iyear_2007	1.536943	0.433633	3.54	0	0.687038	2.386848
_Iyear_2008	1.552972	0.438617	3.54	0	0.693298	2.412646
_Iyear_2009	1.171857	0.460043	2.55	0.011	0.270189	2.073526
_Iyear_2010	0.6450191	0.494574	1.3	0.192	-0.32433	1.614365
_Iid_2	1.624207	0.838391	1.94	0.053	-0.01901	3.267424
_Iid_3	-0.5718515	0.850929	-0.67	0.502	-2.23964	1.095939
_Iid_4	-0.8980355	1.084413	-0.83	0.408	-3.02345	1.227375
_Iid_5	0.615806	0.322218	1.91	0.056	-0.01573	1.247341
_Iid_6	-1.440355	1.166357	-1.23	0.217	-3.72637	0.845663
_Iid_7	2.419472	1.304772	1.85	0.064	-0.13783	4.976778
_Iid_8	-1.196196	0.664245	-1.8	0.072	-2.49809	0.1057
_Iid_9	-3.646798	0.644871	-5.66	0	-4.91072	-2.38288
_Iid_10	-4.445278	1.047288	-4.24	0	-6.49792	-2.39263
_Iid_11	0.2115481	0.690821	0.31	0.759	-1.14244	1.565533
_Iid_12	-2.683688	0.561381	-4.78	0	-3.78397	-1.5834
_Iid_13	-0.1830558	1.452456	-0.13	0.9	-3.02982	2.663705

_Iid_14	-2.70759	0.69951	-3.87	0	-4.07861	-1.33658
_Iid_15	0.7720382	0.954424	0.81	0.419	-1.0986	2.642675
_Iid_16	0.1491753	0.621813	0.24	0.81	-1.06956	1.367905
_Iid_17	-2.670921	0.992011	-2.69	0.007	-4.61523	-0.72661
_Iid_18	0.4304607	0.684898	0.63	0.53	-0.91191	1.772836
_Iid_19	-1.464576	0.941149	-1.56	0.12	-3.3092	0.380043
_Iid_20	-1.954918	0.545375	-3.58	0	-3.02383	-0.886
_cons	1.074015	4.99867	0.21	0.83	-8.7232	10.87123
eqn2_lnvar						
_cons	0.2948723	0.069888	4.22	0	0.157894	0.431851

. test [eqn1_mean]PGE1=[eqn2_mean]PGEICRG

[eqn1_mean]PGE1 - [eqn2_mean]PGEICRG =

chi2(1) = 13.76
Prob > chi2 = 0.0003

Table I4: Result for testing the coefficient of non-productive government expenditure in low to middle-income economies before and after ICRG adjustment

	Robust					
	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
eqn1_mean						
UPGE1	-0.038342	0.0169795	-2.26	0.024	-0.07162	-0.00506
INF	0.0022215	0.0032969	0.67	0.5	-0.00424	0.008683
INV	0.1954984	0.0282927	6.91	0	0.140046	0.250951
LFG	-0.1581362	0.1024491	-1.54	0.123	-0.35893	0.04266
LIG	-0.2019974	0.6967083	-0.29	0.772	-1.56752	1.163526
NTR	-0.0412626	0.040374	-1.02	0.307	-0.12039	0.037869
TR	-0.1911163	0.0463462	-4.12	0	-0.28195	-0.10028
SOD	0.252287	0.0396482	6.36	0	0.174578	0.329996
OPN	-0.0051695	0.0084176	-0.61	0.539	-0.02167	0.011329
_Iyear_1996	-0.4374801	0.3601224	-1.21	0.224	-1.14331	0.268347
_Iyear_1997	-0.450467	0.3462974	-1.3	0.193	-1.1292	0.228263
_Iyear_1998	-0.5475039	0.3656055	-1.5	0.134	-1.26408	0.16907
_Iyear_1999	-0.6284846	0.3544654	-1.77	0.076	-1.32322	0.066255
_Iyear_2000	-0.2567407	0.3413368	-0.75	0.452	-0.92575	0.412267
_Iyear_2001	0.3957283	0.3761269	1.05	0.293	-0.34147	1.132924
_Iyear_2002	0.9104597	0.3899221	2.33	0.02	0.146226	1.674693
_Iyear_2003	1.197554	0.3751793	3.19	0.001	0.462217	1.932892

_Iyear_2004	1.556268	0.391885	3.97	0	0.788188	2.324349
_Iyear_2005	2.043476	0.373975	5.46	0	1.310499	2.776454
_Iyear_2006	2.04065	0.4278223	4.77	0	1.202134	2.879166
_Iyear_2007	1.42565	0.4303117	3.31	0.001	0.582255	2.269045
_Iyear_2008	1.451063	0.4362909	3.33	0.001	0.595948	2.306178
_Iyear_2009	1.067534	0.4583613	2.33	0.02	0.169162	1.965906
_Iyear_2010	0.5428305	0.4954144	1.1	0.273	-0.42816	1.513825
_Iid_2	1.466458	0.8504724	1.72	0.085	-0.20044	3.133353
_Iid_3	-0.5620798	0.8614688	-0.65	0.514	-2.25053	1.126368
_Iid_4	-0.8247355	1.142026	-0.72	0.47	-3.06307	1.413594
_Iid_5	0.6107857	0.31766	1.92	0.055	-0.01182	1.233388
_Iid_6	-1.239003	1.210794	-1.02	0.306	-3.61212	1.134109
_Iid_7	2.386834	1.345219	1.77	0.076	-0.24975	5.023414
_Iid_8	-1.023916	0.6708494	-1.53	0.127	-2.33876	0.290925
_Iid_9	-3.55295	0.6714672	-5.29	0	-4.869	-2.2369
_Iid_10	-4.414482	1.084176	-4.07	0	-6.53943	-2.28954
_Iid_11	0.2913061	0.710961	0.41	0.682	-1.10215	1.684764
_Iid_12	-2.632911	0.5712378	-4.61	0	-3.75252	-1.51331
_Iid_13	0.0161002	1.547591	0.01	0.992	-3.01712	3.049324
_Iid_14	-2.605723	0.7154427	-3.64	0	-4.00797	-1.20348
_Iid_15	0.6503978	0.9755098	0.67	0.505	-1.26157	2.562362
_Iid_16	0.3153711	0.6121678	0.52	0.606	-0.88446	1.515198
_Iid_17	-2.614645	1.021785	-2.56	0.011	-4.61731	-0.61198
_Iid_18	0.3785273	0.7080299	0.53	0.593	-1.00919	1.76624
_Iid_19	-1.329449	0.945807	-1.41	0.16	-3.1832	0.524298
_Iid_20	-1.790671	0.5516743	-3.25	0.001	-2.87193	-0.70941
_cons	5.802507	4.257244	1.36	0.173	-2.54154	14.14655
eqn1_lnvar						
_cons	0.3047234	0.069448	4.39	0	0.168608	0.440839
eqn2_mean						
UPGEICRG	-0.0374906	0.0176614	-2.12	0.034	-0.07211	-0.00287
INF	0.0023862	0.003306	0.72	0.47	-0.00409	0.008866
INV	0.1956239	0.0283048	6.91	0	0.140148	0.2511
LFG	-0.1602267	0.1026407	-1.56	0.119	-0.3614	0.040945
LIG	-0.22533	0.6996773	-0.32	0.747	-1.59667	1.146012
NTR	-0.0427232	0.040464	-1.06	0.291	-0.12203	0.036585
TR	-0.1898438	0.046542	-4.08	0	-0.28106	-0.09862
SOD	0.2538099	0.039658	6.4	0	0.176082	0.331538
OPN	-0.0053775	0.008426	-0.64	0.523	-0.02189	0.011137
_Iyear_1996	-0.4379801	0.359962	-1.22	0.224	-1.14349	0.267533
_Iyear_1997	-0.4513825	0.3458118	-1.31	0.192	-1.12916	0.226396
_Iyear_1998	-0.5504088	0.365116	-1.51	0.132	-1.26602	0.165205
_Iyear_1999	-0.6313241	0.3541313	-1.78	0.075	-1.32541	0.062761

_Iyear_2000	-0.2611669	0.3405094	-0.77	0.443	-0.92855	0.406219
_Iyear_2001	0.3897305	0.3749826	1.04	0.299	-0.34522	1.124683
_Iyear_2002	0.9025971	0.3888121	2.32	0.02	0.14054	1.664655
_Iyear_2003	1.18861	0.3740202	3.18	0.001	0.455544	1.921676
_Iyear_2004	1.54569	0.3908097	3.96	0	0.779717	2.311663
_Iyear_2005	2.03298	0.3729947	5.45	0	1.301924	2.764037
_Iyear_2006	2.030258	0.4271152	4.75	0	1.193128	2.867389
_Iyear_2007	1.415091	0.4297409	3.29	0.001	0.572814	2.257367
_Iyear_2008	1.442095	0.4357533	3.31	0.001	0.588034	2.296155
_Iyear_2009	1.059213	0.4578268	2.31	0.021	0.161889	1.956537
_Iyear_2010	0.5354865	0.4952267	1.08	0.28	-0.43514	1.506113
_Iid_2	1.451063	0.852725	1.7	0.089	-0.22025	3.122373
_Iid_3	-0.5565306	0.8648032	-0.64	0.52	-2.25151	1.138453
_Iid_4	-0.7770813	1.146379	-0.68	0.498	-3.02394	1.46978
_Iid_5	0.6056802	0.3179077	1.91	0.057	-0.01741	1.228768
_Iid_6	-1.245837	1.215816	-1.02	0.306	-3.62879	1.13712
_Iid_7	2.438864	1.345834	1.81	0.07	-0.19892	5.07665
_Iid_8	-1.000626	0.6724477	-1.49	0.137	-2.3186	0.317347
_Iid_9	-3.520563	0.6752882	-5.21	0	-4.8441	-2.19702
_Iid_10	-4.391161	1.089711	-4.03	0	-6.52696	-2.25537
_Iid_11	0.3284269	0.7114612	0.46	0.644	-1.06601	1.722865
_Iid_12	-2.634691	0.572631	-4.6	0	-3.75703	-1.51236
_Iid_13	0.10912	1.555179	0.07	0.944	-2.93898	3.157215
_Iid_14	-2.576423	0.7180285	-3.59	0	-3.98373	-1.16911
_Iid_15	0.6544396	0.977657	0.67	0.503	-1.26173	2.570612
_Iid_16	0.3432263	0.6116639	0.56	0.575	-0.85561	1.542066
_Iid_17	-2.576267	1.025314	-2.51	0.012	-4.58585	-0.56669
_Iid_18	0.3907822	0.710903	0.55	0.583	-1.00256	1.784127
_Iid_19	-1.309912	0.9463824	-1.38	0.166	-3.16479	0.544964
_Iid_20	-1.769062	0.5537063	-3.19	0.001	-2.85431	-0.68382
_cons	5.925037	4.273793	1.39	0.166	-2.45144	14.30152
eqn2_lnvar						
_cons	0.3063865	0.0694435	4.41	0	0.17028	0.442493

. test [eqn1_mean]UPGE1=[eqn2_mean]UPGEICRG

[eqn1_mean]UPGE1 -
[eqn2_mean]UPGEICRG = 0

chi2(1) = 0.83
Prob > chi2 = 0.3615

Table I5: Result for testing the coefficient of productive government expenditure in high-income economies before and after CPI adjustment

	Robust					
	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
eqn1_mean						
PGE1	0.155066	0.035958	4.31	0	0.08459	0.225543
INF	-0.20752	0.064325	-3.23	0.001	-0.3336	-0.08145
INV	0.275627	0.061261	4.5	0	0.155559	0.395696
LFG	0.086831	0.172631	0.5	0.615	-0.25152	0.425181
LIG	-5.42731	1.515557	-3.58	0	-8.39775	-2.45688
NTR	-0.30821	0.073299	-4.2	0	-0.45187	-0.16454
TR	-0.13152	0.085439	-1.54	0.124	-0.29898	0.035937
SOD	0.218833	0.048647	4.5	0	0.123487	0.314178
OPN	0.054523	0.01162	4.69	0	0.031749	0.077297
_Iyear_2001	0.092626	0.243675	0.38	0.704	-0.38497	0.57022
_Iyear_2002	0.330232	0.23287	1.42	0.156	-0.12618	0.786649
_Iyear_2003	0.185517	0.24652	0.75	0.452	-0.29765	0.668687
_Iyear_2004	0.49341	0.259906	1.9	0.058	-0.016	1.002816
_Iyear_2005	0.691917	0.275266	2.51	0.012	0.152406	1.231428
_Iyear_2006	0.098605	0.286175	0.34	0.73	-0.46229	0.659499
_Iyear_2007	-1.15268	0.304265	-3.79	0	-1.74903	-0.55634
_Iyear_2008	-1.00682	0.315517	-3.19	0.001	-1.62522	-0.38842
_Iyear_2009	-1.11257	0.347836	-3.2	0.001	-1.79432	-0.43083
_Iyear_2010	-1.62254	0.38219	-4.25	0	-2.37161	-0.87346
_Iid_2	4.815866	1.345193	3.58	0	2.179336	7.452396
_Iid_3	0.363337	1.336525	0.27	0.786	-2.25621	2.982878
_Iid_4	2.996245	0.817531	3.66	0	1.393914	4.598576
_Iid_5	-9.0555	2.487202	-3.64	0	-13.9303	-4.18067
_Iid_6	-4.16877	2.221753	-1.88	0.061	-8.52333	0.185782
_Iid_7	-5.11142	2.383561	-2.14	0.032	-9.78311	-0.43972
_Iid_8	4.028518	1.736929	2.32	0.02	0.624201	7.432835
_Iid_9	-6.45468	2.945877	-2.19	0.028	-12.2285	-0.68086
_Iid_10	6.010062	1.29709	4.63	0	3.467812	8.552312
_Iid_11	7.110974	1.443171	4.93	0	4.28241	9.939538
_Iid_12	6.150078	1.56623	3.93	0	3.080323	9.219833
_Iid_13	2.590832	1.421275	1.82	0.068	-0.19482	5.37648
_Iid_14	3.04869	0.846715	3.6	0	1.389159	4.70822
_Iid_15	-2.16345	1.256498	-1.72	0.085	-4.62614	0.299245
_Iid_16	-0.60285	1.256487	-0.48	0.631	-3.06552	1.859818
_Iid_17	3.683999	0.855169	4.31	0	2.007899	5.3601
_Iid_18	-7.81815	2.01515	-3.88	0	-11.7678	-3.86853
_Iid_19	-7.30881	3.310509	-2.21	0.027	-13.7973	-0.82033
_Iid_20	-4.40393	2.502026	-1.76	0.078	-9.30781	0.499952

_Iid_21	2.611839	1.529104	1.71	0.088	-0.38515	5.608828
_Iid_22	-0.85034	0.512811	-1.66	0.097	-1.85544	0.154747
_Iid_23	6.648222	1.905125	3.49	0	2.914245	10.3822
_Iid_24	-0.47712	2.405359	-0.2	0.843	-5.19154	4.237294
_Iid_25	-1.02643	1.43389	-0.72	0.474	-3.83681	1.783942
_Iid_26	-24.9731	4.67293	-5.34	0	-34.1319	-15.8143
_Iid_27	-5.42893	2.784135	-1.95	0.051	-10.8857	0.027875
_Iid_28	-1.27751	1.991957	-0.64	0.521	-5.18167	2.626654
_Iid_29	0.309022	1.278349	0.24	0.809	-2.1965	2.814541
_Iid_30	6.264777	1.18861	5.27	0	3.935143	8.59441
_Iid_31	2.238262	1.398717	1.6	0.11	-0.50317	4.979698
_Iid_32	5.379299	0.791266	6.8	0	3.828447	6.930151
_cons	45.72528	14.53266	3.15	0.002	17.24179	74.20876
eqn1_lnvar						
_cons	-0.08806	0.067867	-1.3	0.194	-0.22107	0.044958
eqn2_mean						
PGECPI	0.159031	0.035971	4.42	0	0.088529	0.229532
INF	-0.2045	0.064581	-3.17	0.002	-0.33108	-0.07792
INV	0.27378	0.061342	4.46	0	0.153552	0.394008
LFG	0.094832	0.172502	0.55	0.582	-0.24327	0.432929
LIG	-5.6627	1.525824	-3.71	0	-8.65326	-2.67214
NTR	-0.31044	0.072403	-4.29	0	-0.45235	-0.16853
TR	-0.1363	0.084935	-1.6	0.109	-0.30277	0.03017
SOD	0.219466	0.048593	4.52	0	0.124226	0.314707
OPN	0.053937	0.011557	4.67	0	0.031287	0.076588
_Iyear_2001	0.097722	0.243964	0.4	0.689	-0.38044	0.575883
_Iyear_2002	0.340662	0.233298	1.46	0.144	-0.11659	0.797918
_Iyear_2003	0.199112	0.248054	0.8	0.422	-0.28706	0.685288
_Iyear_2004	0.510725	0.261558	1.95	0.051	-0.00192	1.023369
_Iyear_2005	0.716251	0.276879	2.59	0.01	0.173579	1.258923
_Iyear_2006	0.130394	0.287481	0.45	0.65	-0.43306	0.693846
_Iyear_2007	-1.11678	0.305942	-3.65	0	-1.71641	-0.51714
_Iyear_2008	-0.96599	0.317138	-3.05	0.002	-1.58757	-0.34441
_Iyear_2009	-1.06591	0.349497	-3.05	0.002	-1.75091	-0.38091
_Iyear_2010	-1.57089	0.384212	-4.09	0	-2.32393	-0.81785
_Iid_2	4.97868	1.336194	3.73	0	2.359789	7.597572
_Iid_3	0.62756	1.329777	0.47	0.637	-1.97876	3.233875
_Iid_4	3.05378	0.808974	3.77	0	1.468221	4.639339
_Iid_5	-9.32069	2.491757	-3.74	0	-14.2044	-4.43694
_Iid_6	-3.98541	2.205958	-1.81	0.071	-8.30901	0.33819
_Iid_7	-4.89546	2.363546	-2.07	0.038	-9.52792	-0.26299
_Iid_8	4.187833	1.731709	2.42	0.016	0.793747	7.58192
_Iid_9	-6.46438	2.935136	-2.2	0.028	-12.2171	-0.71162

_Iid_10	6.053853	1.28373	4.72	0	3.537788	8.569919
_Iid_11	7.311876	1.443754	5.06	0	4.48217	10.14158
_Iid_12	6.273609	1.556867	4.03	0	3.222205	9.325013
_Iid_13	2.90414	1.40896	2.06	0.039	0.14263	5.665651
_Iid_14	3.136455	0.843437	3.72	0	1.483349	4.789561
_Iid_15	-1.9174	1.244895	-1.54	0.124	-4.35735	0.522553
_Iid_16	-0.47349	1.248672	-0.38	0.705	-2.92084	1.973862
_Iid_17	4.04178	0.888129	4.55	0	2.30108	5.782481
_Iid_18	-7.5421	1.968177	-3.83	0	-11.3997	-3.68455
_Iid_19	-7.27151	3.294763	-2.21	0.027	-13.7291	-0.81389
_Iid_20	-4.02663	2.480156	-1.62	0.104	-8.88765	0.834383
_Iid_21	2.712035	1.515272	1.79	0.073	-0.25784	5.681914
_Iid_22	-0.9569	0.509216	-1.88	0.06	-1.95494	0.041147
_Iid_23	6.876306	1.918301	3.58	0	3.116504	10.63611
_Iid_24	-0.41973	2.383759	-0.18	0.86	-5.09181	4.252355
_Iid_25	-0.92082	1.419816	-0.65	0.517	-3.70361	1.861967
_Iid_26	-25.0198	4.668572	-5.36	0	-34.17	-15.8695
_Iid_27	-5.19368	2.759428	-1.88	0.06	-10.6021	0.2147
_Iid_28	-1.13877	1.97309	-0.58	0.564	-5.00596	2.728413
_Iid_29	0.425496	1.265505	0.34	0.737	-2.05485	2.90584
_Iid_30	6.365445	1.187689	5.36	0	4.037617	8.693274
_Iid_31	2.374186	1.395162	1.7	0.089	-0.36028	5.108653
_Iid_32	5.466232	0.799568	6.84	0	3.899109	7.033356
_cons	48.23746	14.55595	3.31	0.001	19.70832	76.76661
eqn2_lnvar						
_cons	-0.08715	0.06742	-1.29	0.196	-0.21929	0.044994

. test [eqn1_mean]PGE1=[eqn2_mean]PGECPI

[eqn1_mean]PGE1 - [eqn2_mean]PGECPI = 0

chi2(1) = 3.56
Prob > chi2 = 0.0593

Table I6: Result for testing the coefficient of non-productive government expenditure in high-income economies before and after CPI adjustment

	Robust					
	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
eqn1_mean						
UPGE1	-0.15787	0.035638	-4.43	0	-0.22772	-0.08802
INF	-0.21394	0.063909	-3.35	0.001	-0.33919	-0.08868

INV	0.282922	0.060964	4.64	0	0.163434	0.40241
LFG	0.067497	0.173048	0.39	0.697	-0.27167	0.406664
LIG	-5.41215	1.515896	-3.57	0	-8.38325	-2.44105
NTR	-0.31136	0.072681	-4.28	0	-0.45382	-0.16891
TR	-0.12698	0.086572	-1.47	0.142	-0.29666	0.042694
SOD	0.218572	0.048428	4.51	0	0.123655	0.313489
OPN	0.056067	0.011696	4.79	0	0.033144	0.07899
_Iyear_2001	0.089303	0.240324	0.37	0.71	-0.38172	0.560329
_Iyear_2002	0.318521	0.230672	1.38	0.167	-0.13359	0.77063
_Iyear_2003	0.167221	0.244037	0.69	0.493	-0.31108	0.645524
_Iyear_2004	0.471489	0.257059	1.83	0.067	-0.03234	0.975316
_Iyear_2005	0.656437	0.271376	2.42	0.016	0.12455	1.188323
_Iyear_2006	0.054847	0.282485	0.19	0.846	-0.49881	0.608508
_Iyear_2007	-1.18672	0.300968	-3.94	0	-1.77661	-0.59684
_Iyear_2008	-1.03944	0.312329	-3.33	0.001	-1.6516	-0.42729
_Iyear_2009	-1.14418	0.344779	-3.32	0.001	-1.81994	-0.46843
_Iyear_2010	-1.65145	0.378902	-4.36	0	-2.39409	-0.90882
_Iid_2	4.824064	1.324073	3.64	0	2.228928	7.4192
_Iid_3	0.271727	1.327202	0.2	0.838	-2.32954	2.872996
_Iid_4	3.033355	0.804934	3.77	0	1.455715	4.610996
_Iid_5	-8.92254	2.493004	-3.58	0	-13.8087	-4.03635
_Iid_6	-4.12953	2.221641	-1.86	0.063	-8.48387	0.224805
_Iid_7	-5.1675	2.387022	-2.16	0.03	-9.84597	-0.48902
_Iid_8	3.91637	1.763087	2.22	0.026	0.460783	7.371958
_Iid_9	-6.53244	2.9474	-2.22	0.027	-12.3092	-0.75564
_Iid_10	5.981394	1.274033	4.69	0	3.484335	8.478453
_Iid_11	7.203985	1.428789	5.04	0	4.40361	10.00436
_Iid_12	6.236399	1.547366	4.03	0	3.203618	9.269181
_Iid_13	2.667919	1.418543	1.88	0.06	-0.11237	5.448213
_Iid_14	2.986293	0.853675	3.5	0	1.31312	4.659466
_Iid_15	-2.31517	1.249243	-1.85	0.064	-4.76364	0.133302
_Iid_16	-0.57315	1.260026	-0.45	0.649	-3.04276	1.896457
_Iid_17	3.741311	0.846371	4.42	0	2.082454	5.400167
_Iid_18	-7.85873	2.041087	-3.85	0	-11.8592	-3.85827
_Iid_19	-7.3195	3.325571	-2.2	0.028	-13.8375	-0.8015
_Iid_20	-4.69805	2.4864	-1.89	0.059	-9.57131	0.175204
_Iid_21	2.5977	1.508256	1.72	0.085	-0.35843	5.553827
_Iid_22	-0.84924	0.512621	-1.66	0.098	-1.85396	0.155483
_Iid_23	6.694749	1.893381	3.54	0	2.98379	10.40571
_Iid_24	-0.3889	2.408617	-0.16	0.872	-5.1097	4.331899
_Iid_25	-0.90836	1.429771	-0.64	0.525	-3.71066	1.893943
_Iid_26	-25.4246	4.691447	-5.42	0	-34.6197	-16.2295
_Iid_27	-5.4776	2.787972	-1.96	0.049	-10.9419	-0.01327
_Iid_28	-1.26839	1.983856	-0.64	0.523	-5.15668	2.619897
_Iid_29	0.379908	1.276409	0.3	0.766	-2.12181	2.881623

_Iid_30	6.254919	1.188984	5.26	0	3.924553	8.585284
_Iid_31	2.233343	1.379531	1.62	0.105	-0.47049	4.937175
_Iid_32	5.494906	0.792581	6.93	0	3.941477	7.048336
_cons	60.89126	15.50531	3.93	0	30.50141	91.2811
eqn1_lnvar						
_cons	-0.09281	0.067955	-1.37	0.172	-0.226	0.040375
eqn2_mean						
UPGECPI	-0.1699	0.036576	-4.65	0	-0.24158	-0.09821
INF	-0.21821	0.063284	-3.45	0.001	-0.34225	-0.09418
INV	0.285783	0.060583	4.72	0	0.167044	0.404523
LFG	0.059831	0.172366	0.35	0.729	-0.278	0.397662
LIG	-5.21755	1.495196	-3.49	0	-8.14808	-2.28702
NTR	-0.32369	0.072223	-4.48	0	-0.46525	-0.18214
TR	-0.12183	0.086213	-1.41	0.158	-0.2908	0.047148
SOD	0.216536	0.048185	4.49	0	0.122096	0.310976
OPN	0.05699	0.011675	4.88	0	0.034108	0.079872
_Iyear_2001	0.086873	0.239514	0.36	0.717	-0.38257	0.556312
_Iyear_2002	0.313774	0.230062	1.36	0.173	-0.13714	0.764687
_Iyear_2003	0.160072	0.242974	0.66	0.51	-0.31615	0.636292
_Iyear_2004	0.459792	0.255755	1.8	0.072	-0.04148	0.961062
_Iyear_2005	0.63814	0.270064	2.36	0.018	0.108825	1.167455
_Iyear_2006	0.028729	0.281449	0.1	0.919	-0.5229	0.58036
_Iyear_2007	-1.21561	0.299586	-4.06	0	-1.80279	-0.62844
_Iyear_2008	-1.07324	0.311103	-3.45	0.001	-1.68299	-0.46349
_Iyear_2009	-1.18139	0.343381	-3.44	0.001	-1.85441	-0.50838
_Iyear_2010	-1.69137	0.377054	-4.49	0	-2.43038	-0.95235
_Iid_2	5.004291	1.318643	3.8	0	2.419799	7.588783
_Iid_3	0.255697	1.313341	0.19	0.846	-2.31841	2.829798
_Iid_4	3.225709	0.813814	3.96	0	1.630663	4.820755
_Iid_5	-8.66848	2.463082	-3.52	0	-13.496	-3.84093
_Iid_6	-4.09637	2.204979	-1.86	0.063	-8.41805	0.225315
_Iid_7	-5.15097	2.368693	-2.17	0.03	-9.79352	-0.50841
_Iid_8	3.926481	1.756082	2.24	0.025	0.484624	7.368338
_Iid_9	-6.33595	2.916352	-2.17	0.03	-12.0519	-0.62
_Iid_10	6.272505	1.283481	4.89	0	3.756928	8.788081
_Iid_11	7.366228	1.418925	5.19	0	4.585186	10.14727
_Iid_12	6.482213	1.544214	4.2	0	3.455608	9.508817
_Iid_13	2.656518	1.404883	1.89	0.059	-0.097	5.410039
_Iid_14	2.874647	0.848646	3.39	0.001	1.211331	4.537963
_Iid_15	-2.46893	1.245888	-1.98	0.048	-4.91083	-0.02704
_Iid_16	-0.56328	1.247016	-0.45	0.651	-3.00738	1.88083
_Iid_17	3.6491	0.81856	4.46	0	2.044753	5.253447
_Iid_18	-7.99283	2.038287	-3.92	0	-11.9878	-3.99786

_Iid_19	-7.23909	3.302449	-2.19	0.028	-13.7118	-0.76641
_Iid_20	-4.85612	2.468931	-1.97	0.049	-9.69513	-0.0171
_Iid_21	2.779849	1.498779	1.85	0.064	-0.1577	5.717402
_Iid_22	-0.73139	0.511517	-1.43	0.153	-1.73395	0.271161
_Iid_23	6.835947	1.879266	3.64	0	3.152653	10.51924
_Iid_24	-0.22858	2.391552	-0.1	0.924	-4.91594	4.458774
_Iid_25	-0.79051	1.418239	-0.56	0.577	-3.57021	1.989189
_Iid_26	-25.823	4.685728	-5.51	0	-35.0069	-16.6392
_Iid_27	-5.46379	2.766461	-1.98	0.048	-10.886	-0.04163
_Iid_28	-1.13095	1.965286	-0.58	0.565	-4.98284	2.720937
_Iid_29	0.494873	1.26719	0.39	0.696	-1.98877	2.97852
_Iid_30	6.416394	1.194294	5.37	0	4.07562	8.757168
_Iid_31	2.333669	1.370845	1.7	0.089	-0.35314	5.020476
_Iid_32	5.586761	0.790297	7.07	0	4.037808	7.135713
_cons	59.08772	15.25699	3.87	0	29.18457	88.99088
eqn2_lnvar						
_cons	-0.10168	0.06808	-1.49	0.135	-0.23512	0.031754

. test [eqn1_mean]UPGE1=[eqn2_mean]UPGECPI

[eqn1_mean]UPGE1 - [eqn2_mean]UPGECPI = 0

chi2(1) = 54.43
Prob > chi2 = 0.0000

Table I7: Result for testing the coefficient of productive government expenditure in low to middle-income economies before and after CPI adjustment

		Robust				
	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
eqn1_mean						
PGE1	0.055218	0.031129	1.77	0.076	-0.00579	0.116229
INF	0.115183	0.030458	3.78	0	0.055487	0.174879
INV	0.173909	0.045457	3.83	0	0.084814	0.263004
LFG	0.250902	0.149115	1.68	0.092	-0.04136	0.543162
LIG	1.251734	1.339046	0.93	0.35	-1.37275	3.876215
NTR	-0.05295	0.052477	-1.01	0.313	-0.1558	0.049901
TR	-0.02467	0.074733	-0.33	0.741	-0.17114	0.121808
SOD	0.247743	0.05531	4.48	0	0.139337	0.356149
OPN	-0.06432	0.010994	-5.85	0	-0.08586	-0.04277
_Iyear_2001	0.956433	0.317109	3.02	0.003	0.334912	1.577954
_Iyear_2002	1.629793	0.34549	4.72	0	0.952645	2.306942

_Iyear_2003	2.00693	0.34258	5.86	0	1.335487	2.678374
_Iyear_2004	2.417217	0.370735	6.52	0	1.690589	3.143844
_Iyear_2005	2.864996	0.400022	7.16	0	2.080968	3.649024
_Iyear_2006	2.874447	0.477399	6.02	0	1.938763	3.810131
_Iyear_2007	2.134653	0.487693	4.38	0	1.178792	3.090515
_Iyear_2008	2.06894	0.51246	4.04	0	1.064536	3.073344
_Iyear_2009	1.686449	0.557912	3.02	0.003	0.592961	2.779937
_Iyear_2010	1.17776	0.547666	2.15	0.032	0.104354	2.251166
_Iid_2	3.358688	1.678564	2	0.045	0.068764	6.648612
_Iid_3	1.478702	1.312126	1.13	0.26	-1.09302	4.050422
_Iid_4	-0.917	1.930042	-0.48	0.635	-4.69981	2.865813
_Iid_5	0.519241	0.568912	0.91	0.361	-0.59581	1.634287
_Iid_6	1.402183	2.870339	0.49	0.625	-4.22358	7.027944
_Iid_7	4.176632	2.907785	1.44	0.151	-1.52252	9.875787
_Iid_8	0.208323	1.364852	0.15	0.879	-2.46674	2.883384
_Iid_9	-3.21251	1.062411	-3.02	0.002	-5.2948	-1.13023
_Iid_10	3.929325	1.085474	3.62	0	1.801836	6.056814
_Iid_11	-1.87351	1.081224	-1.73	0.083	-3.99267	0.245655
_Iid_12	2.918792	2.138817	1.36	0.172	-1.27321	7.110796
_Iid_13	0.350877	1.089368	0.32	0.747	-1.78425	2.485999
_Iid_14	1.43922	1.850906	0.78	0.437	-2.18849	5.06693
_Iid_15	2.578694	1.503514	1.72	0.086	-0.36814	5.525528
_Iid_16	1.243652	1.433122	0.87	0.386	-1.56522	4.05252
_Iid_17	4.094833	1.540455	2.66	0.008	1.075597	7.114069
_Iid_18	-1.49861	1.107991	-1.35	0.176	-3.67023	0.673015
_cons	-11.127	9.391793	-1.18	0.236	-29.5346	7.280588
eqn1_lnvar						
_cons	-0.06205	0.088402	-0.7	0.483	-0.23531	0.111216
eqn2_mean						
PGECPI	0.057151	0.033077	1.73	0.084	-0.00768	0.12198
INF	0.115842	0.030504	3.8	0	0.056056	0.175628
INV	0.171795	0.045727	3.76	0	0.082173	0.261417
LFG	0.250792	0.149544	1.68	0.094	-0.04231	0.543893
LIG	1.284223	1.342879	0.96	0.339	-1.34777	3.916218
NTR	-0.05412	0.052476	-1.03	0.302	-0.15697	0.048732
TR	-0.02796	0.07528	-0.37	0.71	-0.17551	0.119586
SOD	0.249834	0.055227	4.52	0	0.141591	0.358078
OPN	-0.06413	0.011007	-5.83	0	-0.0857	-0.04256
_Iyear_2001	0.959423	0.317708	3.02	0.003	0.336728	1.582119
_Iyear_2002	1.633401	0.346146	4.72	0	0.954966	2.311835
_Iyear_2003	2.0114	0.343746	5.85	0	1.337671	2.685129
_Iyear_2004	2.419773	0.37185	6.51	0	1.69096	3.148586
_Iyear_2005	2.864916	0.401252	7.14	0	2.078477	3.651356

_Iyear_2006	2.870221	0.478085	6	0	1.933191	3.807251
_Iyear_2007	2.12846	0.488669	4.36	0	1.170687	3.086232
_Iyear_2008	2.059891	0.51291	4.02	0	1.054605	3.065177
_Iyear_2009	1.67582	0.55836	3	0.003	0.581455	2.770185
_Iyear_2010	1.161359	0.547946	2.12	0.034	0.087404	2.235314
_Iid_2	3.245295	1.664405	1.95	0.051	-0.01688	6.50747
_Iid_3	1.431083	1.315056	1.09	0.276	-1.14638	4.008545
_Iid_4	-1.0857	1.936797	-0.56	0.575	-4.88175	2.710354
_Iid_5	0.458446	0.564052	0.81	0.416	-0.64707	1.563967
_Iid_6	1.4626	2.874684	0.51	0.611	-4.17168	7.096876
_Iid_7	4.011554	2.902313	1.38	0.167	-1.67688	9.699983
_Iid_8	0.228524	1.36542	0.17	0.867	-2.44765	2.904698
_Iid_9	-3.18151	1.059449	-3	0.003	-5.258	-1.10503
_Iid_10	3.810564	1.087338	3.5	0	1.67942	5.941707
_Iid_11	-1.8254	1.077115	-1.69	0.09	-3.9365	0.285712
_Iid_12	2.750471	2.131036	1.29	0.197	-1.42628	6.927225
_Iid_13	0.339177	1.092782	0.31	0.756	-1.80264	2.480991
_Iid_14	1.335831	1.843484	0.72	0.469	-2.27733	4.948993
_Iid_15	2.510079	1.507097	1.67	0.096	-0.44378	5.463935
_Iid_16	1.112625	1.425749	0.78	0.435	-1.68179	3.907042
_Iid_17	4.125625	1.53881	2.68	0.007	1.109613	7.141637
_Iid_18	-1.48494	1.109095	-1.34	0.181	-3.65872	0.688851
_cons	-11.0714	9.413691	-1.18	0.24	-29.5219	7.379071
eqn2_lnvar						
_cons	-0.06116	0.088486	-0.69	0.489	-0.23459	0.112269

. test [eqn1_mean]PGE1=[eqn2_mean]PGECPI

[eqn1_mean]PGE1 - [eqn2_mean]PGECPI = 0

chi2(1) = 0.59
Prob > chi2 = 0.4416

Table I8: Result for testing the coefficient of non-productive government expenditure in low to middle-income economies before and after CPI adjustment

		Robust				
	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
eqn1_mean						
UPGE1	-0.05192	0.030735	-1.69	0.091	-0.11216	0.008321
INF	0.114983	0.030531	3.77	0	0.055144	0.174822
INV	0.172715	0.045946	3.76	0	0.082662	0.262767

LFG	0.261851	0.154389	1.7	0.09	-0.04075	0.564447
LIG	1.378371	1.358475	1.01	0.31	-1.28419	4.040932
NTR	-0.05453	0.05253	-1.04	0.299	-0.15749	0.048423
TR	-0.03361	0.076468	-0.44	0.66	-0.18349	0.11626
SOD	0.255908	0.053851	4.75	0	0.150361	0.361454
OPN	-0.06321	0.011179	-5.65	0	-0.08512	-0.04129
_Iyear_2001	0.940807	0.318478	2.95	0.003	0.316602	1.565012
_Iyear_2002	1.59996	0.34373	4.65	0	0.926262	2.273658
_Iyear_2003	1.963895	0.340404	5.77	0	1.296715	2.631074
_Iyear_2004	2.366849	0.367257	6.44	0	1.647037	3.08666
_Iyear_2005	2.799746	0.394908	7.09	0	2.025741	3.573752
_Iyear_2006	2.794674	0.469935	5.95	0	1.873619	3.715729
_Iyear_2007	2.048001	0.483505	4.24	0	1.100349	2.995653
_Iyear_2008	1.979747	0.509978	3.88	0	0.980208	2.979286
_Iyear_2009	1.590293	0.553973	2.87	0.004	0.504526	2.67606
_Iyear_2010	1.077159	0.544359	1.98	0.048	0.010234	2.144083
_Iid_2	3.124415	1.650959	1.89	0.058	-0.11141	6.360235
_Iid_3	1.351282	1.317828	1.03	0.305	-1.23161	3.934178
_Iid_4	-1.21187	1.951199	-0.62	0.535	-5.03615	2.612408
_Iid_5	0.483724	0.570031	0.85	0.396	-0.63352	1.600964
_Iid_6	1.618597	2.883625	0.56	0.575	-4.0332	7.270398
_Iid_7	3.855546	2.918051	1.32	0.186	-1.86373	9.574821
_Iid_8	0.289562	1.370724	0.21	0.833	-2.39701	2.976132
_Iid_9	-3.24867	1.081851	-3	0.003	-5.36906	-1.12828
_Iid_10	3.766648	1.098877	3.43	0.001	1.612889	5.920406
_Iid_11	-1.79287	1.085591	-1.65	0.099	-3.92059	0.334848
_Iid_12	2.615708	2.143624	1.22	0.222	-1.58572	6.817133
_Iid_13	0.273297	1.121484	0.24	0.807	-1.92477	2.471365
_Iid_14	1.236363	1.843334	0.67	0.502	-2.37651	4.849231
_Iid_15	2.375306	1.531524	1.55	0.121	-0.62643	5.377037
_Iid_16	1.043336	1.432108	0.73	0.466	-1.76355	3.850216
_Iid_17	4.074539	1.553703	2.62	0.009	1.029337	7.119741
_Iid_18	-1.43187	1.106587	-1.29	0.196	-3.60075	0.736998
_cons	-6.36621	9.168437	-0.69	0.487	-24.336	11.60359
eqn1_lnvar						
_cons	-0.06066	0.08823	-0.69	0.492	-0.23359	0.112263
eqn2_mean						
UPGECPI	-0.05713	0.033049	-1.73	0.084	-0.12191	0.007643
INF	0.114797	0.030495	3.76	0	0.055027	0.174567
INV	0.172876	0.045864	3.77	0	0.082985	0.262768
LFG	0.265709	0.154871	1.72	0.086	-0.03783	0.56925
LIG	1.381505	1.356129	1.02	0.308	-1.27646	4.039469
NTR	-0.05338	0.052505	-1.02	0.309	-0.15629	0.049529

TR	-0.03256	0.076182	-0.43	0.669	-0.18187	0.116756
SOD	0.254474	0.05397	4.72	0	0.148694	0.360254
OPN	-0.06322	0.011163	-5.66	0	-0.0851	-0.04134
_Iyear_2001	0.94022	0.318349	2.95	0.003	0.316267	1.564173
_Iyear_2002	1.599843	0.343527	4.66	0	0.926542	2.273143
_Iyear_2003	1.963731	0.340208	5.77	0	1.296935	2.630527
_Iyear_2004	2.368695	0.366836	6.46	0	1.64971	3.087679
_Iyear_2005	2.802423	0.394375	7.11	0	2.029462	3.575384
_Iyear_2006	2.79884	0.469455	5.96	0	1.878725	3.718956
_Iyear_2007	2.052844	0.482883	4.25	0	1.106411	2.999278
_Iyear_2008	1.984703	0.509411	3.9	0	0.986275	2.98313
_Iyear_2009	1.595018	0.553189	2.88	0.004	0.510788	2.679247
_Iyear_2010	1.083691	0.543588	1.99	0.046	0.018279	2.149103
_Iid_2	3.183447	1.653713	1.93	0.054	-0.05777	6.424665
_Iid_3	1.39081	1.316689	1.06	0.291	-1.18985	3.971474
_Iid_4	-1.16569	1.945574	-0.6	0.549	-4.97894	2.647565
_Iid_5	0.508553	0.571721	0.89	0.374	-0.612	1.629105
_Iid_6	1.62504	2.874922	0.57	0.572	-4.0097	7.259783
_Iid_7	3.91697	2.915495	1.34	0.179	-1.7973	9.631234
_Iid_8	0.297964	1.365516	0.22	0.827	-2.3784	2.974327
_Iid_9	-3.24549	1.075976	-3.02	0.003	-5.35436	-1.13661
_Iid_10	3.803583	1.09633	3.47	0.001	1.654816	5.952351
_Iid_11	-1.78856	1.082448	-1.65	0.098	-3.91012	0.332994
_Iid_12	2.685065	2.143475	1.25	0.21	-1.51607	6.8862
_Iid_13	0.284638	1.115687	0.26	0.799	-1.90207	2.471345
_Iid_14	1.281128	1.841937	0.7	0.487	-2.329	4.891257
_Iid_15	2.395565	1.52821	1.57	0.117	-0.59967	5.390802
_Iid_16	1.096018	1.432328	0.77	0.444	-1.71129	3.903329
_Iid_17	4.080261	1.55075	2.63	0.009	1.040847	7.119675
_Iid_18	-1.42534	1.100549	-1.3	0.195	-3.58238	0.731696
_cons	-6.41744	9.149349	-0.7	0.483	-24.3498	11.51496
eqn2_lnvar						
_cons	-0.06162	0.088109	-0.7	0.484	-0.23431	0.111065

. test [eqn1_mean]UPGE1=[eqn2_mean]UPGECPI

[eqn1_mean]UPGE1 - [eqn2_mean]UPGECPI = 0

chi2(1) = 4.63
Prob > chi2 = 0.0314

Table I9: Result for testing the coefficient of government expenditure on education in OECD economies before and after ICRG adjustment

		Robust				
	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
eqn1_mean						
EDU	0.140353	0.033498	4.19	0	0.074698	0.206008
INF	0.005088	0.049544	0.1	0.918	-0.09202	0.102193
INV	0.080575	0.045573	1.77	0.077	-0.00875	0.169895
LFG	-0.13738	0.150904	-0.91	0.363	-0.43315	0.158382
NTR	-0.10147	0.043795	-2.32	0.021	-0.1873	-0.01563
TR	0.12535	0.075502	1.66	0.097	-0.02263	0.273332
SOD	0.178806	0.042952	4.16	0	0.094621	0.262991
OPN	0.030876	0.007429	4.16	0	0.016315	0.045437
_Iyear_1996	0.216712	0.27336	0.79	0.428	-0.31906	0.752488
_Iyear_1997	-0.03943	0.267883	-0.15	0.883	-0.56447	0.485609
_Iyear_1998	-0.27065	0.298184	-0.91	0.364	-0.85508	0.313779
_Iyear_1999	-0.71776	0.300954	-2.38	0.017	-1.30762	-0.1279
_Iyear_2000	-1.25273	0.286882	-4.37	0	-1.81501	-0.69046
_Iyear_2001	-1.66424	0.280165	-5.94	0	-2.21336	-1.11513
_Iyear_2002	-1.74736	0.275391	-6.35	0	-2.28712	-1.20761
_Iyear_2003	-2.05571	0.285177	-7.21	0	-2.61464	-1.49677
_Iyear_2004	-1.85887	0.290686	-6.39	0	-2.4286	-1.28913
_Iyear_2005	-1.6834	0.30498	-5.52	0	-2.28115	-1.08565
_Iyear_2006	-2.16381	0.3179	-6.81	0	-2.78689	-1.54074
_Iyear_2007	-3.52987	0.336643	-10.49	0	-4.18968	-2.87006
_Iyear_2008	-3.51504	0.364749	-9.64	0	-4.22994	-2.80015
_Iyear_2009	-3.75017	0.380253	-9.86	0	-4.49545	-3.00489
_Iyear_2010	-4.40279	0.408355	-10.78	0	-5.20315	-3.60243
_Iid_2	0.381863	0.779045	0.49	0.624	-1.14504	1.908762
_Iid_3	-2.19598	0.938527	-2.34	0.019	-4.03546	-0.3565
_Iid_4	0.444029	0.495903	0.9	0.371	-0.52792	1.415982
_Iid_5	-4.71066	1.363983	-3.45	0.001	-7.38402	-2.03731
_Iid_6	1.092198	1.665429	0.66	0.512	-2.17198	4.356378
_Iid_7	0.330873	0.816223	0.41	0.685	-1.26889	1.930641
_Iid_8	1.581373	0.882562	1.79	0.073	-0.14842	3.311162
_Iid_9	1.711202	0.973308	1.76	0.079	-0.19645	3.61885
_Iid_10	3.386646	1.000598	3.38	0.001	1.425511	5.347781
_Iid_11	-1.68795	0.514378	-3.28	0.001	-2.69611	-0.67978
_Iid_12	-1.0048	1.067415	-0.94	0.347	-3.0969	1.087291
_Iid_13	0.755265	0.698496	1.08	0.28	-0.61376	2.124292
_Iid_14	0.272888	0.508077	0.54	0.591	-0.72292	1.268701
_Iid_15	-6.78195	1.857704	-3.65	0	-10.423	-3.14091
_Iid_16	-0.27406	1.102689	-0.25	0.804	-2.43529	1.887172
_Iid_17	-2.4393	0.449887	-5.42	0	-3.32106	-1.55754

_Iid_18	-2.31843	1.138205	-2.04	0.042	-4.54927	-0.08758
_Iid_19	0.362017	0.91376	0.4	0.692	-1.42892	2.152953
_Iid_20	2.212448	1.385583	1.6	0.11	-0.50324	4.92814
_Iid_21	0.417288	1.108219	0.38	0.707	-1.75478	2.589358
_Iid_22	1.358148	0.836384	1.62	0.104	-0.28114	2.997431
_Iid_23	-0.81877	0.870093	-0.94	0.347	-2.52412	0.886582
_Iid_24	-0.64141	0.952009	-0.67	0.5	-2.50732	1.224488
_Iid_25	0.435563	0.477543	0.91	0.362	-0.5004	1.371529
_cons	-3.40334	2.064091	-1.65	0.099	-7.44888	0.642203
eqn1_lnvar						
_cons	0.004292	0.084224	0.05	0.959	-0.16078	0.169367
eqn2_mean						
FLO	0.139266	0.033873	4.11	0	0.072875	0.205657
INF	0.007059	0.050523	0.14	0.889	-0.09197	0.106082
INV	0.079975	0.045528	1.76	0.079	-0.00926	0.169209
LFG	-0.1427	0.153265	-0.93	0.352	-0.44309	0.157698
NTR	-0.10225	0.043899	-2.33	0.02	-0.18829	-0.01621
TR	0.126577	0.075368	1.68	0.093	-0.02114	0.274295
SOD	0.179698	0.043037	4.18	0	0.095347	0.26405
OPN	0.030882	0.007459	4.14	0	0.016262	0.045501
_Iyear_1996	0.219544	0.274721	0.8	0.424	-0.3189	0.757987
_Iyear_1997	-0.04202	0.268522	-0.16	0.876	-0.56832	0.484268
_Iyear_1998	-0.27201	0.298473	-0.91	0.362	-0.857	0.31299
_Iyear_1999	-0.7169	0.301247	-2.38	0.017	-1.30734	-0.12647
_Iyear_2000	-1.24834	0.287407	-4.34	0	-1.81164	-0.68503
_Iyear_2001	-1.65723	0.280485	-5.91	0	-2.20697	-1.10749
_Iyear_2002	-1.73732	0.275602	-6.3	0	-2.27749	-1.19715
_Iyear_2003	-2.04318	0.285386	-7.16	0	-2.60253	-1.48384
_Iyear_2004	-1.84439	0.291086	-6.34	0	-2.41491	-1.27387
_Iyear_2005	-1.66958	0.30548	-5.47	0	-2.26831	-1.07085
_Iyear_2006	-2.15077	0.318222	-6.76	0	-2.77447	-1.52707
_Iyear_2007	-3.51724	0.336994	-10.44	0	-4.17773	-2.85674
_Iyear_2008	-3.50238	0.365129	-9.59	0	-4.21802	-2.78674
_Iyear_2009	-3.73784	0.380813	-9.82	0	-4.48422	-2.99146
_Iyear_2010	-4.39003	0.409345	-10.72	0	-5.19233	-3.58773
_Iid_2	0.394151	0.781047	0.5	0.614	-1.13667	1.924974
_Iid_3	-2.16938	0.941092	-2.31	0.021	-4.01389	-0.32487
_Iid_4	0.425124	0.49479	0.86	0.39	-0.54465	1.394894
_Iid_5	-4.74669	1.361098	-3.49	0	-7.41439	-2.07899
_Iid_6	1.160561	1.664835	0.7	0.486	-2.10246	4.423577
_Iid_7	0.317783	0.819567	0.39	0.698	-1.28854	1.924105

_Iid_8	1.614556	0.882682	1.83	0.067	-0.11547	3.344581
_Iid_9	1.724972	0.974393	1.77	0.077	-0.1848	3.634746
_Iid_10	3.413947	0.999313	3.42	0.001	1.455331	5.372564
_Iid_11	-1.69458	0.518961	-3.27	0.001	-2.71173	-0.67744
_Iid_12	-0.95905	1.067096	-0.9	0.369	-3.05052	1.132422
_Iid_13	0.811068	0.69884	1.16	0.246	-0.55863	2.180769
_Iid_14	0.302293	0.507717	0.6	0.552	-0.69281	1.297399
_Iid_15	-6.76791	1.868302	-3.62	0	-10.4297	-3.10611
_Iid_16	-0.26265	1.107599	-0.24	0.813	-2.4335	1.908206
_Iid_17	-2.43394	0.452527	-5.38	0	-3.32088	-1.54701
_Iid_18	-2.32782	1.141606	-2.04	0.041	-4.56533	-0.09032
_Iid_19	0.403847	0.912851	0.44	0.658	-1.38531	2.193003
_Iid_20	2.25355	1.384963	1.63	0.104	-0.46093	4.968027
_Iid_21	0.470365	1.107468	0.42	0.671	-1.70023	2.640963
_Iid_22	1.394278	0.835898	1.67	0.095	-0.24405	3.032608
_Iid_23	-0.82975	0.870229	-0.95	0.34	-2.53537	0.875868
_Iid_24	-0.62114	0.953139	-0.65	0.515	-2.48926	1.246979
_Iid_25	0.447766	0.478229	0.94	0.349	-0.48955	1.385077
_cons	-3.3971	2.065207	-1.64	0.1	-7.44483	0.650629
eqn2_lnvar						
_cons	0.006353	0.084208	0.08	0.94	-0.15869	0.171398

. test [eqn1_mean]EDU=[eqn2_mean]FLO

[eqn1_mean]EDU - [eqn2_mean]FLO = 0

chi2(1) = 0.25
Prob > chi2 = 0.6201

Table I10: Result for testing the coefficient of government expenditure on education in ASEAN economies before and after ICRG adjustment

		Robust				
	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
eqn1_mean						
EDU	0.1549801	0.0366266	4.23	0	0.083193	0.226767
INF	-0.1349679	0.0360261	-3.75	0	-0.20558	-0.06436
INV	0.0287115	0.0384368	0.75	0.455	-0.04662	0.104046
LFG	-0.318059	0.1207783	-2.63	0.008	-0.55478	-0.08134
NTR	-0.0183796	0.0926013	-0.2	0.843	-0.19987	0.163116
TR	-0.0840314	0.05629	-1.49	0.135	-0.19436	0.026295

SOD	0.4472661	0.0935105	4.78	0	0.263989	0.630543
OPN	0.0076422	0.0060803	1.26	0.209	-0.00427	0.019559
_Iyear_1996	-1.544974	0.5423358	-2.85	0.004	-2.60793	-0.48202
_Iyear_1997	-1.752535	0.6572103	-2.67	0.008	-3.04064	-0.46443
_Iyear_1998	-1.6826	0.7978298	-2.11	0.035	-3.24632	-0.11888
_Iyear_1999	-2.252687	0.8819817	-2.55	0.011	-3.98134	-0.52403
_Iyear_2000	-1.779736	0.9676103	-1.84	0.066	-3.67622	0.116745
_Iyear_2001	-0.3915877	0.9306623	-0.42	0.674	-2.21565	1.432477
_Iyear_2002	-0.0131829	0.9352454	-0.01	0.989	-1.84623	1.819864
_Iyear_2003	-0.1447389	0.9216564	-0.16	0.875	-1.95115	1.661675
_Iyear_2004	0.2605228	0.8793682	0.3	0.767	-1.46301	1.984053
_Iyear_2005	0.4250367	0.8084522	0.53	0.599	-1.1595	2.009574
_Iyear_2006	0.0684848	0.793297	0.09	0.931	-1.48635	1.623318
_Iyear_2007	-1.011649	0.8364869	-1.21	0.227	-2.65113	0.627836
_Iyear_2008	-0.2272021	0.8021588	-0.28	0.777	-1.79941	1.345
_Iyear_2009	-0.3990626	0.7931318	-0.5	0.615	-1.95357	1.155447
_Iyear_2010	-0.5010492	0.8252014	-0.61	0.544	-2.11841	1.116316
_Iid_2	-2.660057	0.6610518	-4.02	0	-3.95569	-1.36442
_Iid_3	-8.678472	2.304214	-3.77	0	-13.1947	-4.1623
_Iid_4	-3.994526	0.9375176	-4.26	0	-5.83203	-2.15703
_Iid_5	0.9837375	0.4938481	1.99	0.046	0.015813	1.951662
_cons	5.249436	1.398259	3.75	0	2.508899	7.989973
eqn1_lnvar						
_cons	-0.8537874	0.1146373	-7.45	0	-1.07847	-0.6291
eqn2_mean						
FLO	0.1563957	0.0372802	4.2	0	0.083328	0.229464
INF	-0.1346931	0.0365283	-3.69	0	-0.20629	-0.0631
INV	0.0284622	0.0384505	0.74	0.459	-0.0469	0.103824
LFG	-0.3156457	0.1210775	-2.61	0.009	-0.55295	-0.07834
NTR	-0.0179856	0.0928953	-0.19	0.846	-0.20006	0.164086
TR	-0.0830587	0.0566375	-1.47	0.143	-0.19407	0.027949
SOD	0.451721	0.0934557	4.83	0	0.268551	0.634891
OPN	0.0074633	0.006124	1.22	0.223	-0.00454	0.019466
_Iyear_1996	-1.538763	0.5436297	-2.83	0.005	-2.60426	-0.47327
_Iyear_1997	-1.741362	0.6578266	-2.65	0.008	-3.03068	-0.45205
_Iyear_1998	-1.662679	0.7973068	-2.09	0.037	-3.22537	-0.09999
_Iyear_1999	-2.227142	0.8807989	-2.53	0.011	-3.95348	-0.50081
_Iyear_2000	-1.748313	0.965742	-1.81	0.07	-3.64113	0.144507
_Iyear_2001	-0.3578899	0.9303429	-0.38	0.7	-2.18133	1.465549
_Iyear_2002	0.022506	0.9343898	0.02	0.981	-1.80886	1.853876
_Iyear_2003	-0.1099486	0.9213815	-0.12	0.905	-1.91582	1.695926
_Iyear_2004	0.2917914	0.8804123	0.33	0.74	-1.43379	2.017368
_Iyear_2005	0.4508788	0.8094695	0.56	0.578	-1.13565	2.03741

_Iyear_2006	0.0890717	0.7932349	0.11	0.911	-1.46564	1.643784
_Iyear_2007	-0.9881221	0.8362757	-1.18	0.237	-2.62719	0.650948
_Iyear_2008	-0.2024908	0.8021031	-0.25	0.801	-1.77458	1.369602
_Iyear_2009	-0.3749233	0.7930731	-0.47	0.636	-1.92932	1.179472
_Iyear_2010	-0.4743944	0.8257152	-0.57	0.566	-2.09277	1.143978
_Iid_2	-2.611634	0.6599643	-3.96	0	-3.90514	-1.31813
_Iid_3	-8.66401	2.316495	-3.74	0	-13.2043	-4.12376
_Iid_4	-3.912588	0.9407549	-4.16	0	-5.75643	-2.06874
_Iid_5	1.019087	0.4967407	2.05	0.04	0.045493	1.99268
_cons	5.254232	1.402674	3.75	0	2.505041	8.003423
eqn2_lnvar						
_cons	-0.8508478	0.1147072	-7.42	0	-1.07567	-0.62603

. test [eqn1_mean]EDU=[eqn2_mean]FLO

[eqn1_mean]EDU - [eqn2_mean]FLO = 0

chi2(1) = 0.66
Prob > chi2 = 0.4158

Table I11: Result for testing the coefficient of government expenditure on health in OECD economies before and after ICRG adjustment

		Robust				
	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
eqn1_mean						
HEA	-0.10506	0.033786	-3.11	0.002	-0.17128	-0.03884
INF	0.057145	0.057054	1	0.317	-0.05468	0.168968
INV	0.071815	0.044936	1.6	0.11	-0.01626	0.159888
LFG	-0.30066	0.162888	-1.85	0.065	-0.61991	0.018597
NTR	-0.06553	0.054051	-1.21	0.225	-0.17147	0.040412
TR	0.122088	0.073574	1.66	0.097	-0.02211	0.26629
SOD	0.256164	0.043699	5.86	0	0.170516	0.341812
OPN	0.018245	0.00659	2.77	0.006	0.005329	0.03116
_Iyear_1996	0.26137	0.259582	1.01	0.314	-0.2474	0.770141
_Iyear_1997	0.019959	0.259325	0.08	0.939	-0.48831	0.528227
_Iyear_1998	-0.20937	0.282746	-0.74	0.459	-0.76354	0.344803
_Iyear_1999	-0.58822	0.293218	-2.01	0.045	-1.16292	-0.01352
_Iyear_2000	-1.02435	0.280338	-3.65	0	-1.5738	-0.4749
_Iyear_2001	-1.35945	0.269996	-5.04	0	-1.88863	-0.83027
_Iyear_2002	-1.34214	0.269669	-4.98	0	-1.87068	-0.81359

_Iyear_2003	-1.56171	0.280048	-5.58	0	-2.1106	-1.01283
_Iyear_2004	-1.29733	0.285879	-4.54	0	-1.85764	-0.73702
_Iyear_2005	-1.10245	0.304763	-3.62	0	-1.69977	-0.50512
_Iyear_2006	-1.55126	0.314896	-4.93	0	-2.16845	-0.93408
_Iyear_2007	-2.87013	0.331282	-8.66	0	-3.51943	-2.22082
_Iyear_2008	-2.79769	0.355669	-7.87	0	-3.49479	-2.10059
_Iyear_2009	-2.99131	0.357002	-8.38	0	-3.69102	-2.2916
_Iyear_2010	-3.56502	0.392803	-9.08	0	-4.3349	-2.79514
_Iid_2	0.527552	0.817233	0.65	0.519	-1.07419	2.129299
_Iid_3	-1.16144	0.83451	-1.39	0.164	-2.79705	0.474168
_Iid_4	-1.35844	0.611976	-2.22	0.026	-2.55789	-0.15899
_Iid_5	-4.13413	1.387654	-2.98	0.003	-6.85389	-1.41438
_Iid_6	2.397944	1.309332	1.83	0.067	-0.1683	4.964187
_Iid_7	0.089251	0.887351	0.1	0.92	-1.64993	1.828427
_Iid_8	1.466563	1.005962	1.46	0.145	-0.50509	3.438212
_Iid_9	1.356035	1.079834	1.26	0.209	-0.7604	3.472472
_Iid_10	2.663183	1.134127	2.35	0.019	0.440334	4.886031
_Iid_11	0.010311	0.56924	0.02	0.986	-1.10538	1.126
_Iid_12	1.353085	0.850685	1.59	0.112	-0.31423	3.020397
_Iid_13	1.730784	0.690443	2.51	0.012	0.377541	3.084027
_Iid_14	-0.01761	0.579635	-0.03	0.976	-1.15367	1.118457
_Iid_15	-4.71672	1.43106	-3.3	0.001	-7.52154	-1.91189
_Iid_16	0.397089	1.045721	0.38	0.704	-1.65249	2.446665
_Iid_17	-0.72375	0.444881	-1.63	0.104	-1.5957	0.148201
_Iid_18	-3.40627	1.160054	-2.94	0.003	-5.67994	-1.13261
_Iid_19	1.349361	0.770546	1.75	0.08	-0.16088	2.859604
_Iid_20	3.462143	1.15849	2.99	0.003	1.191545	5.732742
_Iid_21	1.173201	0.94976	1.24	0.217	-0.6883	3.034696
_Iid_22	1.530965	0.882495	1.73	0.083	-0.19869	3.260623
_Iid_23	-0.73698	0.870805	-0.85	0.397	-2.44373	0.969764
_Iid_24	-0.22448	0.89473	-0.25	0.802	-1.97812	1.529156
_Iid_25	1.032979	0.472608	2.19	0.029	0.106684	1.959275
_cons	-0.26772	2.366692	-0.11	0.91	-4.90635	4.370913
eqn1_lnvar						
_cons	0.021159	0.088658	0.24	0.811	-0.15261	0.194925
eqn2_mean						
GEN	-0.11174	0.032823	-3.4	0.001	-0.17608	-0.04741
INF	0.05737	0.057156	1	0.315	-0.05465	0.169393
INV	0.072642	0.044943	1.62	0.106	-0.01544	0.160728
LFG	-0.30388	0.163654	-1.86	0.063	-0.62463	0.016878
NTR	-0.06241	0.053893	-1.16	0.247	-0.16804	0.043215
TR	0.118674	0.073496	1.61	0.106	-0.02537	0.262723
SOD	0.258788	0.043461	5.95	0	0.173605	0.34397

OPN	0.017948	0.006521	2.75	0.006	0.005167	0.030728
_Iyear_1996	0.259931	0.257514	1.01	0.313	-0.24479	0.764649
_Iyear_1997	0.021764	0.257931	0.08	0.933	-0.48377	0.527299
_Iyear_1998	-0.20879	0.281567	-0.74	0.458	-0.76066	0.343068
_Iyear_1999	-0.58857	0.292065	-2.02	0.044	-1.161	-0.01613
_Iyear_2000	-1.0252	0.278734	-3.68	0	-1.57151	-0.47889
_Iyear_2001	-1.36065	0.268277	-5.07	0	-1.88646	-0.83484
_Iyear_2002	-1.34317	0.267596	-5.02	0	-1.86765	-0.81869
_Iyear_2003	-1.56185	0.277558	-5.63	0	-2.10586	-1.01785
_Iyear_2004	-1.29658	0.283129	-4.58	0	-1.8515	-0.74166
_Iyear_2005	-1.10058	0.301659	-3.65	0	-1.69182	-0.50934
_Iyear_2006	-1.54801	0.311386	-4.97	0	-2.15832	-0.93771
_Iyear_2007	-2.86455	0.327779	-8.74	0	-3.50698	-2.22211
_Iyear_2008	-2.79068	0.352235	-7.92	0	-3.48104	-2.10031
_Iyear_2009	-2.98318	0.353642	-8.44	0	-3.67631	-2.29006
_Iyear_2010	-3.55498	0.390277	-9.11	0	-4.31991	-2.79005
_Iid_2	0.495711	0.816274	0.61	0.544	-1.10416	2.095578
_Iid_3	-1.18285	0.831707	-1.42	0.155	-2.81297	0.447262
_Iid_4	-1.41315	0.606175	-2.33	0.02	-2.60123	-0.22506
_Iid_5	-4.06827	1.386641	-2.93	0.003	-6.78604	-1.3505
_Iid_6	2.319248	1.312397	1.77	0.077	-0.253	4.891499
_Iid_7	0.063522	0.885055	0.07	0.943	-1.67116	1.798198
_Iid_8	1.403149	1.00566	1.4	0.163	-0.56791	3.374207
_Iid_9	1.298709	1.078326	1.2	0.228	-0.81477	3.412189
_Iid_10	2.577653	1.133435	2.27	0.023	0.356161	4.799146
_Iid_11	0.068959	0.565008	0.12	0.903	-1.03844	1.176353
_Iid_12	1.362399	0.842579	1.62	0.106	-0.28903	3.013824
_Iid_13	1.697481	0.689697	2.46	0.014	0.345699	3.049262
_Iid_14	-0.07512	0.581902	-0.13	0.897	-1.21562	1.065391
_Iid_15	-4.74549	1.424731	-3.33	0.001	-7.53792	-1.95307
_Iid_16	0.362749	1.043295	0.35	0.728	-1.68207	2.407569
_Iid_17	-0.68671	0.444036	-1.55	0.122	-1.55701	0.183583
_Iid_18	-3.46568	1.156284	-3	0.003	-5.73196	-1.19941
_Iid_19	1.305597	0.77153	1.69	0.091	-0.20657	2.817768
_Iid_20	3.408789	1.158327	2.94	0.003	1.13851	5.679069
_Iid_21	1.101679	0.952822	1.16	0.248	-0.76582	2.969175
_Iid_22	1.471291	0.88134	1.67	0.095	-0.2561	3.198687
_Iid_23	-0.74122	0.871018	-0.85	0.395	-2.44838	0.965944
_Iid_24	-0.26467	0.893039	-0.3	0.767	-2.015	1.485651
_Iid_25	1.030387	0.472203	2.18	0.029	0.104886	1.955888
_cons	-0.11906	2.35205	-0.05	0.96	-4.729	4.490872
eqn2_lnvar						
_cons	0.01874	0.088633	0.21	0.833	-0.15498	0.192457

. test [eqn1_mean]HEA=[eqn2_mean]GEN

[eqn1_mean]HEA - [eqn2_mean]GEN = 0

chi2(1) = 4.93
Prob > chi2 = 0.0264

Table I12: Result for testing the coefficient of government expenditure on health in ASEAN economies before and after ICRG adjustment

		Robust				
	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
eqn1_mean						
HEA	-0.1315467	0.1371244	-0.96	0.337	-0.40031	0.137212
INF	-0.1635205	0.0400827	-4.08	0	-0.24208	-0.08496
INV	0.0714476	0.0334682	2.13	0.033	0.005851	0.137044
LFG	-0.4484606	0.1233199	-3.64	0	-0.69016	-0.20676
NTR	-0.0773621	0.0933982	-0.83	0.407	-0.26042	0.105695
TR	-0.076096	0.0570567	-1.33	0.182	-0.18793	0.035733
SOD	0.5915144	0.1174758	5.04	0	0.361266	0.821763
OPN	0.0214895	0.0078967	2.72	0.007	0.006012	0.036967
_Iyear_1996	-1.259339	0.5767112	-2.18	0.029	-2.38967	-0.12901
_Iyear_1997	-1.295419	0.6525544	-1.99	0.047	-2.5744	-0.01644
_Iyear_1998	-1.178061	0.77452	-1.52	0.128	-2.69609	0.339971
_Iyear_1999	-1.609145	0.8635087	-1.86	0.062	-3.30159	0.083301
_Iyear_2000	-1.126747	0.910912	-1.24	0.216	-2.9121	0.658608
_Iyear_2001	0.0604798	0.8995636	0.07	0.946	-1.70263	1.823592
_Iyear_2002	0.2725682	0.9127012	0.3	0.765	-1.51629	2.06143
_Iyear_2003	-0.0208442	0.9115203	-0.02	0.982	-1.80739	1.765703
_Iyear_2004	0.1980684	0.8659773	0.23	0.819	-1.49922	1.895353
_Iyear_2005	0.265258	0.7971059	0.33	0.739	-1.29704	1.827557
_Iyear_2006	-0.1916375	0.7862836	-0.24	0.807	-1.73273	1.34945
_Iyear_2007	-1.055148	0.8300189	-1.27	0.204	-2.68196	0.571659
_Iyear_2008	0.0689159	0.8126931	0.08	0.932	-1.52393	1.661765
_Iyear_2009	-0.0564144	0.8142014	-0.07	0.945	-1.65222	1.539391
_Iyear_2010	-0.0369864	0.8686849	-0.04	0.966	-1.73958	1.665605
_Iid_2	-1.711341	0.6841354	-2.5	0.012	-3.05222	-0.37046
_Iid_3	-11.60454	2.964833	-3.91	0	-17.4155	-5.79357
_Iid_4	-2.455287	1.354987	-1.81	0.07	-5.11101	0.200438
_Iid_5	0.9122291	0.5716979	1.6	0.111	-0.20828	2.032736
_cons	5.433027	1.439313	3.77	0	2.612025	8.254029
eqn1_lnvar						
_cons	-0.715966	0.1118971	-6.4	0	-0.93528	-0.49665

eqn2_mean						
GEN	-0.1455233	0.1450308	-1	0.316	-0.42978	0.138732
INF	-0.1642153	0.0401911	-4.09	0	-0.24299	-0.08544
INV	0.0714616	0.0333362	2.14	0.032	0.006124	0.136799
LFG	-0.4508525	0.1234205	-3.65	0	-0.69275	-0.20895
NTR	-0.0777539	0.0929741	-0.84	0.403	-0.25998	0.104472
TR	-0.0758107	0.0570318	-1.33	0.184	-0.18759	0.03597
SOD	0.5943189	0.1172356	5.07	0	0.364541	0.824096
OPN	0.0217836	0.0079464	2.74	0.006	0.006209	0.037358
_Iyear_1996	-1.254293	0.5764055	-2.18	0.03	-2.38403	-0.12456
_Iyear_1997	-1.289881	0.6513326	-1.98	0.048	-2.56647	-0.01329
_Iyear_1998	-1.173995	0.7723778	-1.52	0.129	-2.68783	0.339837
_Iyear_1999	-1.606552	0.8607861	-1.87	0.062	-3.29366	0.080558
_Iyear_2000	-1.12671	0.9078425	-1.24	0.215	-2.90605	0.652629
_Iyear_2001	0.0561284	0.8965559	0.06	0.95	-1.70109	1.813346
_Iyear_2002	0.2646873	0.9097578	0.29	0.771	-1.51841	2.04778
_Iyear_2003	-0.0313059	0.9086722	-0.03	0.973	-1.81227	1.749659
_Iyear_2004	0.1848889	0.8637743	0.21	0.831	-1.50808	1.877855
_Iyear_2005	0.2518671	0.7955596	0.32	0.752	-1.3074	1.811135
_Iyear_2006	-0.2044513	0.7849548	-0.26	0.795	-1.74293	1.334032
_Iyear_2007	-1.061223	0.827578	-1.28	0.2	-2.68325	0.5608
_Iyear_2008	0.0693969	0.8110537	0.09	0.932	-1.52024	1.659033
_Iyear_2009	-0.0537514	0.8123306	-0.07	0.947	-1.64589	1.538387
_Iyear_2010	-0.0295943	0.866166	-0.03	0.973	-1.72725	1.66806
_Iid_2	-1.722337	0.6855332	-2.51	0.012	-3.06596	-0.37872
_Iid_3	-11.66635	2.965354	-3.93	0	-17.4783	-5.85437
_Iid_4	-2.425607	1.357276	-1.79	0.074	-5.08582	0.234606
_Iid_5	0.907002	0.5719093	1.59	0.113	-0.21392	2.027924
_cons	5.449953	1.437783	3.79	0	2.63195	8.267956
eqn2_lnvar						
_cons	-0.7170138	0.1119627	-6.4	0	-0.93646	-0.49757

. test [eqn1_mean]HEA=[eqn2_mean]GEN

[eqn1_mean]HEA - [eqn2_mean]GEN = 0

chi2(1) = 2.66
Prob > chi2 = 0.1026

Table I13: Result for testing the coefficient of government expenditure on human capital in OECD economies before and after ICRG adjustment

		Robust				

	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
eqn1_mean						
ECO	0.0160214	0.0348224	0.46	0.645	-0.05223	0.084272
INF	0.0173179	0.0473493	0.37	0.715	-0.07548	0.110121
INV	0.0664724	0.0460363	1.44	0.149	-0.02376	0.156702
LFG	-0.1473947	0.1502673	-0.98	0.327	-0.44191	0.147124
NTR	-0.1157761	0.0528742	-2.19	0.029	-0.21941	-0.01214
TR	0.1870423	0.0690686	2.71	0.007	0.05167	0.322414
SOD	0.1901796	0.0492104	3.86	0	0.093729	0.28663
OPN	0.0247625	0.0080649	3.07	0.002	0.008956	0.040569
_Iyear_1996	0.2534603	0.2751071	0.92	0.357	-0.28574	0.79266
_Iyear_1997	0.0169695	0.2713216	0.06	0.95	-0.51481	0.54875
_Iyear_1998	-0.2216138	0.2955437	-0.75	0.453	-0.80087	0.357641
_Iyear_1999	-0.6193124	0.3031571	-2.04	0.041	-1.21349	-0.02514
_Iyear_2000	-1.098953	0.2919533	-3.76	0	-1.67117	-0.52674
_Iyear_2001	-1.463798	0.2838875	-5.16	0	-2.02021	-0.90739
_Iyear_2002	-1.495854	0.2853434	-5.24	0	-2.05512	-0.93659
_Iyear_2003	-1.769603	0.3011979	-5.88	0	-2.35994	-1.17927
_Iyear_2004	-1.558768	0.3106138	-5.02	0	-2.16756	-0.94998
_Iyear_2005	-1.385009	0.3321121	-4.17	0	-2.03594	-0.73408
_Iyear_2006	-1.856241	0.3464925	-5.36	0	-2.53535	-1.17713
_Iyear_2007	-3.208443	0.3678037	-8.72	0	-3.92932	-2.48756
_Iyear_2008	-3.15959	0.4058722	-7.78	0	-3.95509	-2.3641
_Iyear_2009	-3.365305	0.4147076	-8.11	0	-4.17812	-2.55249
_Iyear_2010	-3.978827	0.4309086	-9.23	0	-4.82339	-3.13426
_Iid_2	0.9633893	0.8381855	1.15	0.25	-0.67942	2.606203
_Iid_3	-1.161816	0.9672605	-1.2	0.23	-3.05761	0.73398
_Iid_4	-0.0359964	0.7007991	-0.05	0.959	-1.40954	1.337545
_Iid_5	-5.054811	1.345656	-3.76	0	-7.69225	-2.41737
_Iid_6	3.413015	1.442584	2.37	0.018	0.585602	6.240427
_Iid_7	0.8901853	0.8821992	1.01	0.313	-0.83889	2.619264
_Iid_8	2.260733	0.9845586	2.3	0.022	0.331033	4.190432
_Iid_9	2.390386	1.033474	2.31	0.021	0.364815	4.415957
_Iid_10	3.991722	1.044459	3.82	0	1.94462	6.038824
_Iid_11	-0.9144804	0.7383922	-1.24	0.216	-2.3617	0.532742
_Iid_12	0.3326968	1.163301	0.29	0.775	-1.94733	2.612726
_Iid_13	1.807435	0.7326463	2.47	0.014	0.371475	3.243395
_Iid_14	0.5558224	0.563862	0.99	0.324	-0.54933	1.660972
_Iid_15	-4.24795	1.677755	-2.53	0.011	-7.53629	-0.95961
_Iid_16	1.054278	1.075503	0.98	0.327	-1.05367	3.162225
_Iid_17	-1.386363	0.5859779	-2.37	0.018	-2.53486	-0.23787
_Iid_18	-2.053388	1.194556	-1.72	0.086	-4.39468	0.287899
_Iid_19	1.829213	0.8326987	2.2	0.028	0.197154	3.461273
_Iid_20	3.627191	1.334192	2.72	0.007	1.012224	6.242159

_Iid_21	1.917048	1.023859	1.87	0.061	-0.08968	3.923775
_Iid_22	2.275962	0.825638	2.76	0.006	0.657742	3.894183
_Iid_23	-0.4831618	0.9043829	-0.53	0.593	-2.25572	1.289396
_Iid_24	0.4856682	0.8861256	0.55	0.584	-1.25111	2.222442
_Iid_25	0.9991829	0.5120663	1.95	0.051	-0.00445	2.002814
_cons	-3.802358	2.359582	-1.61	0.107	-8.42705	0.822338
eqn1_lnvar						
_cons	0.0476678	0.0877298	0.54	0.587	-0.12428	0.219615
eqn2_mean						
DEF	0.0113337	0.0351907	0.32	0.747	-0.05764	0.080306
INF	0.0197586	0.0481767	0.41	0.682	-0.07467	0.114183
INV	0.0661644	0.045997	1.44	0.15	-0.02399	0.156317
LFG	-0.1552237	0.1521852	-1.02	0.308	-0.4535	0.143054
NTR	-0.1141642	0.0529974	-2.15	0.031	-0.21804	-0.01029
TR	0.1862432	0.0689405	2.7	0.007	0.051122	0.321364
SOD	0.1935286	0.0491961	3.93	0	0.097106	0.289951
OPN	0.0242897	0.0080797	3.01	0.003	0.008454	0.040126
_Iyear_1996	0.2553496	0.27465	0.93	0.353	-0.28295	0.793654
_Iyear_1997	0.0184548	0.2709983	0.07	0.946	-0.51269	0.549602
_Iyear_1998	-0.2196817	0.2949184	-0.74	0.456	-0.79771	0.358348
_Iyear_1999	-0.6146757	0.3027243	-2.03	0.042	-1.208	-0.02135
_Iyear_2000	-1.09017	0.2913302	-3.74	0	-1.66117	-0.51917
_Iyear_2001	-1.451891	0.2825496	-5.14	0	-2.00568	-0.8981
_Iyear_2002	-1.479758	0.2833013	-5.22	0	-2.03502	-0.9245
_Iyear_2003	-1.749712	0.2987789	-5.86	0	-2.33531	-1.16412
_Iyear_2004	-1.535786	0.3082145	-4.98	0	-2.13988	-0.9317
_Iyear_2005	-1.361225	0.3300828	-4.12	0	-2.00818	-0.71427
_Iyear_2006	-1.831293	0.3441629	-5.32	0	-2.50584	-1.15675
_Iyear_2007	-3.181725	0.3656726	-8.7	0	-3.89843	-2.46502
_Iyear_2008	-3.130829	0.4043018	-7.74	0	-3.92325	-2.33841
_Iyear_2009	-3.335194	0.4133902	-8.07	0	-4.14542	-2.52496
_Iyear_2010	-3.945747	0.4299469	-9.18	0	-4.78843	-3.10307
_Iid_2	0.9644175	0.8394498	1.15	0.251	-0.68087	2.609709
_Iid_3	-1.125653	0.9653755	-1.17	0.244	-3.01775	0.766448
_Iid_4	-0.110735	0.6983352	-0.16	0.874	-1.47945	1.257977
_Iid_5	-5.030463	1.346496	-3.74	0	-7.66955	-2.39138
_Iid_6	3.448829	1.43859	2.4	0.017	0.629245	6.268413
_Iid_7	0.8701803	0.8836179	0.98	0.325	-0.86168	2.602039
_Iid_8	2.252335	0.9868481	2.28	0.022	0.318148	4.186522
_Iid_9	2.368165	1.035	2.29	0.022	0.339603	4.396728
_Iid_10	3.95695	1.043167	3.79	0	1.912379	6.00152
_Iid_11	-0.8524346	0.7498722	-1.14	0.256	-2.32216	0.617288
_Iid_12	0.4259836	1.15431	0.37	0.712	-1.83642	2.68839

_Iid_13	1.844007	0.7314876	2.52	0.012	0.410318	3.277696
_Iid_14	0.5450062	0.5652389	0.96	0.335	-0.56284	1.652854
_Iid_15	-4.188632	1.679037	-2.49	0.013	-7.47949	-0.89778
_Iid_16	1.067748	1.078096	0.99	0.322	-1.04528	3.180776
_Iid_17	-1.325238	0.5896584	-2.25	0.025	-2.48095	-0.16953
_Iid_18	-2.105433	1.191126	-1.77	0.077	-4.44	0.229132
_Iid_19	1.858966	0.8309019	2.24	0.025	0.230428	3.487504
_Iid_20	3.671475	1.326632	2.77	0.006	1.071324	6.271627
_Iid_21	1.93876	1.018217	1.9	0.057	-0.05691	3.934429
_Iid_22	2.277139	0.8261604	2.76	0.006	0.657894	3.896383
_Iid_23	-0.4855843	0.904754	-0.54	0.591	-2.25887	1.287701
_Iid_24	0.4917005	0.8855513	0.56	0.579	-1.24395	2.227349
_Iid_25	1.019409	0.5120535	1.99	0.047	0.015803	2.023016
_cons	-3.658181	2.364835	-1.55	0.122	-8.29317	0.976811
eqn2_lnvar						
_cons	0.0481069	0.0878448	0.55	0.584	-0.12407	0.220279

. test [eqn1_mean]ECO=[eqn2_mean]DEF

[eqn1_mean]ECO - [eqn2_mean]DEF = 0

chi2(1) = 2.16
Prob > chi2 = 0.1416

Table I14: Result for testing the coefficient of government expenditure on human capital in ASEAN economies before and after ICRG adjustment

		Robust				
	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
eqn1_mean						
ECO	0.1217242	0.035261	3.45	0.001	0.052613	0.190835
INF	-0.1279038	0.03473	-3.68	0	-0.19597	-0.05983
INV	0.0467736	0.038622	1.21	0.226	-0.02892	0.122471
LFG	-0.3089456	0.123877	-2.49	0.013	-0.55174	-0.06615
NTR	-0.0427315	0.095914	-0.45	0.656	-0.23072	0.145256
TR	-0.0897769	0.056116	-1.6	0.11	-0.19976	0.020207
SOD	0.3967261	0.10135	3.91	0	0.198084	0.595369
OPN	0.0053731	0.006381	0.84	0.4	-0.00713	0.01788
_Iyear_1996	-1.610933	0.563061	-2.86	0.004	-2.71451	-0.50735
_Iyear_1997	-1.812211	0.690037	-2.63	0.009	-3.16466	-0.45976
_Iyear_1998	-1.750194	0.832737	-2.1	0.036	-3.38233	-0.11806
_Iyear_1999	-2.274075	0.933651	-2.44	0.015	-4.104	-0.44415

_Iyear_2000	-1.775395	1.012618	-1.75	0.08	-3.76009	0.2093
_Iyear_2001	-0.343256	0.95863	-0.36	0.72	-2.22214	1.535624
_Iyear_2002	0.059461	0.960087	0.06	0.951	-1.82227	1.941196
_Iyear_2003	-0.0581444	0.939768	-0.06	0.951	-1.90006	1.783768
_Iyear_2004	0.3774688	0.889313	0.42	0.671	-1.36555	2.12049
_Iyear_2005	0.5546208	0.81427	0.68	0.496	-1.04132	2.150561
_Iyear_2006	0.1751862	0.80046	0.22	0.827	-1.39369	1.744059
_Iyear_2007	-0.9975487	0.860632	-1.16	0.246	-2.68436	0.689259
_Iyear_2008	-0.2392514	0.832466	-0.29	0.774	-1.87085	1.392351
_Iyear_2009	-0.4454237	0.827665	-0.54	0.59	-2.06762	1.176769
_Iyear_2010	-0.6079554	0.878849	-0.69	0.489	-2.33047	1.114557
_Iid_2	-2.271321	0.635186	-3.58	0	-3.51626	-1.02638
_Iid_3	-7.515927	2.376162	-3.16	0.002	-12.1731	-2.85874
_Iid_4	-4.279819	0.982172	-4.36	0	-6.20484	-2.3548
_Iid_5	1.054975	0.505431	2.09	0.037	0.064348	2.045602
_cons	4.923023	1.381358	3.56	0	2.21561	7.630435
eqn1_lnvar						
_cons	-0.8072212	0.114079	-7.08	0	-1.03081	-0.58363
eqn2_mean						
DEF	0.1251954	0.036188	3.46	0.001	0.054268	0.196123
INF	-0.1275823	0.035231	-3.62	0	-0.19663	-0.05853
INV	0.0452924	0.038769	1.17	0.243	-0.03069	0.121277
LFG	-0.3055955	0.124209	-2.46	0.014	-0.54904	-0.06215
NTR	-0.0403674	0.096217	-0.42	0.675	-0.22895	0.148215
TR	-0.0888401	0.056386	-1.58	0.115	-0.19935	0.021674
SOD	0.4014303	0.10111	3.97	0	0.203258	0.599602
OPN	0.0051363	0.006426	0.8	0.424	-0.00746	0.017732
_Iyear_1996	-1.605667	0.563755	-2.85	0.004	-2.71061	-0.50073
_Iyear_1997	-1.803841	0.690067	-2.61	0.009	-3.15635	-0.45133
_Iyear_1998	-1.732998	0.831649	-2.08	0.037	-3.363	-0.103
_Iyear_1999	-2.254358	0.931019	-2.42	0.015	-4.07912	-0.4296
_Iyear_2000	-1.750581	1.009646	-1.73	0.083	-3.72945	0.228289
_Iyear_2001	-0.3159365	0.956859	-0.33	0.741	-2.19135	1.559472
_Iyear_2002	0.0897035	0.957293	0.09	0.925	-1.78656	1.965964
_Iyear_2003	-0.0273804	0.937308	-0.03	0.977	-1.86447	1.80971
_Iyear_2004	0.4056201	0.888603	0.46	0.648	-1.33601	2.147249
_Iyear_2005	0.5777227	0.813594	0.71	0.478	-1.01689	2.172338
_Iyear_2006	0.1951934	0.798494	0.24	0.807	-1.36983	1.760213
_Iyear_2007	-0.9744797	0.858137	-1.14	0.256	-2.6564	0.707438
_Iyear_2008	-0.2190388	0.831018	-0.26	0.792	-1.8478	1.409726
_Iyear_2009	-0.4251353	0.826412	-0.51	0.607	-2.04487	1.194603
_Iyear_2010	-0.5854679	0.877524	-0.67	0.505	-2.30538	1.134448
_Iid_2	-2.250422	0.635411	-3.54	0	-3.4958	-1.00504

_Iid_3	-7.532846	2.38686	-3.16	0.002	-12.211	-2.85469
_Iid_4	-4.219723	0.97627	-4.32	0	-6.13318	-2.30627
_Iid_5	1.082764	0.506712	2.14	0.033	0.089627	2.075901
_cons	4.935236	1.384816	3.56	0	2.221046	7.649427
eqn2_lnvar						
_cons	-0.807183	0.114071	-7.08	0	-1.03076	-0.58361

. test [eqn1_mean]ECO=[eqn2_mean]DEF

[eqn1_mean]ECO - [eqn2_mean]DEF = 0

chi2(1) = 2.8
Prob > chi2 = 0.0944